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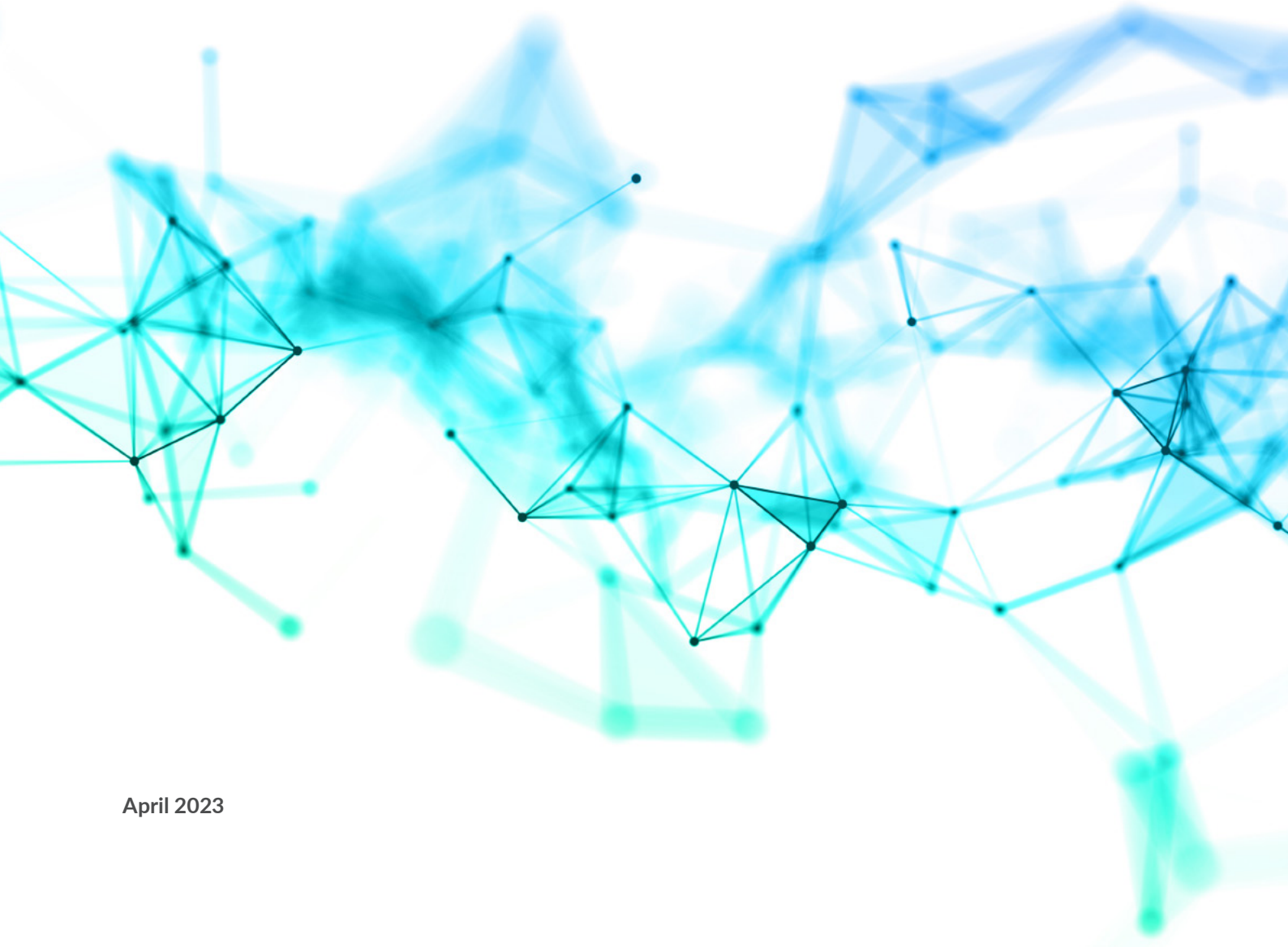
Digital Assets in Technology: Asset by Asset

Commercial Opportunities & Practical Considerations for Tokenisation for the Securities Financing Market



April 2023

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Executive Summary

The first blockchain was created in 2009 with the launch of Bitcoin, a decentralised digital currency that uses cryptography to control its creation and management, rather than relying on traditional centralised settlement infrastructures. One of the most important developments arising from blockchain to date has been tokenisation, the process of representing real-world assets on a blockchain. This allows for the creation of digital assets that can be traded and exchanged on decentralised exchanges.

Institutional adoption of blockchain technology began in earnest in 2017 . In the years that followed, several large banks and financial institutions began to experiment with blockchain technology, leading to a growing interest in blockchain technology among institutional investors.

Although still in its infancy, the use of tokenisation across financial services has been steadily growing, with the Value Exchange recently reporting over $1.3bn in live digital debt issuance as at March 2023[2]; a value that is expected to grow exponentially in the years to come.

In recognition of this rapidly developing market, the Financial Stability Board in its 2023 Work Plan identified the importance of harnessing the benefits of digital innovation whilst containing and understanding its risks. To underline this point, it described how digitalisation is fundamentally changing the way finance and the financial industry is organised. In a separate objective, it also pointed to the ongoing work with IOSCO to enhance the functioning and resilience of short term funding markets. As we will discuss, tokenisation is likely to be an integral part of any future market stability toolkit as it gains further acceptance and credence from market participants and policy makers alike.

This paper considers tokenisation from the perspective of securities financing markets, and how tokenising assets can open up multiple opportunities for the industry, especially in respect of the collateralised leg of the trade. Some of these include, but are not limited to:

- Increased mobility of trapped assets
- Increased accessibility to investors for illiquid assets
- The ability to optimise asset utility across fragmented asset pools
- Reduced operational processing timeframes
- ‘Securitisation’ of fund structures
- Reduction of delivery risk through a combination of tokens with smart contracts
- Improved supply chain transparency including Environmental, Social & Governance (ESG) markers
- Potential for more exotic use cases in the future including decoupling of asset rights into individual packages, and the transfer of contractual rights of a transaction separately to the assets themselves

[1] *https://siliconangle.com/2017/10/16/jp-morgan-chase-announces-new-blockchain-based-platform-cross-border-transactions/*

[2] *https://thevalueexchange.viewer.foleon.com/2023/thenumbersbehindtokenisationissuance/digital-issuance-in-numbers*

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Tokenisation has the potential to enable full use of all available assets across multiple custodial accounts through a Distributed Ledger Technology (DLT) layer. Fractionalisation enables the divisibility of hitherto discrete assets. Combining these two features provides for a powerful method of fully optimising asset use. In times of market stress, such as the recent liquidity volatility during the Liability-Driven Investment (LDI) crisis, the increased mobility and optimisation of collateral that tokenisation enables should result in greater resiliency. Adoption of the technology can assist market participants in ensuring that the correct collateral is in the right place at the right time.

The use of smart contracts in conjunction with tokenised assets allows for true delivery vs. delivery transactions, with transaction durations in minutes rather than days or weeks being realistically achievable. Combining this with the 24/7 nature of the technology, means that intra-day financing, with its connotations for reduction of financing costs currently accrued due to assets or cash not being in the right place at the time of settlement cut off, again represents potential for more efficient use of financial resources available to a firm.

Using tokenisation as a way of ‘securitising’ certain fund structures is another use case explored in the paper. Facilitating the ownership transfer of funds without the processing of redemptions and repurchases would again reduce operational burden, as well as having the potential to reduce impact to liquidity during times of stress.

As with any new business expansion and technology deployment there are risks and challenges to overcome. The paper considers amongst others:

- Legal and regulatory uncertainty across multiple jurisdictions
- The potential multiple disparate solutions for cash on-chain
- Connectivity and inter-operability across multiple DLTs
- The requirement to solve for such events as corporate actions

It is worth stressing within this summary that realising the full potential of tokenisation will require firms to look very closely at the legal structuring of any venture to ensure viability and that the solution will achieve the intended business outcome. If implemented with the correct attention to due diligence, investor protection, control and risk management, and practices which are long established within the industry, tokenisation provides a chance to revolutionise the securities financing industry alongside the wider capital markets ecosystem.

What is Tokenisation?

A token is a representation of an asset or bundle of rights that can be issued, traded, distributed and tracked on a blockchain[3].

There are two main activities that are meant when the term tokenisation is used in securities markets at time of writing:

a) **Tokenised Assets**

Tokens that represent ownership of an existing asset or bundle of rights, such as bonds, stocks, other types of securities, real estate[4], artwork, or even tractors[5]. These tokens can be traded on a blockchain platform, providing increased mobility and fractional ownership.

For example, tokenising bonds can enable investors to buy and sell fractions of bonds, allowing for greater liquidity by providing accessibility to a wider range of investors. Tokenising custodied assets, such as gold, can enable investors to hold fractional ownership of the asset without the need for physical custody or storage. This raises the possibility of these tokens being borrowed, lent, and used as collateral in a similar way to traditional securities.

Datonomy[6], which classifies digital assets, further breaks down this category into:

Asset-Backed Tokens
Tokenized assets that are backed by other assets, such as cryptocurrencies, securities, or commodities. The underlying assets backing these tokens are typically held in a segregated account on or off-chain.

Synthetic Tokens
Tokens that mimic the one-to-one value or price of another asset, such as cryptocurrencies, securities, or commodities. These tokens provide exposure to a particular asset without having to hold or own the asset itself.

[3] *https://coinmarketcap.com/alexandria/glossary/blockchain*

[4] *See for example: https://digishares.io/*

[5] *Sandner, P. (2022) Tokenization of Industrial Goods: 'Tractor-as-A-token', Forbes. Forbes Magazine. Available at: https://www.forbes.com/sites/philiptpsandner/2022/01/11/tokenization-of-industrial-goods-tractor-as-a-token/?sh=2964865f73c2 (Accessed: February 27, 2023).*

[6] *https://www.msci.com/documents/1296102/33887102/Datonomy+Methodology.pdf*

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b) **Natively Digital Issuances**

This involves creating tokens that represent ownership of a new security, such as equity or debt, that is natively digital and issued on a blockchain. These tokens can be sold in security token offerings (STOs), providing investors with a new way to participate in capital raising and ownership. Native digital issuances have accelerated with digital bond issues announced denominated in CHF[7], EUR and GBP[8], amongst others.

These two forms of tokenisation are largely treated separately at the current time, but it is likely that in the future their usage will converge. Some issuances also combine digital and traditional issuance characteristics.[9]

Note that as discussed in ISLA's initial paper with Ashurst on extending the GMSLA, whether a digital asset is a traditional asset in digital form or representation, or a new and/or natively digital asset as described above, may be difficult to immediately ascertain. For example, a registered bond might be constituted using traditional documentation but the issuer may elect to maintain the register on DLT. In this instance, the digital records on the DLT-based register might be considered 'digital assets' but they only represent the record of ownership and not the bond itself. Consequently, a third party would only be able to discern that the digital assets are mere evidential records of ownership (as opposed to representations of the bond itself) by having access to the underlying constituting documentation.[10]

Unless otherwise stated this document will use tokenisation to refer to tokenised assets rather than native digital issuances.

It should also be noted that many other forms of 'token' exist to perform various functions, including for instance the right to vote on future behaviour or issues impacting a particular blockchain, so called governance tokens[11]. These are out of scope of this paper. Datonomy provides a comprehensive classification of many types of digital assets across the full spectrum of usage. BNP also provides a factsheet[12] which helpfully disambiguates the use of the term token with respect to other computer science and cyber security meanings.

[7] *Six (2021) Six launches its six digital exchange by successfully issuing the world's first digital bond in a fully regulated environment, SIX. SIX. Available at: https://www.six-group.com/en/newsroom/media-releases/2021/20211118-six-sdx-digital-bond.html (Accessed: February 27, 2023).*

[8] *EIB (2023) EIB issues its first ever digital bond in Pound Sterling, European Investment Bank. European Investment Bank. Available at: https://www.eib.org/en/press/all/2023-030-eib-issues-its-first-ever-digital-bond-in-british-pounds. (Accessed: February 27, 2023).*

[9] *Hong Kong Monetary Authority (2023) Eddie Yue on tokenised bond: Huge potential to be unlocked, Hong Kong Monetary Authority. Available at: https://www.hkma.gov.hk/eng/news-and-media/insight/2023/02/20230216/ (Accessed: February 27, 2023).*

[10] *Isla publishes joint paper on GMSLA for an evolving Digital Asset Landscape - Isla News (2022) ISLA. Available at: https://www.islaemea.org/news/isla-publishes-joint-paper-on-gmsla-for-an-evolving-digital-asset-landscape/ (Accessed: January 29, 2023).*

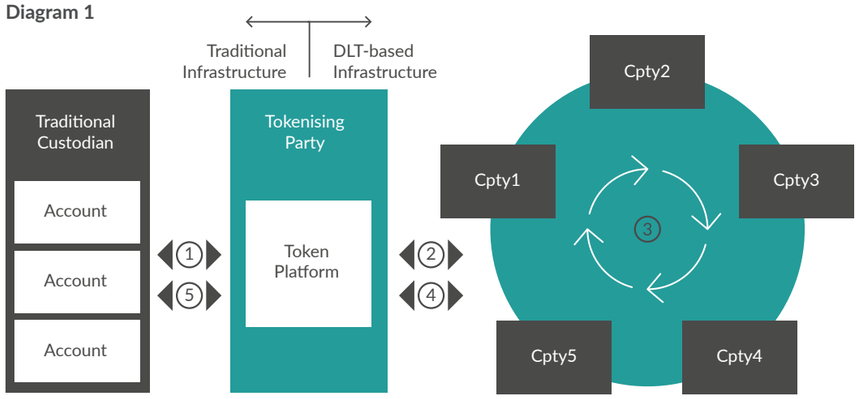
[11] *https://coinmarketcap.com/alexandria/glossary/governance-token*

[12] *Token and tokenisation in the financial world - securities services Available at: https://securities.cib.bnpparibas/app/uploads/sites/3/2021/04/ss-files-brochure-techmemo-token-and-tokenisation-in-the-financial-world.pdf (Accessed: March 24, 2023).*

Creating a Tokenised Asset

There are multiple potential methods of achieving and maintaining a tokenised asset, but the diagram below provides a high-level overview of the concept. More detail is given on the possible methods in the operational section of this paper.

Diagram 1



1. Tokenising party immobilises segregated real-world assets and creates digital tokens in token management platform
2. Tokens are made available for transfer on the blockchain
3. Transactions take place on blockchain; the blockchain records positions and token movement (cash and security tokens)
4. Counterparts redeem tokens with tokenising party
5. Tokenising party 'burns' tokens and relinquishes immobilisation of real-world assets

A tokenised version of a conventional asset should in principle have the same economic, legal and risk characteristics as the non-tokenised version of the asset. There are however two key differences that create a number of important implications from both the operational and the collateral management perspectives:

- The existence of a tokenising party: the party that issues the token and arranges for the safe keeping of the underlying asset. Either on their own account or using some form of custodian It is likely such a party will charge fees for performing this service.
- The use of some form of Distributed Ledger Technology as opposed to conventional financial market infrastructure to record ownership and manage the transfer of ownership

The tokenising party will need to enact controls and systemic methods of ensuring immobilisation of securities (see section 'Implementation Considerations'). These could be analogous to current methods of administering pledged collateral within custody accounts for the purposes of the GMSLA Security Interest 2018[13].

[13] *The agreement is based on the existing GMSLA 2010 and provides ISLA members with an alternative to the title transfer framework (https://www.islaemea.org/gmsla-security-interest/)*

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Opportunities for the Industry

Tokenised securities have the potential to increase utility and mobility of assets, reduce operational costs, and improve the efficiency of trading.

Tokenisation is already being used to improve the efficiency of supply chain management in the goods, raw materials and healthcare industries since it becomes possible to track the movement of these assets through the supply chain in real-time[14]. Similarly in the securities business transparency can be improved, with ESG markers, transaction history and complex transactional chains becoming more visible. This has the potential to remove opportunities for fraud and greenwashing, or at least allow instances to be successfully investigated more quickly and thoroughly[15].

Collateral management is an area particularly endowed with opportunity for improvement through tokenisation. Creating a digital token provides the ability to have a digital record of ownership that can be transferred more quickly and securely than traditional methods of transfer. Smart contracts can release loans on receipt of collateral, or perform simultaneous collateral swaps, automatically, reducing need for manual intervention. This means faster processing times, lower operational cost and reduced operational risk.

Furthermore, tokenised securities, particularly asset-backed tokens have the potential to integrate in the existing ecosystem, with closed networks such as tri-party being a natural place to demonstrate the releasing of trapped assets through tokenisation to deploy in a collateral setting.

Notwithstanding the need for network participants (see section 'Challenges'), tokenisation allows for greater mobility and accessibility of collateral. This is due to increased mobility and transparency as above, but also securities that are trapped within traditional infrastructure constraints or account structures can be tokenised and made available for use.

[14] *Philipp Sandner, Impact of Blockchain-Technology on the Finance-Function of an Industrial Company, Blockchain Center Frankfurt School of Finance & Management. Available at: https://assets.ctfassets.net/19hllh2ssa3x/7zEFFIKJFWDoN32gqa28Wi/bb184bb011f11cc4cb7ad1245b3142a8/_IoBconf_Philipp_Schulden.pdf (Accessed: March 24, 2023).*

[15] *Greggwirth (2022) Innovator Q&A: Digital Currency Risks may be on the rise, but there's hope for tracking fraud, Thomson Reuters Institute. Available at: https://www.thomsonreuters.com/en-us/posts/investigation-fraud-and-risk/innovator-q-a-digital-currency-fraud/ (Accessed: January 29, 2023).*

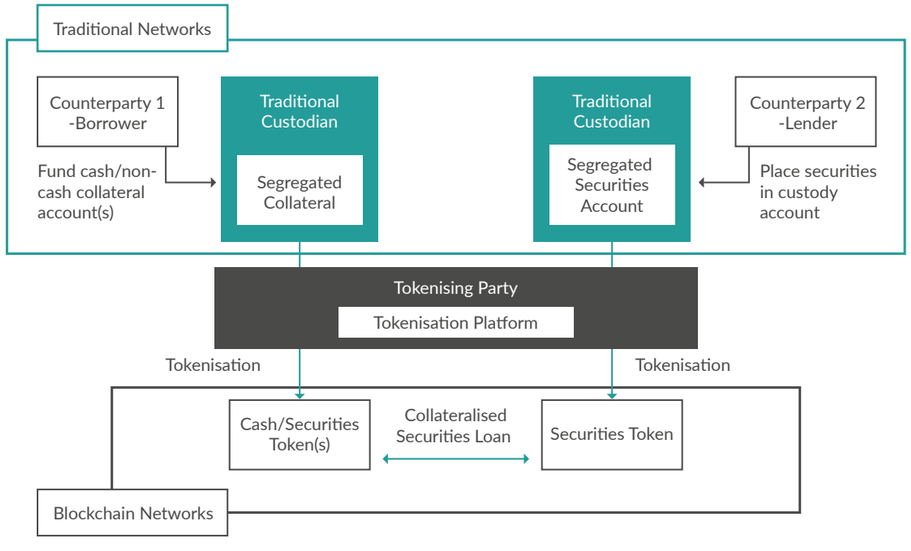
Securities Lending with Tokens - The General Case

The diagram below illustrates conceptually how a securities loan could be achieved using tokenisation of both the principal and collateral legs of the transaction. The example presupposes that the blockchain platform is the same for both tokens, however as discussed later in the paper use cases across chains also exist.

Using smart contracts on the blockchain these transactions can be executed and unwound with high timing precision, simultaneous exchange (atomic settlement) of assets and outside of traditional market settlement cut-offs. This removes delivery risk. It also means that the transaction delays caused by the need to ensure collateral has settled prior to release of loaned securities are removed.

Note that tokens can be created on a one-for-one basis with the real-world asset (i.e., 100 shares results in 100 tokens) or on a multiple-for-one basis (i.e., 100 shares results in one token). This means tokens can represent baskets of assets. Which route is taken will depend on the tokenising platform and the use case. Additionally, tokens can represent fractions of existing assets meaning required collateral values can be achieved with higher precision.

Diagram 2



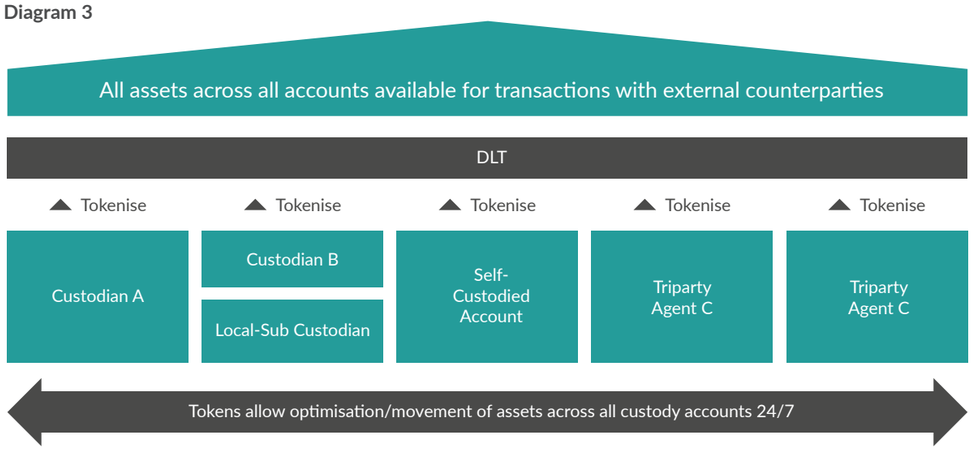
Custodial Fragmentation Solved

Traditional assets are often kept in a complex network of different custody accounts globally, with dedicated collateral management teams and systems looking to optimise use of assets across multiple transactions. Moving assets between accounts to get them to the 'correct place' is time consuming and wasteful. Liquidity and capital are lost through settlement cut offs, re-registration and other operational processes i.e. there are multiple points of failure in the collateral optimisation process.

By tokenising assets across the multiple custodial accounts and using DLT in a similar way to a book entry ledger mechanism, an entire organisation's asset pool can be utilised more effectively. Not only does the whole asset pool become available for use as collateral for transactions with external counterparties (transacted through nodes on a private or public blockchain), but where assets need to be moved between custody accounts this can be achieved at the registry level without the physical movement constraints. This can be achieved outside of traditional settlement cut offs, providing timely cover in an optimal fashion.

In effect tokenisation would act as an abstraction layer unifying infrastructure fragmentation. Diagram 3 represents the ideal fully optimised goal, although in reality, there are likely to be transitional periods of consolidation across the ecosystem. Firms should consider the controls, operational mechanisms and potential trading logistics in a transitional scenario where not all available assets have been tokenised and thus collateral provision is hybrid across existing and new architectures.

Diagram 3



Unlocking Trapped Assets

Assets that today sit in retail customers accounts, or in emerging markets can often be difficult to mobilise for use. In a similar fashion, these can be tokenised onto DLT and used without ever leaving their underlying accounts. In the case of multiple retail accounts, tokenisation can be an efficient way of aggregating many small pools into a larger more useful pool. The registry or tokenisation platform would of course need to be able to ensure traceability to underlying beneficial owners of the assets. Relevant legal and contractual requirements to lend such assets would also need to be in place, just as with traditional lending programmes.

It should be noted that in this case tokenisation is increasing mobility and utility of assets, not strictly liquidity, since in the event of default a collateral received will still need to be able to liquidate the asset[16]. This is discussed further in the section 'Implementation Considerations'.

Usually, illiquid assets are illiquid for a good reason, whether that be infrequent or non-standard valuation, for instance in the case of private equity, or restrictions on ownership in emerging rights. Tokenising assets does not in the majority, if not all, of such cases, remove those fundamental barriers and thus cannot increase liquidity.

Fractionalisation - More Precise Collateralisation

The ability to split real-world assets into multiple tokens, each representing a fragment of the asset's value, creates further opportunities. There is much literature that exists that discusses fractionalisation as a method of making expensive or inherently illiquid discrete assets (such as gold[17], art[18], real estate[19] and carbon credits[20]) more affordable for a wider pool of investors. This effective securitisation of mutual investment has obvious parallels with existing investment fund structures and will no doubt provide opportunities at scale in the future, when the exact legal and regulatory boundaries of this 'tokenised securitisation' become clearer.

In the near term however, fractionalisation of existing securities already held in custody provides an opportunity for firms to be more precise in their collateral optimisations. Today, collateral that is provided versus a loan needs to be equal to or greater than the required threshold as agreed in the terms of the loan- typically 102% or 105%, market-dependent. When this numerical level is translated to real world operational outcomes, the discrete nature of securities, combined with minimum transfer amounts or lots in some markets, mean that securities used in collateral will always have a value in excess of the theoretical collateral requirement. This excess could be seen as wasted asset value that could be used elsewhere. See diagram 4 for a visual analogy.

[16] *The future of the securities lending market: On the cusp of transformation (2022) ISLA. Available at: https://www.islaemea.org/thought-leadership/the-future-of-the-securities-lending-market-on-the-cusp-of-transformation/ (Accessed: March 2, 2023). Article: Tokenisation as a Force for Good with Collateral, Pirie*

[17] *Rayner, A. (2022) Gold is a prime asset for tokenization, Paxos. Available at: https://paxos.com/2022/08/31/gold-is-a-prime-asset-for-tokenization/ (Accessed: March 5, 2023).*

[18] *Rivers, M.L. (2022) The Art of Tokenization: How a Picasso painted itself onto the blockchain, Forbes. Forbes Magazine. Available at: https://www.forbes.com/sites/martinrivers/2022/04/27/the-art-of-tokenization-how-a-picasso-painted-itself-onto-the-blockchain/?sh=58cc18772901 (Accessed: March 5, 2023).*

[19] *The Tokenization of Real Estate: An Introduction to fractional real estate investment (2022) Dentons. Available at: https://www.dentons.com/en/insights/articles/2022/september/6/the-tokenization-of-real-estate (Accessed: March 5, 2023).*

[20] *Simon, D. (2022) Crypto vs. climate change – tokenizing carbon sequestering assets, Crypto Altruism. Crypto Altruism. Available at: https://www.cryptoaltruism.org/blog/crypto-carbon-sequestering-assets (Accessed: March 5, 2023).*

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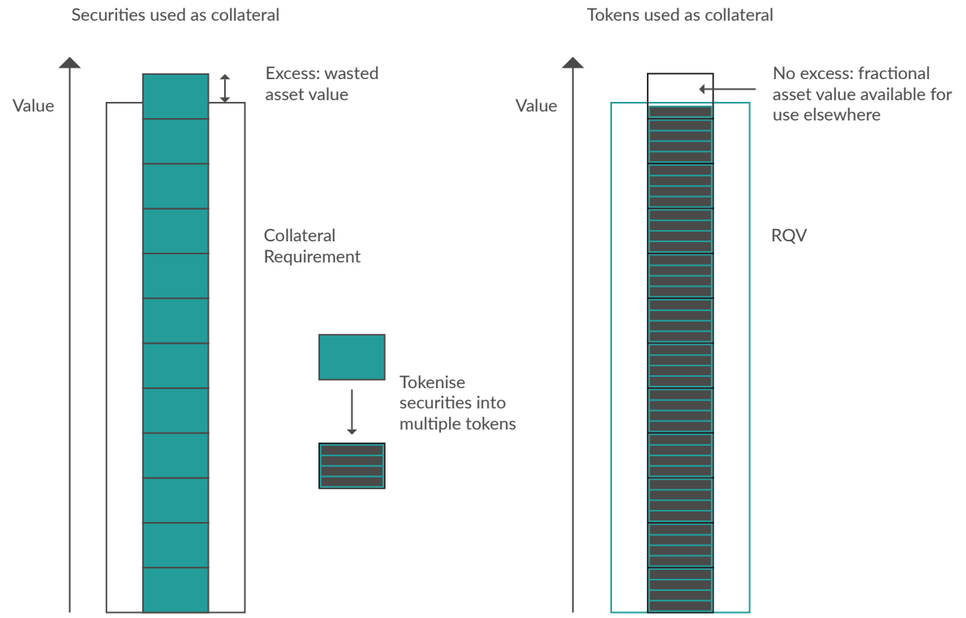
Ostensibly, for any individual security used as collateral or indeed any individual transaction the benefit may not be large. However, when compounded across multiple portfolios and positions, in a raising interest rate environment, the efficiencies add up significantly when a firm can hit their collateral requirements more precisely. Combining this level of precision with the precision in time that can be achieved by smart contracts moving tokenised assets, there is the opportunity to control and optimise collateral extremely tightly on a near to real-time basis.

Diagram 4



This approach obviously requires strong operational systemic controls to ensure that the token population is always in line with the real-world asset population to avoid a) using the same asset multiple times, b) the number of token fractions for any given asset continue to accumulate to the equivalent of one asset and c) there is no possibility that a set of equivalent tokens can be effectively trading at a different value to the asset itself. These controls are relevant to most if not all the use cases outlined in this paper.

Another approach or way of thinking of this is instead of creating multiple tokens, systemically there is the capability of recording and transferring a fraction of a security rather than discrete integer amounts. Pricing, valuation, and other properties of the security will all need to be considered as to how they transform when fractionalised.

Tokenising Fund Structures

The Investment Association publishes guidelines[21] and resources for the concept of tokenised investment funds. Their series of papers describes these:

> *"A tokenised fund, which may also be known as a digital fund or a BTF (blockchain traded fund) is one where shares or units in the fund, or a feeder fund for it, are digitally represented and can be traded and recorded on a distributed ledger. It uses code to mimic the functionalities of a traditional fund and replaces shares or units with tokens. It is not a form of uncertificated security recorded by the fund itself, but by the DLT ledger. Because of this, the difference between investing in a fund and owning the tokens that represent shares or units in the fund are not substantial. However, the costs associated with maintaining investor registers, for example, including where there is secondary market trading, should be greatly reduced where ownership is represented using a token."*[22]

Note that predicting the exact level of cost reduction is likely to be difficult at this stage in the tokenisation journey. The unit cost of performing any transaction on blockchain, the unit cost of transactions on existing infrastructures, the spreads volume and liquidity available on chain are either unknown, note experienced to date or often opaque.

Borrowing and lending a tokenised fund should in theory operate more like lending a share. The secondary market trading efficiencies arise from being able to transfer ownership without having to perform the physical redemption, re-purchasing and fee processing that would normally occur with traditional fund units.

It has been reported[23] that the redemption and repurchase activities can reduce liquidity in the markets during crisis moments. Tokenisation of the funds may provide an antidote to this effect.

Again, the potential in this opportunity is heavily dependent on the legal structure and make-up of the fund and firms should seek advice when considering this avenue.

[21] *Tokenised funds (2023) The Investment Association. Available at: https://www.theia.org/fundoperations/tokenisedfunds (Accessed: March 5, 2023).*

[22] *Tokenised funds- what why and how - the investment association (2020). Available at: https://www.theia.org/sites/default/files/2020-11/Tokenised%20funds%201%20-%20What%20why%20how.pdf (Accessed: March 5, 2023).*

[23] *Johnson, S. (2023) Bond etfs suck liquidity out of market in a crisis, academics say, Financial Times. Financial Times. Available at: https://www.ft.com/content/d13d2c2f-0411-42ea-94dd-42331be05f9a?shareType=nongift (Accessed: March 5, 2023).*

Intra-Day Transactions - Liquidity Spikes

It has been noted that use of tokens in conjunction with smart contracts allows for risk-free atomic settlement, and transaction durations measured in minutes rather than days or weeks. Notwithstanding some of the challenges this poses for certain legacy systems (see section 'Implementation Considerations') this provides firms the ability to manage liquidity spikes and drains intra-day, meaning that significant asset value does not have to be tied up overnight for fluctuations in value between end of day cut-offs. It also covers intra-day risk more efficiently. These efficiencies can be achieved across multiple custodians as noted above, giving full use of the asset pool to deal with intra-day spikes.

It is worth taking the 2022 LDI funding crisis in the UK as an example. Against a tumultuous political backdrop the bond market saw yields rise extremely quickly[24]. The (LDI) products used by pension funds required large amounts of collateral to cover their derivative transactions in a compressed time frame. Ordinarily the pension funds would have been able to reoptimize their asset pools over time: cash levels required are maintained by the operational processes that optimise, sell, settle and re-allocate assets through traditional payment pipes, custodians and security registrars.

The high volatility caused a demand for cash (as the most liquid and acceptable collateral for the LDI contracts) to cover emergency margin calls, which resulted in asset sell-offs that required further cash, creating a spiral of liquidity drain only halted by the Bank of England.

Whilst the contracts in question required cash as margin, it can be hypothesised that any solution that makes the optimisation of collateral more efficient could have had a positive impact on the crisis. Moving siloed collateral through traditional methods competes against the sell-off volumes in the network, not just from a technology perspective, but also in terms of operational personnel having the capacity to manage such volumes.

Time pressure and the sudden on-rush of clients contacting the same personnel in collateral management teams at the same time compounded the issue[25]. Funds that were not receiving information in a timely manner may have decided to start selling more, fearing the worst.

Being able instead to offer collateral from any of your custodial accounts, say for a repo transaction to generate the cash needed and only for as long as the volatility lasts, to the minute, alleviates the risk and operational burden significantly. Finadium looked in more detail at a use case example with the HQLAx product[26].

These solutions become more powerful should cash-on-chain (see Implementation Considerations for further info) solutions become more scaleable. Cash can then be moved via token in a similar fashion to non-cash assets as outlined in the use cases above.

[24] *Person and Huw Jones, S.C. (2022) Explainer: What is LDI? Liability-Driven Investment Strategy explained, Reuters. Thomson Reuters. Available at: https://www.reuters.com/markets/europe/what-is-ldi-liability-driven-investment-strategy-explained-2022-10-04/ (Accessed: March 5, 2023).*

[25] *Heenk, B. It's complicated… 5 questions about what could be done differently following the LDI turmoil, Home – Avida International. Available at: http://www.avida-int.com/blog/its-complicated (Accessed: March 21, 2023).*

[26] *Galper, J. (2022) Could Hqlax's solution have helped ease market and operational disruptions during the recent UK gilt volatility?, Finadium. Available at: https://finadium.com/could-hqlaxs-solution-have-helped-ease-market-and-operational-disruptions-during-the-recent-uk-gilt-volatility/ (Accessed: March 5, 2023).*

Flash Loans - Collateral Substitution using Smart Contracts

It has been mentioned elsewhere in this paper that tokenisation more readily enables the transfer of assets through smart contracts, mitigating delivery risk, enhancing speed of transacting and avoiding limitations in settlement cut-offs which cause unnecessary cost of financing.

Smart contracts can be composable i.e. different individual contracts can be put together into larger pieces of code to achieve more complex outcomes in surprisingly simple ways.

An example use case could be that of collateral substitution where the collateral giver does not initially own the collateral now required. Say that the collateral giver has initially provided security A as collateral, but at some point in time later, the collateral receiver requires security B instead, for instance due to an eligibility change, however the collateral giver does not own security B.

In order to achieve this the collateral giver must perform a series of individual transactions:

a) secure a credit line to borrow cash

b) use the cash to buy security B

c) give security B to the collateral receiver

d) receive security A back from the collateral receiver

e) sell security A

f) repay the cash loan

Each of these transactions is sequential and takes time to perform each transaction, settle and confirm the settlement of each security or cash movement at each stage. Each movement could also transact on a different set of systems or infrastructure.

It is possible to combine individual smart contracts that would perform these transactions into one over-arching whole that effectively transfers all cash and securities atomically, dramatically reducing counterparty risk and financing costs of this substitution. It should be noted that the DeFi community already has applications and protocols that perform these types of transaction including across chains (see section 'Cross-Chain Connectivity - Securities Financing as a Mechanism).

Cross-Chain Connectivity - Securities Financing as a Mechanism

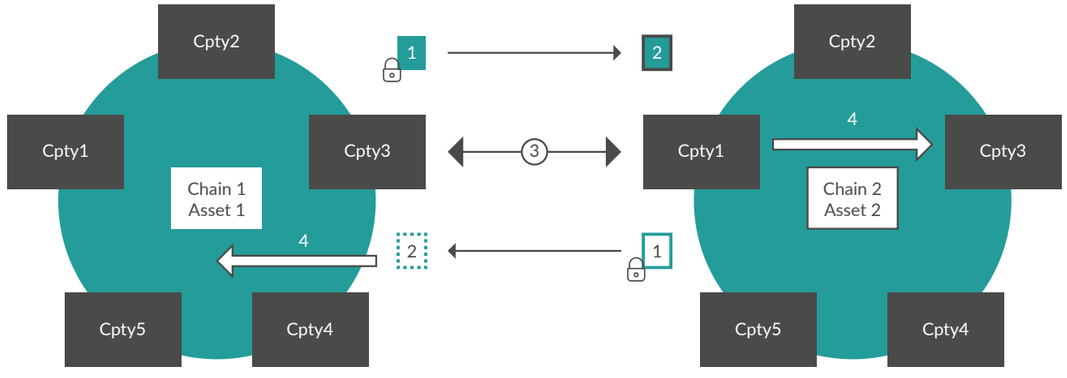
Notwithstanding the desire of the BIS to have a unified ledger[27] it is a given that in the near term not all assets will exist on one large blockchain. Thus, there needs to be methods which allow transfer of value across multiple chains in an efficient manner, else re-use capability and onward transfer of securities becomes difficult (see section 'Implementation Considerations'). This also applies to cash equivalents on-chain such as CBDC.

One method which has been explored by the DeFi community (who are often transacting across chain) is the concept of a cross-chain bridge[28]. This involves locking up tokens on one chain, creating 'wrapped tokens' on a second chain to represent those tokens for onward trading. Effectively this is tokenising a token!

The concept of 'locking up' an asset (in this case the first chain's tokens) and representing as a second token is analogous to tokenising custodied assets and would require similar levels of control. In many DeFi applications collateral is not taken for the locked up or deposited assets. However, following good operational practice it can be seen that the cross-chain bridge would benefit from a similar reverse transaction i.e. the taking of an asset in return. There exists this concept within DeFi too: the cross-chain swap[29].

In traditional finance, the swap is the synthetic cousin of a securities loan, and analogously if the second chain were to provide collateral in excess of the locked up initial token, then effectively there is an open loan between the chains. To facilitate onward lending, collateral re-use and increase global reach it can be envisioned that the future will see a number of institutional distributed ledgers inter-connected with inter-chain loans providing a risk mitigated method of connection.

Diagram 5



1 Assets are immoblilised on their respective DLTs using appropriate accounts by a trusted party (not shown)

2 Tokens on alternative chain representing original assets (wrapped asset) created by a tokenising party (not shown)

3 Loan takes place

4 Wrapped assets are avaibable for onward transfer

[27] *Carstens, A. (2023) Innovation and the future of the monetary system, The Bank for International Settlements. Available at: https://www.bis.org/speeches/sp230222.htm (Accessed: March 24, 2023).*

[28] *What are cross-chain bridges? (2022) What are Cross-Chain Bridges? Available at: https://www.alchemy.com/overviews/cross-chain-bridges (Accessed: March 5, 2023).*

[29] *What is a cross-chain swap? - axelar.network (2023). Available at: https://axelar.network/blog/what-is-a-cross-chain-swap (Accessed: March 5, 2023).*

Pledging & Exercising Rights in a Security Interest Arrangement

Law surrounding the pledging of securities, or the creation of security interest, is complicated and thus it is not intended that this paper explore this subject in depth, though future publications may do so. However, it is worth noting some high-level opportunity in this area.

Depending on the type of DLT used, tokenised securities 'pledged' for collateral purposes could be locked by a smart contract for the benefit of the counterparty without having to use a third party. Delivery of securities could also potentially be achieved globally without the need for local custodians or integration with a local CSD. This opens up the opportunity of building in rules to the smart contract which enforce the transfer of pledged assets to the non-defaulting party in the event of default, automatically triggered by the default.

Aside from the legal intricacies, the technical specifics would need to be worked through too. For example, an agreed-upon oracle (external source of information for a blockchain) that could reliably record and trigger the default of a party would need to be in place.

Practically speaking, parties may not want to agree that digital securities posted as collateral can be transferred / released automatically pursuant to a smart contract unless they can be satisfied that the relevant trigger events will be based on reliable and objective data and that every potential eventuality can be coded for in line with the parties intentions. This may be difficult to achieve in practice, at least in the short term.

De-coupling of Rights

As mentioned in the definition, tokens can represent 'bundles' of rights. Thus, it is entirely possible to conceive of a real-world asset being tokenised in a way that there are multiple tokens, each representing a particular piece of the full package of rights granted by the asset. For example, voting rights or the right to receive a dividend could be decoupled and remain with the beneficial owner even when other aspects of the asset are on loan. This presents opportunities to meet ESG obligations.

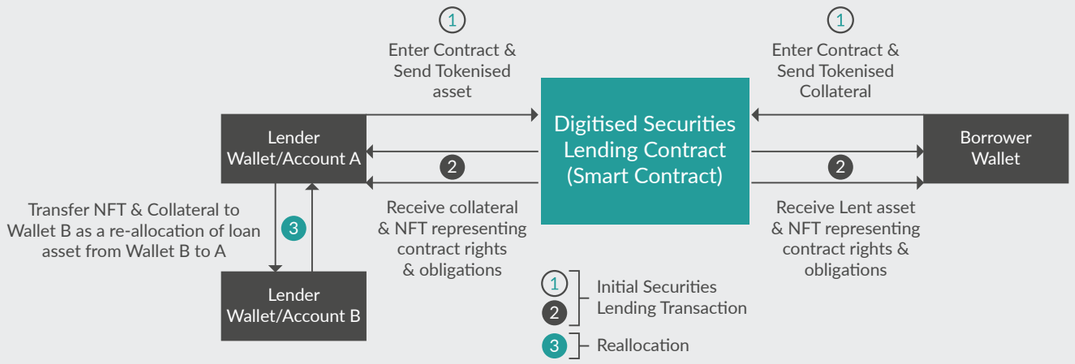
Clearly this concept relies heavily on what is legally, regulatorily, and operationally achievable and firms should take advice when exploring this opportunity angle.

Tokenisation of Contractual Rights & Obligations

A use case which goes beyond tokenising assets discussed in the main body of this paper, but worth mentioning as something with potential for broader application, is the representation of contractual rights and obligations as a non-fungible token (NFT[30]).

The contractual obligations (for example to meet margin calls daily) and rights (for example to take control of collateral provided in the event of default) can be transferred independently of the assets themselves. This gives a technologically efficient method of effecting a novation or even, as shown in the diagram below, re-allocating a loan contract between beneficial owners in an agency program.

The attraction of such a solution would need to be assessed further, but conceptually there could be broader application of this digitisation of contractual terms.



[30] *www.investopedia.com/non-fungible-tokens-nft-5115211*

Implementation Considerations

Whilst tokenisation has the potential to increase efficiency and reduce costs in the securities financing market, several hurdles must be addressed before securities financing on DLT can become fully embedded. Key challenges that are currently preventing the widespread adoption of securities financing on DLT include:

1. **No widely used solution for cash on chain.** One of the main challenges facing securities financing on DLT is the lack of a market agreed solution for handling cash on chain. Many lending transactions typically involve cash collateral. However, there is currently no widely accepted method for handling cash on chain, which makes it difficult to implement securities lending vs cash on DLT or at least realise all of the benefits such as atomic settlement. Potential solutions are:

   a. **CBDC (Central Bank Digital Currency)**[31]. There has been an increase in central banks and others researching this type of solution[32], but is some way off in many developed jurisdictions[33]. However, China[34] and some smaller economies have implemented retail CBDC early (with limited uptake in the latter). For the securities financing industry, wholesale CBDC[35,36], available to financial institutions is a more pertinent form of CBDC.

   b. **Synthetic CBDC.** Synthetic CBDCs are cash tokens issued by private companies as private liabilities though are backed by assets held in accounts with the central bank. A good example is the Utility Settlement Coin (USC) initiative created by Fnality[37,38].

   c. **Stablecoins.** An e-money token issued by a private firm as private liabilities. There exist two primary forms: asset-backed, in which the firm holds other financial instruments to guarantee the redeemability, such as Tether[39]; and algorithmic, in which the value of the token is kept constant through smart contracts issuing and burning other tradeable tokens. Algorithmic stablecoins have been shown to lose their peg value in several well-publicised catastrophic collapses[40] and have fallen from favour. Asset-backed stablecoins remain in use at time of writing, though the issuing firms have garnered some controversy when attempting to prove that sufficient reserves are held at all times[41], and due diligence is recommended when considering this solution.

[31] *Central Bank Digital Currency (CBDC): Digital Assets Glossary (2021) METACO. Available at: https://www.metaco.com/digital-assets-glossary/central-bank-digital-currency-cbdc/ (Accessed: January 28, 2023).*

[23] *BIS innovation hub work on Central Bank Digital Currency (CBDC) (2021) The Bank for International Settlements. Available at: https://www.bis.org/about/bisih/topics/cbdc.htm (Accessed: January 28, 2023).*

[33] *Central Bank Digital Currency tracker (2022) Atlantic Council. Available at: https://www.atlanticcouncil.org/cbdctracker/ (Accessed: January 28, 2023).*

[34] *Digital Yuan: What is it and how does it work? (2021) Deutsche Bank. Available at: https://www.db.com/news/detail/20210714-digital-yuan-what-is-it-and-how-does-it-work (Accessed: January 28, 2023).*

[35] *Demystifying Wholesale Central Bank Digital Currency (2022) European Central Bank. Available at: https://www.ecb.europa.eu/press/key/date/2022/html/ecb.sp220926~5f9b85685a.en.html#:~:text=Central%20bank%20money%20has%20traditionally,digital%20form%20for%20wholesale%20purposes. (Accessed: January 28, 2023).*

[36] *Wholesale CBDC vs. retail CBDC: Key differences (2023) Cointelegraph Available at: https://cointelegraph.com/cryptocurrency-regulation-for-beginners/wholesale-cbdc-vs-retail-cbdc-key-differences (Accessed: January 28, 2023).*

[37] *Fnality International. Available at: https://www.fnality.org/home (Accessed: January 28, 2023).*

[38] *Bignell, F. (2022) CBDC development: Who's leading it with Bitcoin Foundation, WEB3 labs, and more, The Fintech Times. Available at: https://thefintechtimes.com/cbdc-development-whos-leading-it-with-bitcoin-foundation-web3-labs-and-more/. (Accessed: January 28, 2023).*

[39] *tether.to. Tether. [online] Available at: https://tether.to/en/*

[40] *Swanson, T. (2022). Not all algorithmic stabilization mechanisms are the same, May 2022. [online] Great Wall of Numbers. Available at: https://www.ofnumbers.com/2022/05/ [Accessed 28 Jan. 2023].*

[41] *Henn, P. (2022). Tether Reserves | Why Are They Controversial? [online] currency.com. Available at: https://currency.com/tether-reserves [Accessed 28 Jan. 2023].*

   d. **Blockchain-Based Deposits.** Subject to similar supervision and oversight as other regulated bank deposits. This typically requires the depositing of cash to an entity who is tokenising the deposits. There are three broad types of ledger designs that financial institutions can choose to introduce blockchain-based deposits: (I) single bank ledgers, (ii) shared ledgers, and (iii) universal ledgers. The JPM Coin System is a live example of a single bank ledger for blockchain deposit accounts — it is operated by JPMorgan and acts as its own ledger and payments rail for US$ balance transfers among JPMorgan participating customers. Deposit Tokens have been discussed in a paper by Oliver Wyman and Onyx by J.P.Morgan[42].

   e. **Trigger solutions.**[43] That tie on-chain solutions to existing cash payment networks. However, this type of solution requires reconciliation or reliable electronic confirmation of settlement, arguably resulting in the re-introduction of inefficiencies on the settlement of the cash leg that exist in traditional methods of DVP transactions.

2. **Establishment of trusted digital asset custodians.** Digital asset custodians are responsible for holding and managing digital assets on behalf of their clients. As securities lending on DLT involves the lending of digital assets, the establishment of digital asset custodians is a key step in the widespread use securities financing on DLT, at least where lenders do not wish to self-custody. Without digital asset custodians, it is difficult to ensure that digital assets are properly secured and protected, and to give lenders and borrowers confidence in the safety of their assets. AIMA's published industry guide[44] provides a comprehensive overview of the types of digital asset custody and considerations to be made. Many traditional custodians have entered this space[45,46], often in partnership with technology providers operating in the DLT arena. There are also new players in the market though they primarily focus on custody of cryptocurrency[47].

[42] *https://www.jpmorgan.com/onyx/documents/deposit-tokens.pdf*

[43] *Trigger solution (2021) Deutsche Bundesbank. Available at: https://www.bundesbank.de/en/service/media-library/videos/trigger-solution-861426 (Accessed: January 28, 2023).*

[44] *The Alternative Investment Management Association Ltd (2022), Digital Asset Custody An AIMA Industry Guide. Available at: https://www.aima.org/sound-practices/industry-guides/digital-asset-custody-guide.html. (Accessed: January 29 2023)*

[45] *'New Digital Asset Custody Platform: Crypto Custody.' BNY Mellon, https://www.bnymellon.com/us/en/about-us/newsroom/press-release/bny-mellon-launches-new-digital-asset-custody-platform-130305.html. (Accessed: January 29 2023)*

[46] *Heng, Cheryl. 'State Street Readies Digital Custody Platform for Early 2023 as Race Heats Up.' Asia, Citywire, 12 Oct. 2022, https://citywire.com/asia/news/state-street-readies-digital-custody-platform-for-early-2023-as-race-heats-up/a2399649.*

[47] *Blockdata | List of Crypto Custody Providers. https://www.blockdata.tech/markets/use-cases/custody-solutions.*

3. **Cross-chain connectivity and infrastructure.** Many different DLT platforms are currently in use, and securities financing on DLT will require the ability to connect these different platforms in order to facilitate lending transactions, collateral upgrades and so on. Without cross-chain connectivity, it becomes difficult for different platforms to communicate with each other and for users to move assets between platforms. As mentioned above, this is actually an area in which securities lending & repo products may find an important facilitating role in the interim. Indeed, such use cases have begun to appear[48]. Use of standard methods of representing transactions and lifecycle events such as the Common Domain Model (CDM)[49] developed by ISLA, ISDA and ICMA, would provide the ability to have smart contracts that equivalent on separate chains.
4. **Liquidity on-chain and re-usability of collateral.** Until DLT networks gain in momentum and have sufficient parties on-chain, there can be a lack of liquidity on-chain, which makes it difficult to reuse collateral. Re-usability of collateral is also a concern where it remains unclear how collateral can be reused in different transactions on different platforms. Without liquidity and re-usability, it naturally becomes harder for borrowers to secure loans and less attractive for lenders.
5. **Legal and regulatory uncertainty.** The legal and regulatory environment surrounding tokenisation is uncertain. This uncertainty makes it more onerous to implement securities lending utilising tokens, depending on risk appetite or indeed existing compliance constraints, as it is unclear what regulations and laws will apply to these transactions. Until there is more clarity on the legal and regulatory front, it will be challenging for some firms to fully embrace securities lending on DLT in its purest form. Notwithstanding this, publication of guidelines by the BCBS[50] and statements such as that made by the UK Jurisdiction Taskforce demonstrate that regulators, legislators and advisory bodies are actively working to remove uncertainty. Additionally, other use cases utilising existing regulatory and legal frameworks are possible, and with time and ongoing work on industry standard documentation this barrier will become smaller. See also Legal Considerations and Regulatory Considerations.
6. **Integration with existing technology.** For firms with existing technology platforms and enterprise level risk management, financial accounting platforms, collateral optimisation dashboards, there will be a need to integrate the new networks and systems. This will take time, cash, and skills investment. Aside from messaging integration, existing systems may also need to be slightly re-configured. E.g., to instruct ownership transfers to take place at precise moments in time, or for intra-day trading certain systems may need to be able to calculate interest per minute, something not previously required.
7. **Agreed taxonomies.** Categorisation and definition of the various digital assets is not widely agreed upon. As mentioned earlier in this paper, in 2022 Goldman Sachs, MSCI and CoinMetrics created Datonomy to start providing structure in this area[51]. Integration of such categorisation into standardised industry models such as the CDM could also help embed taxonomies throughout the ecosystem.

[48] *Office, Fnality Press. 'Fnality and HQLAX Demonstrate the First Cross-Chain Repo Swap Pilot.' Fnality International, https://www.fnality.org/news-views/hqlax_crosschain_repo_swap_pilot.*

[49] *www.finos.org/common-domain-model*

[50] *LawtechUK (2023) UKJT legal statement on Digital Securities, LawtechUK. LawtechUK. Available at: https://lawtechuk.io/insights/ukjt-digital-securities (Accessed: February 27, 2023).*

[51] *Datonomy methodology - msci.com (2022). Available at: https://www.msci.com/documents/1296102/33887102/Datonomy+Methodology.pdf?trk=public_post_comment-text (Accessed: March 2, 2023).*

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Legal Considerations

Legal treatment of tokens and other digital assets remains in a state of flux in multiple jurisdictions globally. It is not within this paper's scope to provide a detailed or comprehensive overview of all globally relevant legislation. ISLA continues to advocate for legal certainty in the space on behalf of its members, to assist in providing an environment in which the opportunities outlined above can be fully realised. This includes responding to the UK Law Commission's Digital Asset Consultation[52] in 2022. Other jurisdictions have implemented changes in law recognising the possibility of using DLT for recording issuance of securities including Luxembourg[53] and Germany[54].

Any jurisdiction implementing law reform in this space, will need to ensure that proposals for reform are workable from a practical perspective, and take into consideration the way in which market participants assess the robustness of, enter and manage financial transactions.

Additionally, to aid in consistency and prevent fragmentation of the marketplace ISLA recognises the need to update the industry standard legal framework that is the Global Master Securities Lending Agreement (GMSLA), and work has begun to achieve that[55]. This initial paper examines further the following categories of issues that arise in the context of digital assets:

A

Legal – questions relating to the way in which a digital asset is constituted and, consequently, whether it is capable from a legal perspective of being subject to personal property rights; how those personal property rights can be transferred (either on an outright title transfer basis or by way of security); and how a non-defaulting party can exercise its rights in respect of transactions in digital assets upon the default of its counterparty.

B

Commercial – questions relating to the extent to which digital assets can be used in securities lending transactions (whether as the loaned asset or as collateral); the allocation of commercial and economic risks arising from transacting in digital assets; and whether and/or how to preserve the economics of a securities lending transaction involving digital assets.

C

Documentation – questions relating to whether amendments are required to the existing securities lending documentation to accommodate securities lending transactions involving digital assets.

[52] *Isla responds to consultation on Digital Assets - Isla News (2022) ISLA. Available at: https://www.islaemea.org/news/isla-responds-to-consultation-on-digital-assets/ (Accessed: January 29, 2023).*

[53] *Luxembourg law recognises the use of dlt for the issuance of dematerialised securities (2021). Clifford Chance. Available at: https://www.cliffordchance.com/content/dam/cliffordchance/briefings/2021/01/Client-Briefing-DLT-Law-II.pdf (Accessed: March 29, 2023).*

[54] *AllenOvery (2021) A new era of securities law has begun: Electronic securities act (eWpG) comes into force. Allen Overy. Available at: https://www.allenovery.com/en-gb/global/news-and-insights/publications/gesetz-ueber-elektronische-wertpapiere-tritt-in-kraft (Accessed: March 29, 2023).*

[55] *Isla publishes joint paper on GMSLA for an evolving Digital Asset Landscape - Isla News (2022) ISLA. Available at: https://www.islaemea.org/news/isla-publishes-joint-paper-on-gmsla-for-an-evolving-digital-asset-*

In respect of tokens as outlined in this document, it is assumed that issuers of tokens will need to provide legal assurances that those tokens can ultimately be redeemed by the asset or basket that they represent, as well as assurance that those assets will be kept segregated. Firms should take legal advice on what is required and how to achieve this beyond existing custodial and transactional contracts. Whether or not such assets can be used as collateral under existing collateral regulation e.g., the FCARs in Europe is something that will be worked through in each jurisdiction and firms are advised to stay abreast of these discussions. Per ISLA's response[56] to the UK Law Commission in 2022, it is hoped that the significant benefits of regulation such as the FCARs, insofar as they relate to traditional financial collateral, are extended to digital assets. The mechanism by which that is achieved in each jurisdiction will take further detailed analysis by entities such as the Law Commission.

There are a number of issues to consider if you are looking at using smart contracts to manage collateral in the absence of a third party. For example, parties may only agree that digital assets posted as collateral can be transferred/released automatically pursuant to a smart contract unless they can be satisfied that the relevant trigger events will be based on reliable and objective data and that every potential eventuality can be coded for in line with the parties' intentions. This may be difficult to achieve in practice, at least in the short term.

Finally, when using digital assets as collateral, there will be different legal considerations to make if made under a security interest agreement, particularly at default: is the property to be sold the token or the asset it is linked to? The exact answer will depend on legal construct of the agreement for instance whether the token is an independent piece of property.

[56] *https://www.islaemea.org/news/isla-responds-to-consultation-on-digital-assets/*

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Regulatory Considerations

The regulatory landscape for digital assets is in a state of flux globally with different jurisdictions at different stages with respect to different asset types including tokens. It is not within this paper's scope to provide a detailed or comprehensive overview of all globally relevant regulation. PwC's report[57] at the end of 2022 provides a summary of many jurisdictions with expected outlook for 2023. It is recommended firms looking to utilise tokenisation stay abreast of regulatory developments within the jurisdictions they operate in.

In Dec 2022 the Basel Committee on Banking Supervision (BCBS) published the final prudential standard for the treatment of banks' exposures to cryptoassets[58]. This standard will be implemented by Committee member countries by 1 January 2025. In summary the standard:

- Applies to banks' exposures to 'Cryptoassets' which are defined as 'private digital assets that depend on cryptography and distributed ledger technologies (DLT) or similar technologies' and are 'a digital representation of value, which can be used for payment or investment purposes or to access a good or service.'
- Groups cryptoassets into two main groups with different capital requirements
  - Tokenised traditional assets that meet the test conditions and supervisory requirements set out in the standard fall into Group 1a and are 'subject to capital requirements based on the risk weights of underlying exposures as set out in the existing Basel Framework'.
  - Group 1b assets are cryptoassets with stringently assessed stabilisation mechanisms e.g. certain stablecoins that meet the assessment conditions
  - Those tokens that fail to meet the group 1 classification conditions are deemed to be of higher risk (Group 2) and are 'subject to a newly prescribed conservative capital treatment'
- Proposes an add-on to RWA to cover infrastructure risk, even for Group 1 assets, that national authorities can activate should they observe weaknesses in infrastructure supporting such assets
- A limit to Group 2 exposures

It is recommended that firms looking to utilise tokenisation solutions assess the solutions against these proposed standards and consider potential impact to their risk calculations and operational controls.

At time of writing there have been no proposed changes to cater for tokenised assets within the SFTR framework, though ESMA did introduce the DLT pilot regime[59] for firms wanting to experiment with the technology.

[57] *PricewaterhouseCoopers (2022) PWC Global Crypto Regulation Report 2023, PwC. Available at: https://www.pwc.com/gx/en/about/new-ventures/global-crypto-regulation-report-2023.html (Accessed: March 2, 2023).*

[58] *Prudential treatment of Cryptoasset exposures (2022) The Bank for International Settlements. Available at: https://www.bis.org/bcbs/publ/d545.htm (Accessed: March 2, 2023).*

[59] *Lex - 32022R0720 - en - EUR-Lex (no date) EUR. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R0720 (Accessed: March 24, 2023).*

Operational & Technological Considerations

Public or Private Blockchains

A factor having a major impact on operational processes for tokens is whether the form of DLT used is a private ledger or a public ledger. Theoretically a public ledger has no single accountable party responsible for the operation of the system (including maintenance and code changes), correction/cancellation of errors or having any form of legal liability. Any party can in principle take part in processing transactions or submitting code changes. Note that just because a ledger is public, that does not mean that permissioning is precluded: parties to the blockchain can still be assigned different roles and rights on the network.

A privately managed distributed ledger network has the advantage of a clearly identifiable party that is responsible (and accountable) for the operation of the network. They also (depending on design) have the potential to reverse or block transactions. In fact, many ways a private ledger shares the core operational characteristics of a centralised system built using conventional technologies.

It should also be noted that use of a private or public blockchain is not a binary decision. Some bond issuances[60] have used a central registrar and permissioning, despite being deployed on the Ethereum public blockchain.

Ultimately decisions for institutions around what combination of public, private and permissions to use will come down to regulation[61].

It should also be noted that use of a private or public blockchain is not a binary decision

[60] *Eib (2021) EIB issues its first ever digital bond on a public blockchain, European Investment Bank. European Investment Bank. Available at: https://www.eib.org/en/press/all/2021-141-european-investment-bank-eib-issues-its-first-ever-digital-bond-on-a-public-blockchain (Accessed: March 2, 2023).*

[61] *Ledger Insights (2023) Goldman on tokenization: We're not allowed to issue on public blockchain, Ledger Insights - blockchain for enterprise. Available at: https://www.ledgerinsights.com/goldman-sachs-tokenization-not-public-blockchain/ (Accessed: March 30, 2023).*

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Connectivity

Notwithstanding the above, the general preference of conventional financial institutions for tokenising existing real-world assets to date is for private distributed ledgers.

Parties that want to directly control and transfer their own digital assets will have to build an interface to the private DLT network. This adds to the costs and complexity of firms' IT infrastructure. Private DLT based systems can potentially provide two main models of connectivity:

- running a 'node' on the DLT network (note that running a node still involves extracting data from the node to feed into existing risk, accounting and other systems) or
- communicating with the network using conventional messaging or an API.

For tokens issued on a public blockchain parties will need either

- a third-party piece of software called a 'wallet' for creating transactions,
- to run a full node on the Ethereum network that allows a view of the entire history of a ledger in addition to generating transactions or
- use a middleware application that manages the interaction with public blockchain and allows easier integration with conventional infrastructure.

Rather than create entirely new infrastructure for the post-trade processing of digital assets the most typical approach would be to build interfaces between the connectivity tools described above and existing post-trade systems. These would allow consolidated views of positions and standardisation (as far as possible) of operational processes.

Settlement

Private DLT systems share many of the characteristics of existing financial market infrastructure in terms of governance and management. A central party is typical responsible and accountable for operation of the system and presumably resolve issues include erroneous transactions, bugs in the code and the actions of bad actors. Even though settlement is technically 'probabilistic' (certainty of settlement happening increases over time rather than ever truly reaching finality). The reality of an accountable body running the network is that settlement finality will be equivalent to that in conventional infrastructure.

Settlement on public blockchains is considerably more problematic.

For public blockchain's settlement finality is genuinely probabilistic, processing times for transactions can be highly variable. On the public networks transaction processing times can vary from minutes to days depending on transaction volumes. Also, the cryptocurrency of the relevant blockchain is generally required to pay for transactions to be processed (or at least processed in a timely manner). These facts have the potential to create many challenges for existing settlements teams, their systems and processes.

Additionally, given the integration of new networks with existing technology stacks, it is recommended that new identifiers are incorporated which signify that a token is different to the associated traditional asset. This can be used to prevent existing system flows from attempting to use traditional settlement channels. An identifier such as the FIGI[62] or Digital Token Identifier[63] would be appropriate.

Post-Trade Exception Management

Over the last 10-15 years firms have generally tried to consolidate the management of exceptions in post-trade processes into a small number of systems that display exceptions (particularly matching errors and settlement failures). Having a consolidated view of exceptions allows prioritisation/filtering exceptions, integration to workflows specific to different types of exceptions and consolidated generation of metrics.

The further introduction of digital assets by itself does not mean the end of post trade exceptions. Traders can still mis-book trades, reference data can be wrong, there can be bugs in relevant system (including smart contracts).

Overall, the efficient processing of post-trade exceptions will require integration of the trade processing of tokenised digital assets into existing post-trade systems or the creation of parallel systems and processes just for digital assets.

[62] *https://www.openfigi.com/*

[63] *https://www.iso.org/standard/80601.html*

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Corporate Actions & Fees

One of the most complex and error prone areas of operations in the traditional securities market is the processing of corporate actions. Tokenising assets does not remove the need for or challenges of dealing with corporate actions. The issuer of the tokenised asset would still need to process the corporate actions on the underlying asset and pass the results onto the holder of the tokenised asset, including cash flows and choices relating to matters such as rights issues, corporate actions etc.

Any large-scale adoption of tokenised assets is likely to resemble corporate actions of assets analogous to tokenised securities in the existing world such as American Depository Receipts (ADRs). The precedent of ADRs also raises the question of whether the issuers of tokenised digital assets would need to charge fees to the holders of the assets to cover their costs.

Another consideration to make would be if the assets were being utilised in a fractional manner. It is presumed that in cases of voting right exercise and so on, the entire asset would need to exist in its discrete form with one owner at point of exercising. Thus, the involves the continued practice of recall where fractional assets are on loan, however could have the extra complexity of one discrete asset being out with several counterparties. There is also an opportunity, particularly in the collateral space, for simplification of the corporate action process. Where an asset backed token is created and the token is delivered as collateral, there is the potential for corporate actions to be managed in the custodial layer. For example, this could mean that cash proceeds can be paid directly to the provider and avoid the need for a complex claims process, particularly when there is a long chain of reuse.

Risk Management Considerations

Tokenisation, as hinted at above, does not remove all current operational and financial risks (though it does offer potential for improvement upon many). It can also introduce some new ones of its own.

Risks to be cognisant of:

1. **Cybersecurity**
   Tokenised assets are stored and transferred on DLTs, which like any system come with the potential of cybersecurity threats. Many financial institutions will already have strict cybersecurity measures in place, and these stringent defences should be equally applied to the new networks.

2. **Regulatory**
   As mentioned already, tokenised assets may not be regulated in the same way as traditional securities in all jurisdictions, and there may be a lack of clarity around legal and regulatory requirements for these assets. Indeed, these are likely to change over time, especially in the near future. This can create operational risks for firms dealing with tokenised assets, and it is recommended that firms' regulatory affairs teams monitor closely developments globally given the cross-border nature of many blockchain networks.

3. **Smart Contract Risk**
   Tokenised assets are often managed using smart contracts[64], which are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. If there are errors or vulnerabilities in the smart contract code, it could lead to unintended consequences. Again, many financial institutions will have rigorous technology release procedures which include multiple layers of code review and testing. It is recommended that these controls are extended to smart contracts. There are various guides to specific concerns around smart contracts online[65, 66]. Legal teams should also consider the enforceability of any smart contract being used to transact[67].

[64] *Smart contracts - ISLA Digital & Fintech (2022) ISLA. Available at: https://www.islaemea.org/regulation-and-policy/digital-fintech/digital-assets-technology-in-brief/smart-contracts/ (Accessed: January 28, 2023).*

[65] *A guide to smart contract security (no date) Hedera. Available at: https://hedera.com/learning/smart-contracts/smart-contract-security (Accessed: January 28, 2023).*

[66] *What is a smart contract security audit? A beginner's guide (2022) Cointelegraph. Available at: https://cointelegraph.com/blockchain-for-beginners/what-is-a-smart-contract-security-audit-a-beginners-guide (Accessed: January 28, 2023).*

[67] *Taking a pragmatic approach to smart contracts (2021) D2LT. Available at: https://d2legaltech.com/taking-pragmatic-approach-smart-contracts/ (Accessed: January 28, 2023).*

4. **Liquidity**
   As noted already, private networks can have low trading volume and liquidity. This can make it difficult to buy or sell tokenised assets quickly, leading to operational & financial risks just as with any other financial asset class. It is recommended that firms integrate any platforms used to transact and record tokenised assets into their existing inventory and risk management platforms for complete transparency and timely management of these risks.

5. **Operational**
   Tokenisation creates new operational challenges such as data management, custody, and compliance. As noted elsewhere in this document, tokenised assets may also require new processes and technology to be implemented to handle the unique characteristics of these digital assets. It is recommended that firms use their existing new product proposal processed to analyse al new processes and system flows, implementing the appropriate controls, in particular at the points where these interact with existing technology stacks or operational processes. It remains good practice to operate new product flows in parallel or in nursery phases in which they are closely monitored for any risks not identified prior to implementation.

6. **Reputation**
   Tokenisation brings new challenges for companies and institutions in terms of reputation management. For instance, as with all technology releases, if a platform or application has issues detrimental to customers either financially or experientially, it can lead to reputational damage. As seen during 2022, there can also be unfair tainting of DLT and all new associated asset types, including tokenisation, through bad actors in the wider 'crypto industry'. This requires ongoing education and efforts to demonstrate controls that mitigate all of the risks outlined. It is recommended that firms seek to educate clients on the exact nature of the technology, the distinctions which set it apart from riskier asset types using DLT, and the risk mitigants in place.

7. **Legal Risk**
   As noted already, tokenisation is a relatively new concept and legal framework surrounding it is still evolving. This can lead to legal disputes and challenges that may arise from the use of tokenised assets. It is recommended that firms seek their own detailed legal advice before entering into any business involving tokenisation, as often the legal considerations will be on a case-by-case basis.

8. **Credit Risk**
   There is also the question of the credit worthiness of the issuer of the token and the issuer's processes concerning the reconciliation of tokenised assets and the underlying assets held in custody. See also the BCBS framework outlined in Regulatory Considerations. Firms transacting using tokenised assets will likely need to capture information about the token issuer as well as agreeing how to mitigate credit risk with their internal credit risk teams upon onboarding of the business.

Further Reading

There are a myriad of publications covering tokenisation and digital assets in general, with more appearing daily. The following list is not exhaustive and represents publications that have not been previously referenced elsewhere in this paper.

Tokenisation

OECD (2020), The Tokenisation of Assets and Potential Implications for Financial Markets, OECD Blockchain Policy Series, www.oecd.org/finance/TheTokenisationofAssetsImplicationsforFinancialMarkets.htm (Accessed: January 20, 2023).Collateral Use Cases

Collateral insights: Digital assets and how they can transform Collateral Markets (2022) Spotify. Available at: https://open.spotify.com/episode/6xa0mq3bOK0eg3fRAKzsu3 (Accessed: March 2, 2023).

Digital Asset Custody

Hogan Lovells and Zodia Custody (2022) Digital Asset Custody Paper. Available at: https://engagepremium.hoganlovells.com/resources/blockchain/insight/digital-asset-custody-paper (Accessed: February 27, 2023).

Industry Trends

The DLT journey - DLT in the real world 2022 (2022) The DLT journey - dlt in the real world 2022. ISSA, The Value Exchange. Available at: https://thevalueexchange.foleon.com/dlt-in-the-real-world/dlt-in-the-real-world-2022/the-dlt-journey (Accessed: March 26, 2023).

The Numbers Behind Tokenization. The Value Exchange. Available at: https://thevx.io/campaign/the-numbers-behind-tokenization/ (Accessed: March 30, 2023).

Author Information

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David joined ISLA as a consultant in 2020 to lead the pilot study of a securities lending transaction through a Common Domain Model (CDM).

The success of this initial study has led to a strategic focus by ISLA into the future digitisation of our industry and David joined the team as a permanent member of staff in January 2021 to lead these efforts.

As part of Regulation and Market Practice team, David is responsible for the development and implementation of a Securities Lending Common Domain Model, digital infrastructure, and the ongoing transformation and monitoring of the digital landscape of the Securities Lending market.

Prior to joining ISLA, David held roles in technology and infrastructure at State Street, Barclays and UBS.

ISLA Digital Asset Working Group

The Digital Asset Technology Series is produced in conjunction with members of the ISLA Digital Asset Working Group (DAWG)[68]. The DAWG was established by member request in May 2022, to discuss all topics associated with expansion into new digital asset classes

Voting at the DAWG will determine priority of producing future documents in this series.

For past minutes, meeting frequency and to get involved in any ISLA working group please visit www.islaemea.org

[68] *https://www.islaemea.org/working-groups/digital-asset/*

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