Blockchain and Tokenization in Digital Asset Issuance

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1. Introduction

This chapter describes digital asset issuance. This involves the application of digital processes to the traditional market for issuing securities. What entails is a brief introduction to blockchain; explains tokenization in the context of digital assets; sets out a summary of the technology and programming which underlies the new systems, along with the benefits of this approach, and some of the most common use cases. The digitalisation of the capital markets has become a reality and more issuers look to use the new techniques because of the cost savings and improvements in customer service. Traditional intermediaries are adopting the techniques to preserve their market position. New service providers offer software and services to the industry. New platforms are competing for business with the traditional intermediaries.

1.1. What you should know about blockchain:

Technical definitions

a) Blockchain

Blockchain is a distributed ledger of immutable transaction records. Once validated by network participants, these transactions are grouped into blocks which are added to others so as to form a chain of blocks, hence the blockchain.

b) Smart Legal Contracts

Not all smart contracts are capable of enforcement in a court. A smart legal contract is the conventional name for a smart contract that satisfied the definition of a contract under a legal system and could therefore be enforced by a court process in the same way as an analogue contract.

c) Smart Contracts

A key element of blockchains are smart contracts, essentially coded business logic that can be executed on a blockchain. In the instance of tokenization, the conditions for the security transfer are directly written into the code. The agreements contained within the code remain private and the smart contracts control the execution. The transactions are trackable and immutable.

d) Tokenization

Tokenization is the process of issuing or converting an asset into a digital form that is stored on and transferred over a blockchain infrastructure. In this document we focus on the tokenization of financial instruments.

e) Security Tokens

Security tokens represent all the range of financial securities (like equity, debt, investment funds and so on) which are issued on the blockchain and are simply represented on the blockchain. In this document we will use the terms interchangeably.

f) Ethereum

The Ethereum network is made up of a wide range of computers ("nodes") which are connected to one another. The network looks after the integrity of all transactions that are recorded and updated onto the Ethereum platform.

Ethereum is an open-source, decentralised software platform, where anyone in the world can build their own projects by creating distributed apps ("Dapps") through the use of smart contracts.

When a Dapp is created, a fixed amount of its own native token is also created. Those tokens can then be used to avail the services provided by that particular project. Tokens created on the Ethereum blockchain can be purchased in exchange for Ethereum's own native token, ETH. The scenario below gives an example of how this works in proactive.

Mr X is the creator of a Dapp called "Content Creator Central" which provides content creators (such as photographers graphic designers, animators etc.) a platform where they can upload their works so that they can be properly credited and remunerated whenever their work is used for commercial purposes.

Miss Y is a fashion photographer who is fed up with companies using her work without crediting or paying her. She thinks Mr X's Dapp is a great idea and wants to use the platform . Miss Y first needs to purchase some "CCC coins" which is the Content Creator Central's native token – she can do this by paying for the tokens in ETH . Once Miss Y has purchased some CCC coins she will then be able to use the Content Creator Central platform to upload her work in exchange for the CCC coins.

2. Characteristics of blockchain and tokenization

2.1. Interoperability

Private blockchains in financial markets have launched over the last few years with the aim that they would become the central authority controlling activity of their network. They failed to realize that it would take many years to build such a network, if at all possible, considering it would directly oppose the fundamental principles of shared networks. Private blockchains may improve information transfer within networks but not in a way that fundamentally changes existing infrastructure in capital markets, that is, many isolated and fragmented central networks.

A blockchain is a technical infrastructure that individuals and/or entities can use because they trust the mechanics behind the transac-

tions that run on the blockchain. If the governance or the technical consensus to record transactions across the network is managed by a single or a few entities, it becomes more difficult to trust this network. To create a centralized network, it is generally easier to use a database.

Blockchain technologies and ecosystems have evolved a significant amount in the last few years. Decentralized networks such as Ethereum are resilient enough to be used by financial institutions and investors. Thousands of applications and technical building blocks have proven their efficiencies. Financial institutions are beginning to understand that they don't need to control the IT infrastructure (i.e. the blockchain), but they can control what happens on this infrastructure through the use of smart contracts, for their own organization, or on behalf of their clients.

The most used and widely accepted decentralized network for financial markets is Ethereum. The network is operated by over 8,000 nodes that share the same consensus for transactions. In addition to this, it has a tremendously active community managing the governance and evolution of the open-source system. On top of this, there are hundreds of thousands of developers building tools, libraries and standards every day to make the blockchain more accessible, reliable and secure for its users.

The ability to deploy and execute smart contracts on the blockchain was a seminal moment for the blockchain industry and many tokenized financial products have been launched in the years since. Today, issuers of tokens don't need to manage the underlying infrastructure anymore, they can focus on controlling what they issue on the network: tokens.

More and more, developers are building parallel networks to enhance the capabilities of Ethereum. Cross-chains protocols and side-chains are starting to appear and can be used to improve the speed of transactions, costs and/or stakeholder confidentiality. In May 2020, the amount of BTC on Ethereum through wrapped tokens surpassed

the amount of BTC on the Lightning Network, Bitcoin's second layer scaling network. This cross-chain state is likely to be the future of blockchain, but is only possible through the use of interoperable standards for decentralized networks.

2.2. Smart Contracts Terms

As previously described, smart contracts are code and can be executed on the blockchain. A user can combine several smart contracts for several use cases. For example, the smart contract of the token will generate token keys, and these security tokens will be held in a wallet. When a user wants to use its tokens on a decentralized exchange, its tokens will follow the code imposed by the token smart contract (rules for transfers, etc.), but also the code imposed by the exchange (swap, etc.).

The flexibility of smart contracts is a real benefit for digital securities. A "security token" is usually issued and controlled by a set of smart contracts. These are deployed in order to offer control over the tokens and permit compliance standards and rules to operate. Additional smart contracts can be added and linked to the initial set of smart contracts to automate revenue distributions, add specific management rules, etc. These smart contracts combine to create security token standards that ensure the functionality and compliance across the token's lifecycle.

It is therefore essential for DAMs to utilize standards in a global ecosystem interoperable with other services. This will permit many other applications for the marketplace's customers.

2.3. Available standards

In order to be compatible with an ecosystem, asset issuers must use common standards. Thousands of standards are created every year for various needs.

When the ERC-20 standard was invented and reached its peak in terms of use on Ethereum in 2017, it showcased the significance of

interoperability by unlocking new pathways and allowing more efficient flows for capital from a significantly wider group of investors.[1] The use of common standards like these is required for the interoperability of the blockchain and, without them, new applications and services would not be able to work seamlessly with one another.

The ERC-20, whilst an important invention in the evolution of blockchain technology, doesn't allow for the enforcement of the rules and regulations that govern private securities. For this, many standards have been proposed, with the main ones being the Token for Regulated Exchanges (T-REX) and the ERC-1400. They use a different approach but can enrich each other thanks to the flexibility of code. Both of the standards enable the enforcement of compliance rules and the control of transfers to eligible investors.

The T-REX manages compliance by leveraging the security of the blockchain with an automatic and on-chain validator system. This system applies the transfer rules related to users (identities) and those related to the relevant token offering. The issuer of the securities or its agent always keeps control of the tokens and the transfers. ERC-1400 takes the approach that each trade must be validated by a specific key generated off-chain by the issuer.

The success of blockchain infrastructure in the financial markets and, in particular, of decentralised finance (DeFi) require that they work on common and interoperable standards like these.

To represent assets on the Ethereum blockchain, issuers can use some standards:

ERC-20

ERC-20 is the most important standard to issue tokens on the Ethereum public blockchain. These tokens are compatible with most of the wallets and platforms, bringing a high level of interoperability.

1 Pg 7 <https://assets.kpmg/content/dam/kpmg/us/pdf/2018/11/institutionalization-cryptoassets.pdf>

ERC-20 tokens are fungible tokens, usually non-permissioned, that can be transferred easily between peers on the Ethereum blockchain.

The ERC-20 is a token smart contract that defines and implements all the necessary functions of a standard token on Ethereum such as the token's name, symbol, the total supply, and the number of decimals allowed. Of the 13 functions defined by an ERC-20 token, the most important ones are as follows:

- *balanceOf*: This function allows a smart contract to store and return the balance of an address. The function accepts an address as a parameter, so it follows that the balance of any address is public.
- *totalSupply*: Although the supply could be fixed (as it is with Bitcoin), this function allows an instance of the contract to calculate and return the total amount of the token that exists in circulation.
- *transfer*: This function lets the owner of the contract send a given amount of the token to another address (just like in a conventional cryptocurrency transaction).
- *approve*: When calling this function, the owner of the contract authorizes, or approves, the given address to withdraw instances of the token from the owner's address.
- *transferFrom*: This function allows a smart contract to automate the transfer process and send a given amount of the token on behalf of the owner.

T-REX

In terms of functionality, the T-REX is probably the most advanced standard to tokenize assets on the Ethereum public blockchain. Based on the ERC-20 standard, it supplements it with more than 100 functions to enforce compliance and manage control for the issuer, agents and investors.

The T-REX smart contracts enable compliant securities transfers. It is the only security token protocol with an on-chain compliance trade validator system. Directly on the blockchain, each transfer's offering rules and investor rules are verified to validate or refuse the trade.

Thanks to the T-REX smart contracts, securities issuers and their agents benefit from a high level of control over digital securities. At any time, if authorized, they can carry out the previously mentioned management operations such as creating or destroying securities, making transfers, blocking positions, pausing transfer activity, authorizing or revoking investors, etc. These operations can be performed one by one or by batch in order to reduce the gas costs.

With the recovery function, investors are protected from the loss of their tokens, as long as they can prove their identity to the issuer or appointed agent.

In short, T-REX smart contracts provide:

- An on-chain validator of trade enforcing securities regulations
- An immutable proof of ownership
- An advanced permissions system for issuers, agents and investors
- Dozens of functions to control the tokens (mint, burn, pause, recovery, force transfer, etc.)

ERC-1400

Like the T-REX, the ERC-1400 is open source and was created to transfer security tokens on the Ethereum network. It contains the combination of four other propositions to the Ethereum community:

ERC-1594 – Core Security Token – enables the necessary functions for token issuance, redemption, transfer and validity

ERC-1410 – Token Partition – allows for the creation of partially fungible tokens

ERC-1643 – Document Management – off-chain management of documents

ERC-1644 – Forced Token Transfers and Controller Token Operation – allows for forced token transfers

Although they can work together, there are native differences between the two standards.

Overall, the T-REX manages compliance by leveraging the security of the blockchain with an automatic validator system. This system applies the transfer rules related to users (identities, detailed below) and those related to the offering. The issuer of the securities, or its agent, always keeps control of the tokens and the transfers. ERC1400 is another approach where

each trade must to be validated by a specific certificate generated off-chain.

3. Regulatory framework for blockchain and tokenization

Whilst still a nascent industry, some jurisdictions have begun to pave the way for blockchain/DLT-specific laws. For instance, in 2018, the state of Arizona in the US passed a "blockchain law" to allow corporations based in Arizona to hold and share data on a blockchain. Additionally, the state clarified certain enforceability issues surrounding the use of smart contracts. In the same year, Malta enacted three laws (the Virtual Financial Assets Act (VFA), the Malta Digital Innovation Authority Act (MDIA) and the Innovative Technology Arrangements and Services Act (ITAS)) to establish an overall regulatory framework for cryptocurrency and blockchain/DLT activity in the country.

In 2019, Luxembourg passed Bill 7363 into law to facilitate the use of blockchain technology in financial services. In 2020, Luxembourg continued the bill to explicitly recognise the use of DLT for the dematerialisation of securities. More recently, Switzerland has

finalised its blockchain/DLT laws, which introduces a specific category of licensing rules for crypto exchanges, a legal framework for the segregation of crypto-assets from third-party custodians in the event of bankruptcy proceedings, and the introduction of a legally robust mechanism for the tokenization of securities. These laws are expected to be enforced early this year.

The disruptive nature of blockchain/DLT systems have raised questions on how such systems could fit into our existing legal and regulatory infrastructure. A handful of issues are explored below:

1. Legal nature of blockchain and DLT systems

Nodes involved in these systems are directly linked to one another, and the success of each network relies on the collective performance of those nodes. Therefore, each individual participant in the network share a common aim of joint performance, which subsequently unifies those nodes into one single group entity legally tied together.

Given the mechanics behind blockchain/DLT systems, they could be considered as one of several legal entities, including a joint venture, a multi-party contract or a partnership. It should be noted that there are numerous factors which may influence the form of legal structure that a blockchain/DLT system takes; for example, whether there is an agreement between participants specifying the legal structure, or whether a system is permissioned or permissionless.

2. Legal personality

There is currently no consensus as to the legal personality of blockchain/DLT systems, or indeed, whether it should be given its own personality at all. The absence of a legal personality raises issues in the context of legal disputes, as it is unclear who or what exactly is being claimed against.

Blockchain/DLT systems are considered in Malta as "innovative technology arrangements" pursuant to the enactment of ITAS in 2018.

The legislation provides a process of certification for these technology arrangements, as well as a strict auditing process to ensure that those systems are fit for purpose. Whilst ITAS has provided some form of legal certainty in this respect, particularly as the issued certificates contain a unique number for the purposes of identification, the legislation has not provided that technology arrangements could have its own legal personality.

Attaching a legal personality to entities that make use of blockchain/DLT systems would be advantageous insofar as it could provide protection to counterparties, consumers and developers/designers/coders, as well as protection from any damage caused by anonymous or rogue network participants.

3. Liability issues

When things go wrong in a blockchain/DLT system (for example, where there is problematic coding or negligent performance), it is likely that losses will occur because of those errors. Since there is no fixed point to allocate liability, it is difficult to ascertain fault in those circumstances.

Participants in the system such as smart contract code developers, miners or nodes could be considered as parties which should bear the liability when errors arise, particularly due to the significance of their involvement in the system or network. In any event, there could be ways to bypass such ambiguity; for example, in transactional matters, liability could be allocated and agreed between the parties at the onset of each transaction to attain certainty in that respect.

4. Jurisdictional and governance issues

Theoretically, any computer in the world could join a blockchain network and so it is likely that servers and nodes comprising those networks are located in multiple jurisdictions.

Given the decentralised nature of blockchain/DLT systems, it is generally implied that enforcement of any obligations with respect to those systems should be effected internally. Having multiple nodes from all over the world connected to one particular network therefore creates a type of 'jurisdictional confusion', and the cross-jurisdictional nature of blockchain/DLT systems obscures the certainty of determining which jurisdiction should be governing the rules of each particular system.

There have been suggestions that to give effect to true decentralisation and autonomy, the code written into each system could act as law within its network. Whilst aligned with the very essence of blockchain/DLT systems, this is negated by the fact that this hands too much power to developers, and therefore leaves no room for governance in a traditional sense, which could ultimately lead to abuse of power if left unchecked.

5. Remedies

There is currently no framework to address unexpected and/or erroneous outcomes within permissionless systems. As discussed above, attaching a legal personality to those systems could provide some remedy for those who are wronged in such situations.

Supreme Court Judge, Lord Hodge suggested that unjust enrichment could provide a remedy in such circumstances. However, it is important to note that this has not been passed in law, and equitable remedies such as unjust enrichment do not necessarily apply to all jurisdictions.

6. Regulation

Regulatory considerations are crucial when it comes to blockchain/DLT systems as they are generally used by businesses which operate in regulated environments such as financial services.

In the UK, the HM Treasury recently published a consultation paper which aims to further develop the country's regulatory approach to crypto assets and stablecoins. The paper seeks to expand the current regulatory perimeter, and sets out:

1. Which types of stablecoin should be within the scope of the UK's regulatory framework;
2. The list of activities which would subject crypto-based entities to the new stablecoin regime;
3. Compliance with requirements such as registration, safeguarding, prudential, capital requirements etc., like those required by payment services firms/electronic money institutions authorised by the Financial Conduct Authority; and
4. Additional requirements for specific types of stablecoins, particularly those that can play a similar function to existing payment systems ie. systems that enable persons to make transfers of funds, to be regulated by the Payment Systems Regulator (PSR) and those that are able to reach a systemic scale.

Whilst the regulatory spotlight is primarily shone on the financial services space, guidance should also be provided outside of the financial sector to accommodate for the vast range of use cases for blockchain technology.

7. Property rights and digital assets

Establishing property rights is important for any asset. These rights provide legal ownership to the asset, which ultimately allows the owner to benefit from the protection of the legal system where those property rights are granted. It will therefore be necessary to achieve a degree of international legal consensus on the nature of digital assets as property rights, as this would enable a clearer analysis of any remedies available in instances where things go wrong.

In the recent case of AA v Persons Unknown (2020), the English courts held that crypto assets are classed as property pursuant to the English law definition of property rights. This ruling was followed in the New Zealand case of Ruscoe v Cryptopia (2020), which shows some positive movement towards international unanimity over property rights and digital assets.

8. Data protection

The decentralised nature of blockchain/DLT systems raises at least two issues with the European General Data Protection ('GDPR'): firstly, whether the pseudonymous data uploaded on a blockchain constitutes personal data pursuant to the GDPR, and secondly, whether the 'right to be forgotten' can truly be consistent with an immutable ledger. There are also other issues to consider such as those surrounding the principle of data minimisation, storage limitation and potential difficulties in identifying the data controller and processer in blockchain/DLT systems. As such, there is much to be done to reach a clear consensus in ensuring that data protection laws are aligned with the mechanics behind blockchain technology.

9. Competition, anti-trust and consumer protection

At the time of writing, there are no regulations which directly address competition, anti-trust and consumer protection issues in relation to the use of blockchain/DLT systems. In any event, these should be considered in light of already existing laws and regulation, notwithstanding the absence of direct reference to blockchain/DLT.

10. Taxation

Significant consideration is placed on the development of taxation policies in digital economies. For instance, the UK government's consultation on *Corporate tax and the digital economy* closed in January 2018, with the results to be expected soon. The debate relates to the ability of businesses to gain tax advantages by choosing the location

from where they provide their services; this is further complicated by decentralised systems that are not "owned" by any one person or entity.

Notwithstanding the issues explored above, rules and regulations surrounding the space are technology agnostic; that is to say, regulators tend to take a neutral view on such matters. Consequently, any legal considerations will mirror those of already existing securities laws and financial regulation and should be analysed with that in mind.

4. Applying blockchain technology and tokenization to private markets

Since the global crash in 2008, private markets have grown steadily and consistently, with private capital funds having raised nearly $5 trillion since 2012.[2] In 2019, private capital fundraising posted a banner year, with $888 billion raised across 1,064 funds, the most private capital ever raised on an annual basis. [3]

Despite the upward trajectory across private markets, and the significant opportunities that lie ahead, the industry still suffers from well known challenges. The infrastructure from the initial investor onboarding to the secondary trading of private securities is notoriously manual and cumbersome.

For a primary issuance, investor verification, KYC and AML checks are slow and expensive for market operators to perform. In a typical private placement, investors are verified multiple times by the various parties involved in the offering. These checks are processed every time the investor participates in a new offering from the same service providers. Since these KYC and AML checks involve much manual intervention, they are slow and costly. This process of verification occurs in the primary issuance and also each time the security is traded in the secondary markets.

2 <https://www.ft.com/content/7ce1ee52-2b0e-11e9-88a4-c32129756dd8>

3 PitchBook 2019 Annual Private Fund Strategies Report

The secondary markets are a highly fragmented industry, largely composed of siloed and disconnected OTC networks. Their infrastructure is private and fragmented. As a consequence, the market suffers from poor transferability, with assets thinly or even never traded. Trust is implemented by analogue (and arduous) processes. This is in direct contrast to public markets, where efficiencies lie in the effective distribution of information from a centralized party.

5. Problems in private markets

- Poor Asset Discovery

The lack of connectivity between private market participants makes it difficult for investors to find the right opportunities and for trading to function effectively. OTC platforms generally provide secondary market access to unlisted securities but these networks are very limited and have low trading volumes. In these markets there are multiple disconnected service providers with not much activity, so it is difficult for investors to trade. This leads to a secondary market that has not been fundamentally improved by digital technology and one that is still heavily reliant on personal networks.

- Poor Price Discovery

The fragmented infrastructure makes it difficult for there to be a transparent party that collates volume and facilitates price discovery (the role of an exchange in public markets). Poor price discovery and general asset information leads to delays and inevitably concerns around asset quality and investors demand larger risk premiums. This affects the industry as a whole. Attractive valuations were a concern for 36% of investors attempting to achieve target allocations to private markets in 2019.

- Illiquid Market

The poor transferability of information and localised markets inevitably leads to illiquid markets. Information is often unavailable and outdated, leading to trading difficulties as prices are decided on an

ad-hoc basis and often result in wide bid-ask spreads. There are often long lockup periods for private investments, where there are no restrictions, fees from broker dealers can dissuade investors from parting with their investment, thereby locking up value. These infrastructure related challenges combine to create a market that is highly illiquid, and a barrier to entry for many investors. When investors have significant exposure to illiquid investments it can be difficult to manage liquidity needs, and of course this is worsened in times of recession.

- Blockchain solutions

The use of blockchain as a shared IT infrastructure presents significant advantages for private markets. By applying control and compliance to a network that can be accessed at any time by any party, private markets can accelerate their development.

Using KYC to show benefits from the use of a shared infrastructure, investors can store signatures or crypto-graphic hashes on the blockchain, proving that the data they are providing is valid and has been checked by a trusted third party. The only shared data is the hash or signature, not the personal information, and is only accessible by authorized parties. Needless and duplicate checks don't need to be processed every time an investor wants to subscribe to an offering, one check is saved and shared as the investor permits. According to Goldman Sachs, this process alone could save the bank 10% in operational costs.

Private markets are opaque not because they are intended to be. They are opaque because the underlying infrastructure is unable to offer transparency and deliver the required compliance standards. Blockchain technology will transform private markets by delivering three core benefits for the industry:

- Data transparency

The digitization of private market securities is likely to deliver improvements with regards to data transferability and therefore market transparency. Information about the issuer and the characteristics of

assets can be improved, along with the dissemination of information. This could improve price discovery for market participants in general and have particular application to sustainable finance or impact investments, areas which are heavily reliant on trustworthy information. By bringing visibility over opaque value chains, proofs of sustainability could be embedded into tokenized securities or security tokens (ratings, green labels, etc.) to improve the level of confidence that investors can have in their investment.

- Distributed market

By replacing restricted and fragmented market infrastructures with a globally shared one, issuers can target a wider group of investors from around the world who in turn have broader investment options at their disposal. Providing global reach to issuers and improving investability for investors is a win-win situation. Indeed, once hosted on a blockchain, a security token can be accessed by eligible investors in real time across the globe using any connected device. Issuers can take advantage of a global network with little added cost.

- Transfer of value and improved liquidity

Due to inefficient market infrastructure, privately issued securities are difficult to trade and are therefore illiquid. The use of blockchain allows value to circulate seamlessly by bringing digital trust, as it solves the "double spending" problem. More transparency and dispersed information within the market, along with immutability and the utilization of a faster and more efficient transfer of value will contribute to the improvement of private market liquidity. Value that is currently locked up in assets will be freed up and traded between eligible investors using a seamless and accessible infrastructure.

6. How? Driving liquidity via tokenization

Blockchain technology has created a new method of transferring value that challenges the traditional makeup of financial markets. By

tokenizing assets, many of the typical, low-value and expensive operations in markets can be automated in security offerings. This innovation essentially allows the transfer of value from one party to another in a more secure and efficient way than is seen in traditional capital markets.

- Compliance Enforcement

For financial actors to interact with this new network, there are two tools that are required for them to access the advantages of blockchain technology. The first is the need for firms to apply control and compliance to this shared infrastructure. Since 2008, regulations have been getting stricter and eating into the profitability of financial institutions. Onchain Finance, as explained below, represents the notion of applying compliant centralized finance on a decentralized infrastructure, meaning the stakeholders (issuers, agents, investors) are represented on the blockchain and the market rules and regulations are complied with and improved on this new infrastructure.

In its simplest terms, Onchain Finance consists of two blockchain-based technological layers:

- Permissioned Tokens

These are the representations of a security that can be traded via blockchain technology. As such, they are permissioned and the transfers are controlled by a set of smart contracts deployed on the blockchain. This ensures token holders meet KYC and eligibility rules defined by the issuer (via their legal team) and enables the dynamic whitelisting of investors across the entire life of the security token.

- Onchain Identities

For permissioned security tokens to be distributed to eligible investors, it's essential for investor identities to be known. Onchain identities, acting like an investment passport that is reusable from offering to offering, are created and maintained on a blockchain infrastructure. These identities are created on behalf of all parties in the subscription and transactional process of security tokens (issuer, KYC

provider, security token administrative agent and, obviously, investors). Investors are able to make their information known to third parties on request and can enrich their data with relevant qualifying information such as accreditations, KYC checks, proof of identity etc.

7. Use cases

Use cases for asset tokenization have grown over the years for many reasons, including its ability to lower barriers to entry and its ability to increase liquidity in different markets. Below are examples that the authors have worked on.

- Real Estate

Fractionalising real estate ownership provides investors (both seasoned and new) with opportunities to diversify their investment portfolios by allowing lower upfront investment. Property and asset managers maintain portfolios for valuer increase purposes. Once a property is sold, profits are divided between all owners in proportion to the percentage of their holding.

Information relating to the properties can be uploaded on a peer--to-peer registry on the blockchain, reducing the need for third-party intermediaries when it comes to reviewing the information for due diligence purposes. Streamlining the processes means less operational costs for both the investor and the property/asset managers.

- ESG

The largest potential alternative investment class is in the new market for sustainable investments. The logic of tokenization here is similar to that for the alternative asset classes referenced above. In addition, however, the use of blockchain technology enables transparency in supply chains, and the ability to verify the provenance of assets. The technology also assists in the difficult new topic of ESG reporting. Combining these benefits with those above has made tokenization a natural fit for ESG investors.

- Shares

In a traditional IPO, the issuance of securities is restricted and largely handled by investment banks. Access to primary markets is usually only permitted for certain types of investors.

In a tokenised equity market, costs are reduced, processes improved, companies can access a broader pool of investors and post-trade reporting and settlement is done in real time.

Art, jewellery, fine wine and whiskey

Alternative asset classes have become a significant source of investment over the last cycle. The most significant benefits for investors have been a lack of correlation with traditional markets and returns that have been generated from asset classes that have previously been outside traditional portfolios. The difficulty for investors in this area has been the inaccessibility of the assets, illiquid nature of investments and high transaction costs, among other things. Tokenization is opening up the market, democratising the investor base and providing transparency and liquidity to drive trading opportunities.