Distributed Ledgers: Possibilities and Challenges in Capital Markets Applications

Wide adoption of distributed ledger technology has the potential to revolutionize the financial services industry. While transition to a target state model may take several years to evolve, this disruptive shift will make business processes more autonomous, secure, transparent and efficient.

Executive Summary

In this paper we examine the emerging interest in blockchain technology as a disruptive force to redefine financial services. We explore potential applications of distributed ledgers in mainstream post-trade securities processing. We have used an understanding of the current network model and participants to evaluate the potential impact on the securities processing value chain, and how their roles may evolve as such technologies become more mainstream. Like any other substantial market-led initiative (e.g., T2S), the transition to a target state model may take several years. In the case of newer technological disruptions such as distributed ledgers it may take even longer as the application scenarios are still evolving. Hence coexistence of the current network (and participants) with the potential futuristic market structure is an important aspect to be considered. Finally, we conclude with our point of view on the potential scenarios of evolution for applications of distributed ledgers in post-trade securities processing and the benefits for the industry.

A Quick Recap of Distributed Ledgers over Blockchain

The financial crisis of 2008-2009 exposed several weaknesses of a deeply entangled financial services value chain with overreliance on some highly centralized, ostensibly infallible processing hubs. It became evident at the height of the crisis that the failure of even one hub could jeopardize the entire financial system, and cause ripples in mainstream real economies.

Post-facto analysis and lessons from the crisis ushered in a new era of regulations and measures to prevent similar events. For example, the role of central counterparties became much more pronounced as a mechanism to detangle the financial services value chain. New regulations such as the Volcker Act and the Dodd-Frank Act came into being. There was an impetus to fundamentally review the financial service model, the roles of intermediaries and the dependencies on central agencies. This led to the emergence of "decentralization" as a conceptual framework to simplify the functioning of the financial services value chain.

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Blockchain, the technology that drives the distributed ledger on which bitcoin is built, is a potential solution. All transactions ever executed over blockchain are fortified against tampering and revision, without reliance on a central agency. The mechanics of achieving consensus in the current state bitcoin blockchain network may not be efficient enough to drive mainstream securities processing. However, several variants of consensus algorithms are emerging that could provide a balance between truly distributed, open ledgers in a trust-free network (like bitcoin) and partially-closed networks with a few trusted parties.

Just as an electronic book of records can hold any fiat currency or other financial assets like equities, bonds, commodity contracts, derivatives, etc., blockchain is a mechanism for keeping a record of any "token" of value. As illustrated by "colored coins," the concept of blockchain can be extended to financial assets such as equities, bonds, commodities and real estate. These digital assets (or tokens of value) aim to transfer ownership of underlying assets with alacrity, transparency and low cost. They differ from conventional modes in the following ways:

- The distributed ledger can be made visible to all participants in the network—e.g., for validating the proof of ownership—depending on privacy policies and the authorization level agreed upon by the network.

- The ledger records individual transactions rather than a sum total (position), so that individual ownership can be validated by any participant, right from inception (so the fundamental view changes from account-based to transaction-based).

- Transfer of ownership can be directly agreed upon between the transacting parties, as ownership can be indisputably verified. A consensus mechanism can then be used to irrevocably register the change of ownership, which is visible to the entire network.

The concept is gaining massive momentum, with many leading firms allocating significant budgets to incubate fledgling FinTech firms dedicated to blockchain technology. Most regulators are also taking an active interest in exploring the potential applications of the technology and understanding its implications for financial markets. Regulators and supervisors might also want to be prepared to adopt/enhance the regulatory framework as and when some of the use cases of blockchain technology come into the mainstream.

- The Australian Securities Exchange (ASX) is considering replacing its clearing and settlement system with a blockchain-based system.

- Forty-three banks − including Goldman Sachs, JPMorgan, Credit Suisse, Barclays, RBS and UBS − are planning to develop common standards for blockchain technology to broaden its use across financial services. The group is channeling data, ideas and financial backing to a start-up called R3CEV, a New York-based group of trading and technology executives.

- Retail giant Overstock became the first company to offer a blockchain-based corporate bond, valued at $25 million, as a private bond to qualified institutional investors; the offering is part of the company's bitcoin blockchain-based initiative called Medici.

- Multinational investment bank AXA, also a leading insurance brand, is planning to use bitcoin to cut costs in the remittance market.

Distributed Ledger Technology in Securities Processing

In this section, we explore some potential use cases of distributed ledger technology along the post-trade securities value chain. We also discuss key considerations for coexistence with the current-state functioning of the markets.

Issuance

Initial public offerings (IPOs) over distributed blockchain technology could provide issuers efficient access to global markets and free investors from geographical constraints. Global regulators could prevent Ponzi schemes and other financial shenanigans by thoroughly vetting potential issuers. After obtaining such clearances, issuers could issue digital tokens over the network, representing digital assets. Figure 1, next page, illustrates a possible model.

Though IPOs over blockchain are possible, they would be practical only if issuers can raise sufficient capital over the network. A necessary prerequisite would be an adequate number of institutional and retail investors using such a network for trading or settlement (or both, ideally).
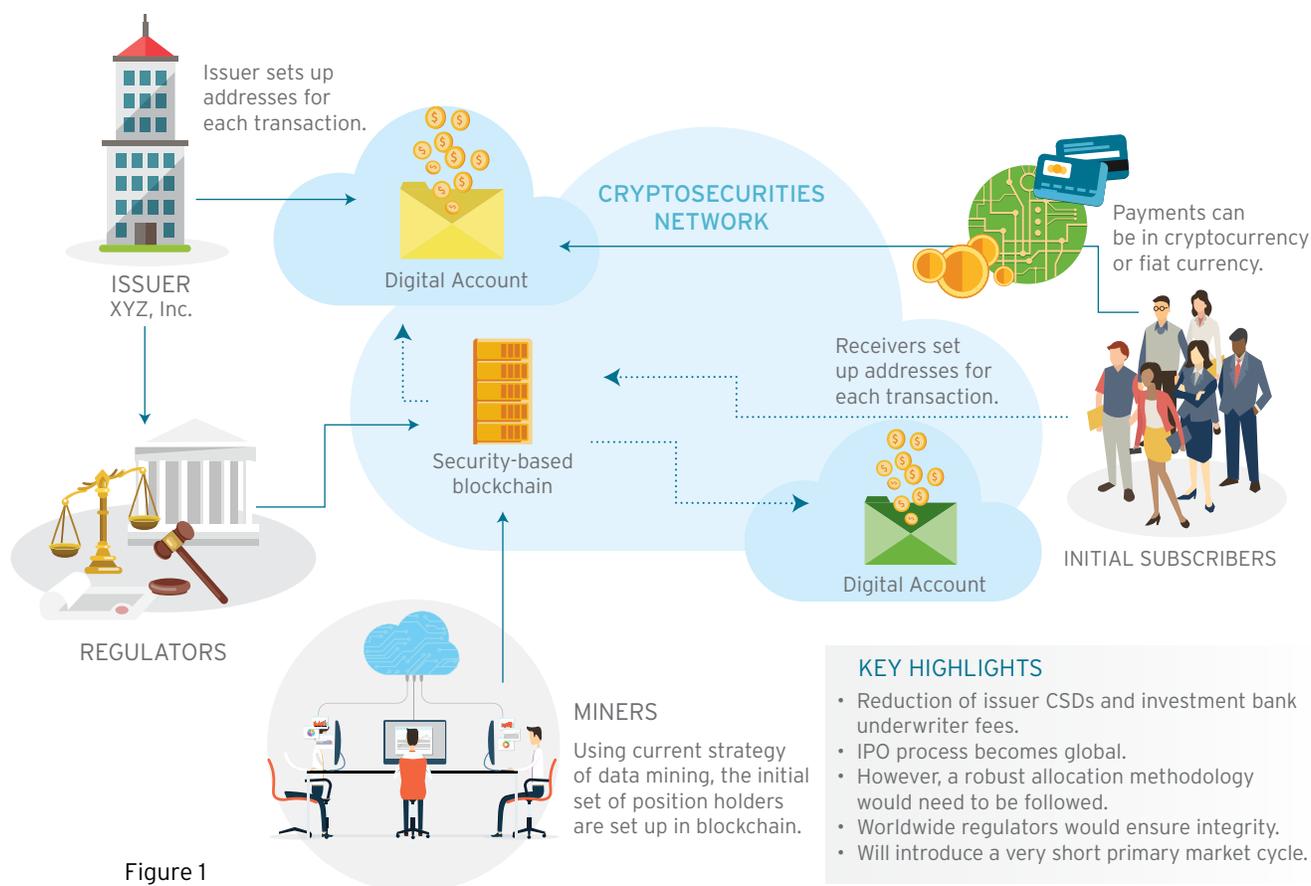
Issuance Process

CRYPTOSECURITIES NETWORK

Issuer sets up addresses for each transaction.

Digital Account

ISSUER
XYZ, Inc.

Payments can be in cryptocurrency or fiat currency.

Receivers set up addresses for each transaction.

Security-based blockchain

Digital Account

INITIAL SUBSCRIBERS

REGULATORS

MINERS
Using current strategy of data mining, the initial set of position holders are set up in blockchain.

KEY HIGHLIGHTS
- Reduction of issuer CSDs and investment bank underwriter fees.
- IPO process becomes global.
- However, a robust allocation methodology would need to be followed.
- Worldwide regulators would ensure integrity.
- Will introduce a very short primary market cycle.

Figure 1

Price Discovery

While there can be disruptive innovations in this area such as a system that matches potential buyers and sellers akin to the "bit torrent" system, liquidity remains a major concern. Market developments following directives like MiFID have already indicated the emergence of alternative trading venues challenging conventional stock exchanges. We believe that, given the right conditions and regulatory framework, equivalent facilities for price discovery and trading over peer-to-peer networks may emerge. In the short term there might be concerns over transparency, fragmentation of liquidity and the best execution regime. However, as has occurred often in the past, market forces could mold a new and efficient market infrastructure.

We believe a hybrid model is most likely, where price discovery and market depth is established on traditional avenues and trade agreements are cleared over a distributed ledger to establish ownership. Further post-trade information can potentially be captured on a blockchain, addressing regulatory requirements such as best

execution, consolidated tape (under MiFIR/MiFID II), etc. in a transparent, indisputable manner.

We believe that some of the most practical use cases of distributed ledgers may emerge in the post-trade processing space, comprising trade agreement (confirmations) and trade settlement. This would, however, require the current entities in this space to work in tandem with this disruptive technology. Figure 2, next page, illustrates a possible working model.

As Figure 2 illustrates, we envisage a conversion layer that transforms market orders into instructions for the transfer of digital assets. The network will operate on a distributed ledger and securities will be represented by assets in a digital account. CSDs/depositories will likely play a critical but potentially different role in the new network as signatories approving ownership and transfer

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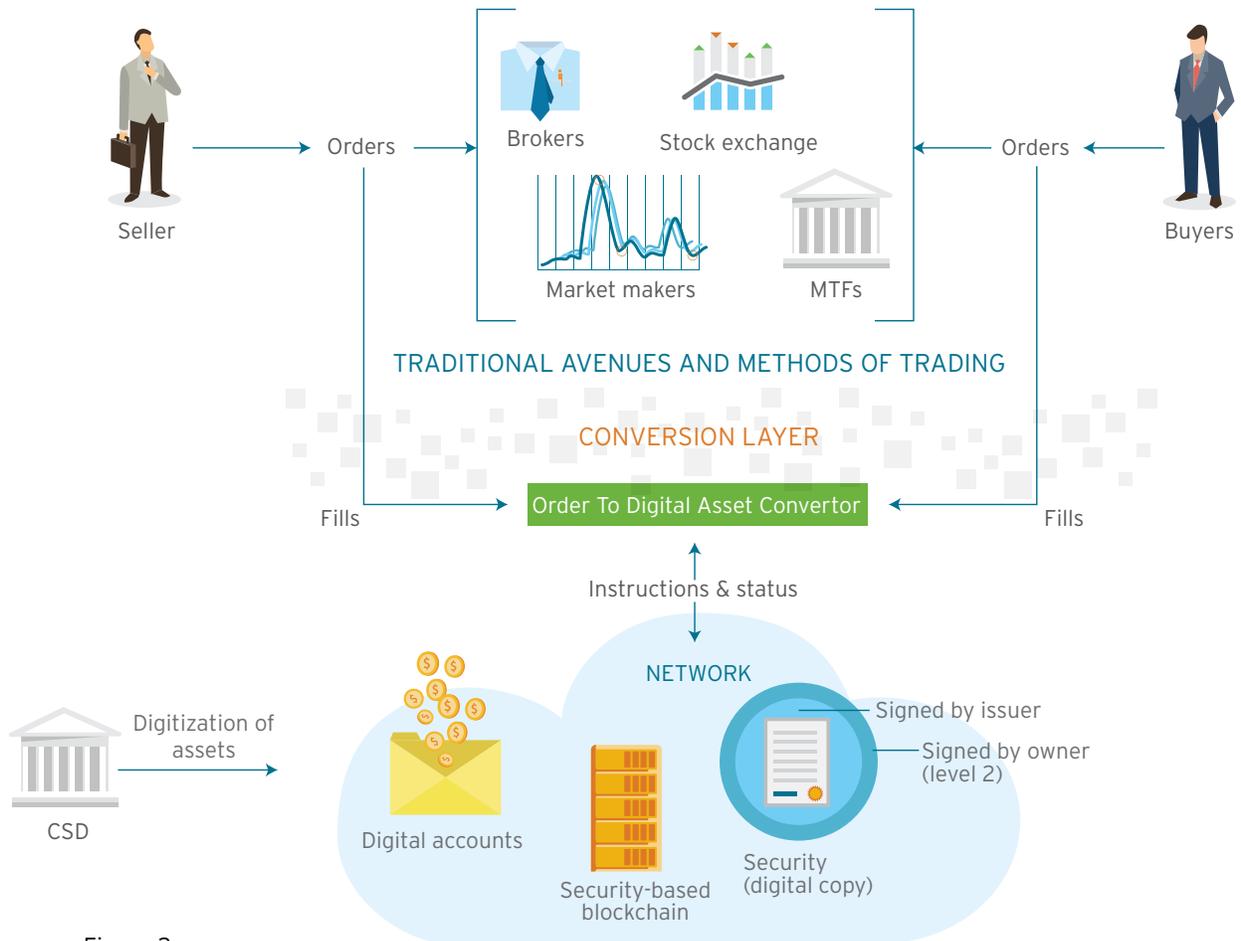## Sample Blockchain Application for Post-Trade Processing

Figure 2

of assets (partially-closed network with limited trusted parties).

Trade Agreement

Once a trade has been struck, the network will ensure that the digital assets to be exchanged between the buyer and the seller are "locked" and rendered "unavailable" for any other transaction. At the same time, the network would ensure that the seller actually owns the asset/s (or is in a position to fulfill the obligations). While this is easy to imagine for simple transactions, facilitating complex transactions and instruments over the blockchain (e.g., short selling, complex options trading strategies, etc.) entails technological upheaval that requires concomitant business innovation.

As a very pertinent use case, global stock and cash records are views that all players in the post-trade industry are always striving to get in a timely and efficient way. However, in the cur-

rent-state model getting such a service is both challenging and costly due to the multiplicity of intermediaries and places of safekeeping driven by several central agencies. While initiatives such as Target 2 Securities (T2S), a pan-European settlement platform, are hoping to address some of these challenges at a regional (Eurozone) level, no such activity is seen at the global level. It is obvious that with securities positions maintained over a distributed ledger, say the golden source of all positions (actually transactions) records, such consolidated views can be easily constructed. Furthermore, views can be designed to provide a true near-instantaneous insight into the holdings, current ownership, fulfillment value chain, etc. to different participants – anonymized, and on a need-to-know basis. For example, as a pre-compliance check before concluding a trade; or post analysis to rapidly construct a fail-proof delivery scenario, even when involving complex instruments such as stock borrow/loans, collateral recall, etc.
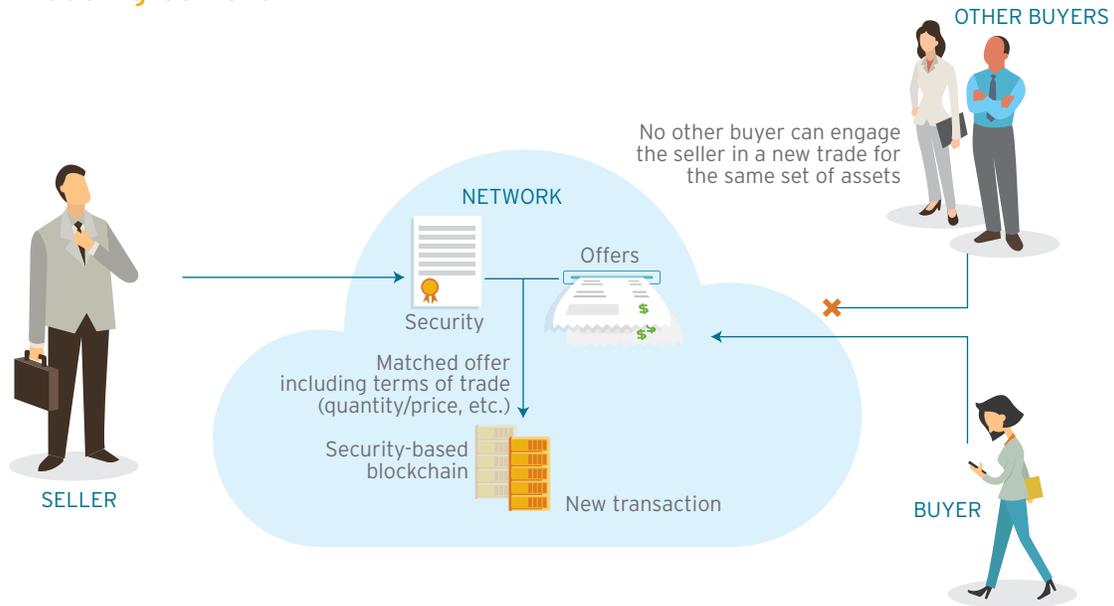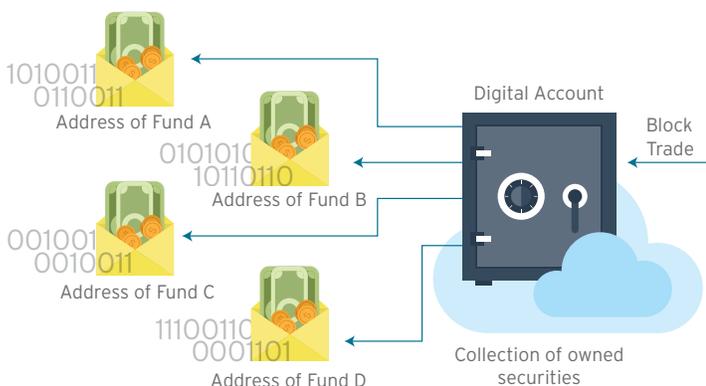
Trade Agreement

Figure 3

Confirmation and Transaction Reporting

There is an obligation to confirm trade agreements between the counterparties, and regulatory requirements to register trades in complex instruments (such as swaps) in a central registry for transparency reasons. In the near to medium term, this process would be handled in a way similar to conventional trading – i.e., using products such as Omgeo CTM's OASYS-Trade Match. However, registering executed trades on a blockchain repository may be an interesting early use case, irrespective of the long-term deeper migration of post-trade securities processing to distributed ledgers.

Allocation

Once a trade is successfully executed, the fund manager allocates the trade to different fund accounts. In the target model, on execution of a block trade the whole trade will be first registered to the fund manager/main digital account of the fund family. Based on the decision taken by the fund manager, it can be moved to other account addresses corresponding to each of the underlying funds. Moving securities from one address to another will incur only minor charges, much lower than current charges. This can be supported by a GUI and can be made available as a service for a minimal charge. Hence, we envision allocations becoming easier and simpler.

Clearance

Trades on regulated markets are registered with a clearing agent, which acts as the central counterparty and performs the important function of disentangling the settlement complexity. Following the financial crisis of 2008, regulators have mandated clearing for several traditionally OTC products (such as swaps) to ensure transparency and reduce counterparty risk. Like trade warehouses, clearing could be an early adopter of distributed ledgers, and these roles may eventually converge, with indisputable proof of the transaction and ensuing change of ownership of the underlying asset, in a transparent manner and equally accessible by participants and regulators/supervisors.

Allocation to Various Portfolios
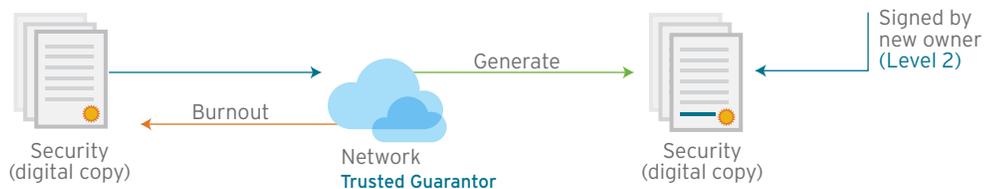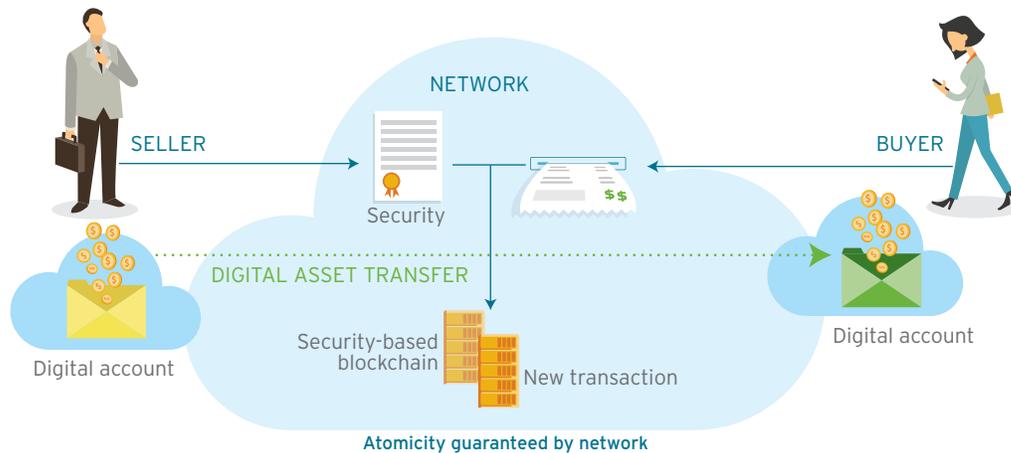
Transfer of Ownership over Blockchain

Figure 5

Trade Settlement

While safekeeping of assets and settlement appears to be most closely aligned to blockchain as a mechanism for tracking ownership, it can also be at the very core of the securities processing value chain. Its widespread use is only likely to come with significant changes in the roles of participants, levels of intermediation and evolution in the current-state market mechanics.

Figure 5 provides a simplified view of transfer of ownership resulting from an already executed and cleared (confirmed/matched) trade on a conventional (current presettlement) network and/or with partial application of distributed ledgers (e.g., trade repositories, CCPs, etc.). The original asset held by the seller is transferred to the digital account of the buyer. This ensures effective change in ownership. The buyer and seller are able to see their latest holding through a simultaneous update of their dashboards, wherein the "frozen assets" move into the "settled assets" rubric. Transparency is ensured by the simultaneous updating of the security-based blockchain.

Derivatives, Structured Products & Stock Borrow Loans

While we believe simpler assets such as equities and fixed income will be digitally managed over distributed ledgers in the short to medium term, it is pertinent that smart contracts on top of such digital assets can be constructed to model the behavior of derivatives, structured products, stock borrow/loans and other contractual obligations. This will address the demands of financial services firms, as well as corporates, institutions and other investors.

The OTC derivative market, with its peer-to-peer ethos, may be particularly suitable for blockchain. However, regulators would be wary of losing oversight on the market lest speculative bubbles and high-risk equity tranches proliferate.

As the technology advances and business practices become more mature with distributed ledgers, the line between decentralization and central oversight is likely to remain blurry for complex instruments.

Role of Partners

With the adoption of distributed ledgers and the emerging trading and post-trade processing landscape, the roles of several intermediaries in the securities processing value chain is likely to evolve. Figure 6, next page, illustrates the potential change in roles of various market players in the aftermath of the migration to a decentralized system of settlement.

Coexistence

As with any market transformation, no matter how insignificant, a prolonged coexistence between the current state and new market practices is necessary to ensure a smooth transition (e.g., electronic bookkeeping of dematerialized securities took several years to become mainstream). So it is reasonable to expect that distributed ledgers for digital (tokenized) assets as a possible alternative to the current mode of trading and settlement would necessarily have to exist in parallel with the traditional mode.

Depending on the level of adoption in the mainstream, different parts of the value chain might transform at a different rate. During the coexistence phase, transition bridges (such as in any traditional business-IT transformation program, but at a completely different scale) would be required to facilitate smooth functioning of markets, irrespective of the underlying trading, settlement and record-keeping methodology used by the participants (as different participants will be at different levels of adoption of the new emerging standards).

Here we examine a specific scenario where trading is still performed at conventional exchanges, but post-trade securities processing leads the adoption of distributed ledgers as a mechanism for settlement, safe keeping and asset servicing.

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The following actions would need to be performed for the decentralized platform (for post-trade operations – settlement) to be used in parallel with a conventional trading platform (order execution):

- Market participants have to be onboarded onto the decentralized network. Taking into consideration KYC compliance norms, the network should ensure that only compliant participants are onboarded to the distributed ledger. Global, regionwide and countrywide regulators would play a big part in the KYC (rather than incumbents).

- Digital accounts have to be created in the network for subscribed participants.

- Digital representation of the assets to be transferred to the participant's digital account is needed. This will require support from current-state position keepers (custodians/CSDs) and is an area where they can have commercial incentives.

- Cutover between book of records held in central databases of custodians/CSDs to the decentralized ledger will be initiated by clients on a security-by-security basis.

- Assets held in the digital accounts of the participants would have multiple public signatures, e.g., the current owner, network validator(s) (assuming partly closed trusted networks would be the norm), issuer (at least with new IPOs), etc.

- Issuers and registrars would also need to be informed of the change of holding type (from CSD to network) for position holders who have migrated. This as such would have no bearing on the settlement process but will be important when corporate actions are announced.

Some additional points to note with regard to coexistence:

- Certain economies may be unwilling to adopt the decentralized solution for fear of unregulated capital flows wreaking havoc in their domestic financial markets by increasing volatility (inflating asset bubbles and causing crashes). Implementing capital controls might be a way to handle these concerns. Conversely, economies may adopt the decentralized solution only if regulated CSDs/central banks play the role of miners so that government/central bank policy can be implemented through them.

- Still another possibility is that governments may allow decentralized trading in certain illiquid assets with loose coupling to overall financial markets.

Blockchain's Foreseen Impact on Market Player Roles

Market Player	Current Function	Probable Future State
Brokers	Agency trading on behalf of clients for commissions/fees.	• The role may merge with market makers and trading venues, as providers of liquidity. Brokers may eventually become liquidity hubs and/or validators of transactions in peer-to-peer networks, registering trades and providing transparency.
Stock Exchanges	A "marketplace" for buyers and sellers to congregate.	• A marketplace where tokens can be exchanged at a fair value in a transparent manner will always be required, though present day exchanges may morph into digital marketplaces accessible by all, with significantly reduced entry barriers. The conditions and service levels may vary – e.g., an individual/retail client can only enter the order book with underlying positions (securities or cash tokens) frozen to ensure instantaneous settlement.
Market Makers	Provide liquidity by trading on their own books, and in the process try to eke out a profit.	• As noted above, the roles of brokers and market makers may converge, providing all the important functions of maintaining liquidity and market depth, along with being registrars and validators of transactions.
Central Counterparty	Affiliated to exchanges and eliminate counterparty risk through "novation." Perform netting of trades to effect a net settlement.	• Role of central counterparties became more pronounced following the 2008 financial meltdown, as a mechanism to simplify highly complex chains of OTC positions and the ensuing counterparty risk. • Other than the simplest peer-to-peer retail transactions in simple (single stage) instruments, complex financial instruments with multistage settlement cycles to service needs of corporates are likely to continue evolving. • While counterintuitive to the concept of distributed ledgers, the role of CCPs is likely to evolve and transform in trust-free networks to support smart contracts representing such products. A possible evolution could be towards partially closed trust networks, where new generation CCPs could be third-party validators (or escrow service providers) for smart contracts.
Custodian Banks/ Settlement Agents/CSDs	Safekeeping of securities in "dematerialized" form on behalf of clients for a fee; servicing of assets when corporate actions are announced; processing of allegements.	• These roles would possibly drive maximum innovation in facilitating digital transactions over distributed ledgers. And this is understandable, as the need for multiple layers of intermediaries would very soon begin to get challenged, with blockchain-style ledgers transparently holding books of records for all participants. • They might evolve into specialized asset servicers, servicing issuers and investors, and compete with brokers as validators and miners of transactions. • They may provide value-added services such as digital accounts or consolidated stock record view (as compared to transaction or value tokens that are the building blocks of the blockchain-based ledgers). • At a further level of maturity, liquidity venues (exchanges), transaction facilitators (brokers and market makers) and record keepers (CSDs/custodians) may all converge, and provide specialized services in certain asset classes or securities issued by specific issuers (end-to-end service model). • Different entities in such new network roles may compete for assets/issuers, act as registrars of digital tokens and provide value-added services (such as tax reporting) to the investor community.
Registrars	Receive notification of change of ownership after settlement; inform issuing companies.	• Our point of view is that such a stand-alone role may not be required and most likely will be merged with transaction miners (brokers/market makers/CSDs).

Figure 6

- Till such a time that traditional fiat currency is in vogue, there may be the need to set up markets for exchange of digital currency with traditional currency. During times of uncertainty and consequent volatility there could be huge fluctuations in the digital/traditional currency exchange rates and market intervention by central banks may prove to be difficult. Therefore, in the medium term a decentralized solution may do away with digital currency and effect the cash leg of transactions with traditional currencies instead. The possibilities are many and may differ from country to country.

Conclusion

Application of distributed ledger technology has the potential to transform capital markets, spanning the mechanics of trading, settlement of trades and provisioning of asset services. The impact need not be limited to simple instruments such as equities and debt, but can be extended to other complex instruments such as derivatives, stock loans, etc.

Key drivers for the financial services industry to actively explore application of this technology in capital markets are:

- **Lower operational cost/shorter settlement cycles:** Potential elimination or change in role for some of the intermediaries would help in driving reduction of commissions and other associated costs. In a true end-state model, the only parties required for a trade would be a willing buyer and seller, envisioning a near instantaneous "T+0" settlement model.

- **Boundaryless trades:** A decentralized trading and settlement model will be truly global, allowing seamless trading across national boundaries.

- **Increased transparency:** The introduction of a globally distributed asset register where all transactions are recorded will significantly increase the trust factor for the financial industry and will be welcomed by regulators.

- **Risk reduction:** Elimination of counterparty risk. Increased regulation of "naked short selling" and other speculative trading methods.

- **Less regulatory reporting:** As all transactions are publicly available, regulators can easily access detailed movement of assets. This will also mean a massive cut in regulatory spend which in turn will benefit end users (buyer/seller).

When the concept of decentralization starts to be woven into the warp and weft of the present-day framework, it will cause considerable upheaval. Incumbent organizations in the financial landscape will need to rediscover, transition and diversify their offerings. Failing that, they may be rendered redundant as decentralization gains traction. The way various processes such as confirmations, settlements, position keeping, etc. are executed will not only undergo significant change, but certain processes may be eliminated altogether or fused into others. The interaction and resultant synergies between organizations will undergo a transformation, and the way various participants are integrated into the ecosystem will be upended.

While the possibilities are vast, so are the challenges. A significant impediment is the scale of the decentralization framework, which must be amplified to be able to handle the sheer volumes in the trading world. Similarly, there are other potential use cases such as the operating model during the coexistence period, the onboarding of structured products and complex instruments, liquidity constraints, legal and regulatory ramifications, etc. that need to be studied.

References

- http://cointelegraph.com/news/114490/overstock-to-offer-25m-corporate-bond-as-the-worlds-first-crypto-security
- http://www.economist.com/news/leaders/21677198-technology-behind-bitcoin-could-transform-how-economy-works-trust-machine
- http://www.economist.com/news/business-and-finance/21661404-spat-between-developers-may-split-digital-currency-forking-hell
- http://www.globalcustodian.com/blog/blogpost.aspx?id=2147490645&blogid=669
- https://blog.ethereum.org/2015/08/07/on-public-and-private-blockchains/
- http://www.finextra.com/news/fullstory.aspx?newsitemid=28041&utm_medium=NewsFlash&utm_source=2015-10-26

- http://dailyfintech.com/2015/08/10/crypto-securities-crypto-trading-a-fintech-revolution-with-p2p-ingredients/
- http://blogs.marketwatch.com/thetell/2014/03/07/major-banks-are-looking-at-bitcoin/

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