DIGITAL ISSUANCE

Digital Issuance - An Optimal Model for Digital Assets and Transactions

White Paper

Digest

This paper describes an opportunity for radical change: this change can drive extensive improvements in the experience of investors and borrowers, and in the economics of investment. The opportunity is open to all participants in the financial markets, including their regulators; it is not targeted specifically at the buy-side or the sell-side, and it doesn't favour service providers, platform vendors or direct market participants.

The opportunity is presented by digitisation. We look at transactions and assets and ask how they may be best represented in a digital form. We define a model which is optimised for digital issuance, rather than replicating the attributes and behaviours of conventional assets and transactions into a digital world.

The paper seeks to show how rethinking our view of assets and transactions can lead to remarkable benefits: a common form of representation for digital assets is possible across asset classes, and a single digital operating model is practical and achievable as a result. This will deliver transformative improvements in financial products both for investors and for the issuers of capital.

The Author

Dr Ian Hunt is a recognised authority on buy-side operations, investment processes and technology. He is an independent advisor to Moody's Analytics on buy-side innovation and design lead for FundAdminChain, a digital fund trading platform, as well as an advisor to a number of innovative fintechs. Dr Hunt has consulted for many leading investment managers and asset owners in the UK, Europe and the USA, and is particularly known for his work in Distributed Ledger Technology (DLT) and the Investment Book of Record (IBOR). He has acted as the Investment Expert on a series of Madoff trials and other investment fraud cases. Dr Hunt is a Freeman of the City of London, and has a BA in Philosophy, an MSc in Computer Science and a PhD in Mathematical Logic from University College London.

Digital Issuance Papers

This white paper is an abbreviated version of a full report, covering the same ground in more depth, and published simultaneously. Both papers aim to show why we need a coherent approach to digital assets, to define an optimal model for digital issuance, and to demonstrate that this model is sound and can deliver substantial benefits. The point is to define a target, and to show that it is a good target; how we get there comes later. The author expects to produce follow up papers, focused on implementation, and addressing different asset classes and product types in more detail.

Sponsors / Supporters

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Caveat

The opinions expressed in this paper are those of the author, and there is no implication that they are approved or supported by any other individual or organisation, including those identified as sponsors, as supporters, as editors / reviewers, or as clients of the author. The parties who have contributed to the paper share one view, which is that the subject of digital issuance is important and needs widespread and intelligent debate.

Structure

Foreword

At the Investment Association (IA), we are committed to supporting the industry in exploring the opportunities that new technology and innovation offer; digitisation represents a key part of this. It is an area that is gathering momentum and represents a major opportunity for the investment industry. The UK Government has announced that it intends to make Britain a global hub for cryptoasset technology and to explore the potentially transformative benefits of Distributed Ledger Technology (DLT). To make constructive progress towards this, we need a collective focus, regulatory buy-in and cross-industry engagement: the IA will work hard to facilitate that.

This paper articulates the need for an optimal and secure approach to digital asset issuance, and an efficient and secure approach to digital transactions. It paints a picture where digital issuance can be consistent across asset classes, and a single operating model can support the management of both assets and transactions.

Whilst the IA may not necessarily agree with every position taken or model proposed in this paper, we do see it as an important contribution to a vital industry topic. The author, Dr Ian Hunt, is a prominent innovator in investment process and technology. The IA has worked with Dr Hunt on previous initiatives in Distributed Ledger Technology and fund tokenisation and this current paper builds on these foundations to lay out and theorise how digitisation could present a new market infrastructure model.

Digitisation and the use of distributed ledger technology in the sector is at an early work-in-progress stage and this presents the industry with a chance to create thoughtful dialogue and effect positive change. We can look at the application of this technology as it applies to the pre-existing market structure, but we can also consider how it might work outside these constraints, as this paper lays out. We know that the pathway towards a more digital world will not be quick or straightforward, and that there will be many solutions and paths to reflect on, but we also know that it is a journey with many potential benefits to realise. As an industry, it is up to us proactively to pursue conversations on what these transformative benefits may be, and how they will work for the good of all market participants, most notably for the end investor.

We intend to run member forums on the subject of digital issuance, following the publication and launch of this paper, and look forward to wide industry participation in these events.

Chris Cummings - Chief Executive, The Investment Association, May 2022

Glossary

The Global Blockchain Business Council (GBBC) has developed a taxonomy for terms relevant to tokenisation, blockchain and distributed ledger technology. This is known as the Global Standards Mapping Initiative (GSMI), and in November 2021, version 2 was launched, logically making it the GBBC-GSMI 2.0[1]. Where relevant, the glossary below follows, or is consistent with, that standard. However, as the smart token model proposed in this paper goes well beyond the current capabilities of decentralised platforms, the glossary offers definitions for many other model-specific terms.

Advertisement	A Smart Token, or a cluster of Smart Tokens, held and visible on the Issuer's Node, indicating that the Issuer is willing to trade on the Terms of the Pledge or Pledges coded on the Smart Tokens. Similar to an IoI
Beneficiary	The receiver and holder of a Pledge from an Issuer, coded onto a Smart Token. The same as Recipient
Bi-Directional Flow	An exchange of Tokens, where both parties are Issuers and Recipients, and Tokens Flow both ways when Triggered
Blockchain	A database that places records of transactions in blocks on a Distributed Ledger network. Each block is linked (or "chained") to the previous block, using cryptographic Signatures, that together make the transactions they contain immutable
Central Bank Digital Currency (CBDC)	Digital cash Tokens issued by (and as a liability of) a jurisdiction's central bank or other monetary authority, and denominated in that jurisdiction's national currency
Cluster	A set of Tokens, with or without an attached Label, used for trading purposes, or as an aggregation key for valuation or risk
Circle of Interest	In the context of this paper, a permissioning definition whereby a Node specifies which other Nodes, and which Smart Tokens, can have visibility of Smart Tokens, and therefore of IoIs, held on that Node
Commitment	The fact of an Issuer having made a Conditional or Unconditional Pledge of a future Flow of Tokens to a Recipient

Condition	A prerequisite for the Self-Execution of a Smart Token, coded onto the Smart Token itself. Alongside a date or date range (where one is specified), the Trigger for self-actuation of the Smart Token
Conditional	Describing a Pledge on a Smart Token which has one or more Conditions (in addition to any date specified) that must be satisfied before the Smart Token can Self-Execute. There is a risk that Conditional Flows will not be Triggered
Constraint	A limitation or compliance restriction on the execution, Fractionalisation or sale of a Smart Token, encoded onto the Smart Token itself and Self-Executed
Crypto Asset / Currency	Digital asset or cash Tokens whose value is wholly independent of any Off-Ledger reference asset or currency
Decentralised	The attribute of a platform which allows participants to interact and control transactions directly, without the intermediation of central controlling entities, without centralised record-keeping, and without central entities maintaining data on behalf of those participants[2]
Digital Asset / Cash	A entitlement Issued as a Token or Cluster of Tokens only On-Ledger (i.e. that does not exist in the conventional registry / banking / custody / depository world), and transacted and settled only On-Ledger (i.e. that is not settled through conventional payment and delivery rails)

[1] See: https://gbbcouncil.org/wp-content/uploads/2021/11/GBBC-GSMI-2.0-Report-1.pdf

[2] GBBC-GSMI 2.0 defines a 'Decentralised System' as a Distributed system wherein control of the system is distributed among the participating entities.

Digital Custody	The protection of digital client funds or securities, or the authority to obtain possession of them. As it relates to crypto assets, custody commonly refers to holding a client's private keys
Distributed Ledger	A decentralised platform which allows multiple Participants to share the same data, and aligns it in real-time, without messaging or reconciliation. Frequently paired with Blockchain data to enable Participants to trust that transaction data is secure and immutable, and that what they see is exactly what their counterparties see[3]
Flow	The movement of Tokens from one Node to another, or from one address to another
Fraction	A Token created by splitting a Token which Commits a larger Flow
Fungible Token	A Token that is interchangeable with an identical Token in part or in Fractions.
Indication of Interest (IoI)	A Smart Token or cluster of Smart Tokens, left visible on the Issuer's Node, showing what the Issuer is prepared to Pledge: used to show interest in a transaction, and to invite responses from counterparties
Intermediary	An entity that is interposed between the two primary parties in a transaction, and carries out an ancillary role in the transaction process
IOU	A metaphor for a Smart Token, as the Token behaves like an IOU – it is given to the Recipient by the Issuer, and held by the Recipient until the Issuer discharges their Commitment, then handed back

Issuer	The creator of a Pledge, the minter / editor of the Smart Token onto which the Pledge is encoded, and the provider of the Tokens Committed in the Pledge to the Recipient
Label	In the context of this paper, a name allocated to a cluster of Tokens. The nearest thing we have in the Smart Token model to the name of an asset or asset type
Liquidity Provider	A service provider to the Token network, operating a special-purpose Node, and advancing cash and / or asset Tokens to its clients, to enable leverage or to underwrite settlement
Net Settlement	The coordinated transfer of Tokens, based on the Self-Execution of multiple Smart Tokens Triggered within a defined time period
Node	For the purposes of this paper, a location on a Distributed Ledger network at which tokens are held; in other exemplar networks, an address associating a Token with the identity of its owner
Non-Fungible Token (NFT)	A Token that, as a result of carrying unique identification codes and data that distinguish it from all other Tokens, it is not interchangeable with any other Token in part or in Fractions
Off-Ledger / On-Ledger	Existing outside / inside the environment of a Distributed Ledger. Generally applied to data, values, assets or cash
Oracle	A service that provides Off-Ledger data to a Distributed Ledger. In the context of this paper, a special-purpose Node, operated by a service provider, which provides Off-Ledger data required by Smart Tokens to evaluate their Terms, such as prices, rates and default frequencies

[3] GBBC-GSMI 2.0 defines 'Distributed Ledger Technology' as a system of electronic records that enables independent entities to establish a consensus around a shared ledger without relying on a central authority to provide or authenticate the authoritative version of the records.

Participant	The owner of a Node or Address, where they can receive and hold Tokens, and where they can issue, edit and transmit Smart Tokens
Pledge	A Conditional or Unconditional promise from an Issuer to a Recipient to empower a future Flow of Tokens from the former to the latter
Recipient	The receiver and holder of a Pledge from an Issuer, coded onto a Smart Token. The same as a Beneficiary
Self-Actuation	The act of a Smart Token going from an inactive to an active state as a result of a Trigger, such that it commences Self-Execution
Self-Execution	The act of a Smart Token running its own code, evaluating its own Terms, and applying its own constraints automatically, without any involvement from its Issuer or Recipient
Settlement Node	A special-purpose Node, to which Triggered Smart Tokens transfer themselves, enabling efficient Flows in a Net Settlement
Signature	Identity data which, when appended to a Smart Token, enables the holder of the Smart Token to identify its issuer and confirm its integrity
Smart Market	In the context of this paper, a special purpose Node which accepts IoIs / Adverts from participating Issuers and Recipients, matches them and creates trades, on an anonymous basis where necessary

Smart Token	A Token onto which Terms, rules and Trigger Conditions can be coded by an Issuer, enabling the Token to self-actuate and self-execute
Stablecoin	A Crypto Asset / Token that aims to maintain a stable value relative to a specified currency, asset, pool of collateral or basket of assets
Terms	The functions and data which enable a Smart Token to compute the number of Tokens to be transferred from the Issuer to the Recipient of a Flow when it is Triggered
Token	Either a digital Label for title to an asset or pool of cash (like a ticket exchanged for a coat in a cloakroom), a digital coin, or a self-executing (smart) digital asset, committing an Issuer to a future Flow of Tokens
Trade	A transaction in which parties agree to the immediate or future exchange of Tokens in a Bidirectional Flow
Trigger	The combination of a date (or date range) and / or a set of Conditions, that specify when a Smart Token will self-actuate (i.e. when it will wake up and Self-Execute)
Unconditional	Describing a Pledge on a Smart Token which has a date specified, at which the Smart Token will Self-Actuate, but no other Conditions. There is no risk that an Unconditional Flow will not be Triggered
Uni-Directional Flow	A single Flow of Tokens from an Issuer to a Recipient, without any requirement for a simultaneous Flow in the opposite direction

The Structure of the Paper

This first part of this paper describes the problem with our current view of transactions, suggests an approach to upgrade it, and shows how we can spread the benefit of that change broadly and cheaply through tokens and fractionalisation. It then demonstrates how distributed ledgers can help us to achieve this. The second part, on digital issuance of assets, sets out the radical potential of smart tokens to create a transformative digital operating model for financial assets, and the dramatic impacts that would follow.

What We Can Achieve If We Get Digital Issuance Right

The paper demonstrates how a change of model, and the implementation of an optimised standard for the issuance of digital assets, would deliver dramatic benefits to manufacturers of financial products, to the investor experience, to the ease of regulation, and to the economics of investment: it is within our reach to deliver new and much more flexible products, while simultaneously achieving a profound reduction in complexity, risk and regulation, leading to materially lower costs for all market participants. Investors can have more product choice, and better access to assets that suit their needs; at the same time, issuers can issue more granular assets that better fit the profile of their funding requirements, and which can be issued more quickly and with more personalisation.

Operationally, if we can achieve a consistent form of representation for digital assets, then we can implement a single operating model across asset classes. All digital assets can be processed in the same way, and the boundaries between asset classes can dissolve: creating new products and asset types becomes straightforward, without operational or technological complexity. As a result, regulation can be made more effective, while being radically simplified through the elimination of redundant processes and roles. System architecture can become simpler and more standardised, making change easier and cheaper, while the requirement for service provision diminishes. Liquidity, trading and liability matching can improve, while security data maintenance, asset-servicing and settlement management shrink, and could evaporate over time.

What Digital Issuance, Digital Assets and Digital Transactions Mean

Because assets are generally represented already on computer systems, there is often confusion about what digital assets are, and how they are distinguished from conventional assets represented digitally. Digital assets are issued only onto a shared digital network (or 'ledger'), and do not exist in the current registry / custody / depository world[4]. Digital transactions are traded, managed and settled on the digital ledger[5], rather than through physical movements of assets and cash, or through conventional book-entry deliveries and payments between bank / custodian accounts. The paper contracts which define the terms of transactions in conventional assets are rationalised and automated in digital assets: necessary terms are embedded in the digital assets themselves, and processed automatically as part of their life-cycle management, wholly on-ledger.

[4] I am grateful to reviewers, Martim Norton dos Reis and Atul Manek, for pointing out that digital records could be shadowed in the records of custodians, banks and depositories. Ultimately this would dilute the value of digitisation, but for a transition period may be necessary to maintain a full picture across digital and non-digital assets.

[5] We will refer to assets, transactions and anything else managed exclusively within the shared digital network as being 'on-ledger'. Anything outside this environment we call 'off-ledger'.

Why We Need an Optimal Model for Digital Issuance

The purpose of the financial products is to transfer value through time. Investment takes funds available now and reengineers them into (hopefully larger) flows in future. Borrowing reengineers future flows into current flows (hopefully cheaply). Investment is a socio-economic necessity, and it needs to deliver both for investors and for those seeking investment. It is a factor of our economic success and a key determinant of our financial security. Access to investment needs to be efficient and investment itself needs to be cost-effective. It is often neither, and this damages our prosperity and our security.

Digitisation offers us the opportunity to achieve a step-change in both the cost and the accessibility of investment. To exploit this opportunity, we need to ensure that we get the implementation of digital right: this means having an optimal model for digital assets, for the form of digital issuance and for the processing of digital transactions. We should not expect that optimal digital processes will simply mirror existing physical processes.

In isolated cases, but increasingly, assets are already being issued in a digital format, and digital custody is becoming accessible[6] . It now seems inevitable the Central Banks will soon begin to issue cash in a purely digital form too[7]. The issuance of fiat currencies in the form of digital cash will accelerate and catalyse the issuance of digital assets, as we will be able to trade legal tender for assets in a purely digital, and highly efficient form[8].

What Will Happen if We do Nothing?

While it is a positive step that assets are being issued digitally, there is no standard approach to this. Diverse issuance models are deployed, and it is inevitable that approaches will become more diverse over time as wider asset types are addressed. This will lead to multiple, isolated ledgers carrying subsets of assets, with diverse forms of representation, supported by diverse operating models. Doing nothing risks landing us back in a fragmented, inaccessible and unnecessarily costly world.

Regulation of digital issuance is currently somewhere between embryonic and immature. Current initiatives in digital issuance are governed largely by existing regulations, drawn up for a very different context[9]. To be acceptable in current regulatory regimes, digital assets essentially have to behave as conventional assets behave, have to be managed by the same entities as manage conventional assets (who have to carry out the same roles), and have to conform to the same rules. To make it practical for regulators to frame effective rules for digital assets, there needs to be a coherent, optimal and generalised model for digital issuance. Doing nothing risks missing the opportunity presented by digital, because regulation won't let us take it.

The ability to manage investor outcomes could be taken away from organised finance if we do not produce a coherent industry approach to digitisation. Defi[10], while by no means fully proven or universally accessible, provides an increasingly accessible and sophisticated environment in which consumers can manage their own digital affairs. The rise of NFTs and the growing market engagement with crypto show that investors are increasingly prepared to back assets which are not underpinned by conventional value. Doing nothing risks losing the business altogether.

[6] Digital bonds and commercial paper are probably the most common assets. Digital custody focuses particularly on private key management and custody of cryptocurrencies / cryptoassets.

[7] China already does, and Sweden expects to by 2026. There are also the Sand Dollar (Bahamas), DCash (Eastern Caribbean) and E-Naira (Nigeria); otherwise, see: https://www.bis.org/speeches/sp210127.pdf

[8] See the Bank of England's Consultation on digital currency – "New Forms of Digital Money" 7th June 2021: https://www.bankofengland.co.uk/paper/2021/new-forms-of-digital-money and the UK Government's announcement on crypto and stablecoin regulation, 4th April 2022: https://www.gov.uk/government/news/government-sets-out-plan-to-make-uk-a-global-cryptoasset-technology-hub

[9] This is true for many regulators; others have retrofitted digital issuance into existing regulations, or built bespoke regulations e.g. Malta.

[10] Decentralised Finance. See https://en.wikipedia.org/wiki/Decentralized_finance for a basic explanation.

The Parties Who Really Matter

There are only two parties whose participation justifies the existence of the financial markets. These are the asset owners[11], who want to invest money, and the capital issuers[12], who want to raise money, and need access to investment. Size is irrelevant: either may be as big as a nation or as small as an individual investor or borrower. Everyone else in the process is there just as an intermediary, and their role (and cost) is only justified if they make transactions between the asset owner and the capital issuer easier, cheaper, safer, and (in the case of the regulators) fairer. Ideally the two significant parties would interact directly, and with the least possible friction[13].

Our Current Model of Transactions

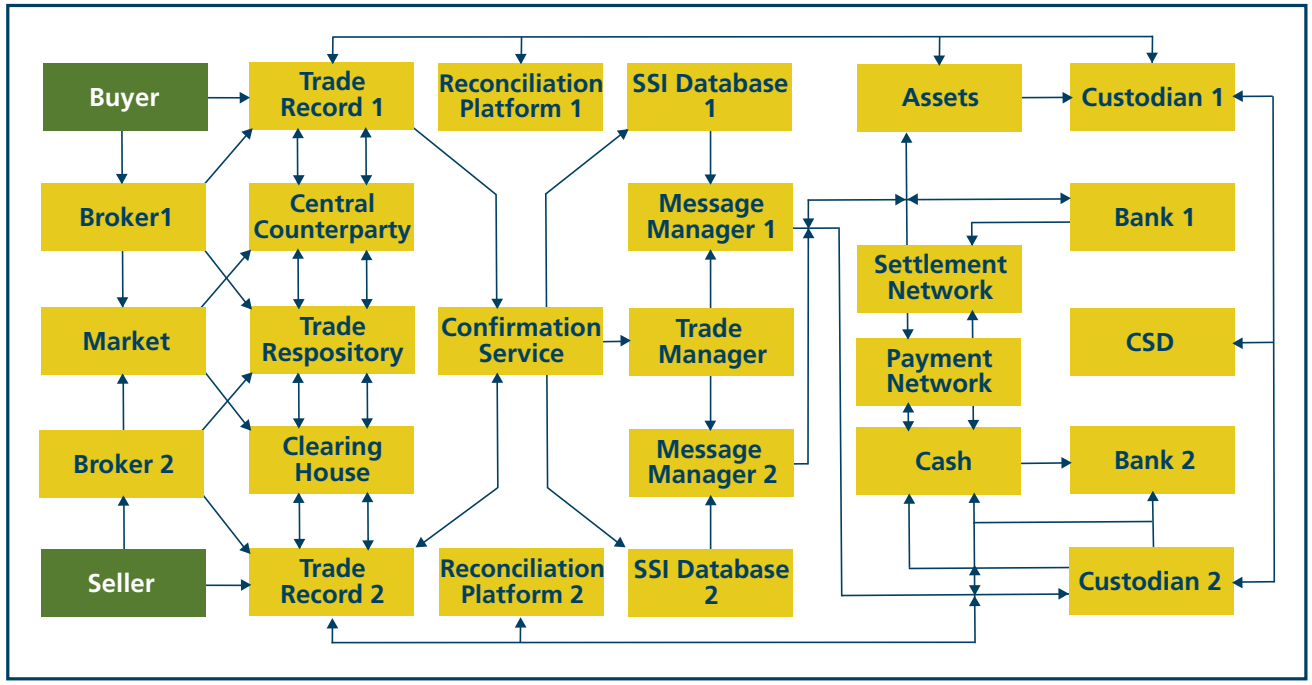
While asset classes have different structures and operating models, there is some commonality in the way that we approach the management of transactions. What follows is a generalisation, but not an unreasonable or inaccurate generalisation.

Below is a simplified diagram to help the reader to follow the flow. For clarity, the diagram includes only entities and relationships: the addition of processes would more accurately represent the complexity of the current model, but would result in illegibility.

[11] Asset owners include pension schemes, sovereign wealth funds and individuals with savings. They are often represented by (and confused with) influential agents: these are asset managers (on the asset side) and investment consultants (on the liability side).

[12] Capital issuers include companies borrowing to finance business expansion, and individuals taking on a mortgage to buy a house.

[13] The point is not that peer-to-peer interaction should be the only model, but that it should always be possible; intermediation should be an option for the primary parties, not a necessity.



Brokers are often engaged to find liquidity, facilitate trades on behalf of market participants and report them to trade repositories. Brokers place and execute trades in the relevant markets. Independent records of the trade are taken by each party. Confirmation services are deployed to match these trade records, to ensure that they are consistent. To mitigate counterparty risk before settlement, trades may be laid off to a central counterparty, or subject to a margining or collateral management regime[14].

The trades are netted by a clearing house to reduce both funding, and the deliveries and payments in the settlement process. Settlement instruction databases enable us to find the bank and custodian accounts for delivery of assets and cash to counterparties. Messaging infrastructure allows us to send the account details as settlement instructions to the bank that is to effect payment and to the custodian that is to deliver stock. On the agreed settlement date, the bank sends payment via a payment network and the custodian sends the stock via a similar network facility. The new stock ownership is reflected in the records of the relevant Central Securities Depository for the stock. The parties reconcile their records, to ensure that the trade has settled as expected, and the transaction is complete.

[14] Margining generally applies to exchange-traded derivatives and central counterparties, while collateral agreements are more common in OTC derivatives and securities financing trades.

A Familiar But Outdated View

This all appears quite familiar and comfortable, but actually it is a wasteful, overcomplex mess. The root of the problem is that we still think of assets as physical goods and money as physical cash. As a result, our model of a transaction is an outdated allegory of the exchange of goods for gold. Even though we have dematerialised most assets, and most cash is held electronically, we still talk about deliveries and payments, and manage them as if they were physical movements.

Why Are All These Intermediaries Needed?

We have brokers because access to most markets is too hard for most participants. We have markets because decentralised, peer-to-peer transaction is not readily accessible. We have trade repositories because trading activity is opaque. We need to confirm trades because each participant takes a separate record of the transaction. We need central counterparties and collateral because the timing of settlement is some time after the trade[15]. We need banks and custodians in settlement because we can't trust the other side of a trade to have the cash or assets that they claim, or to pay us or deliver to us on settlement. We need settlement instructions because we are making deliveries and payments (even though the assets and cash are dematerialised) and we need to know where to pay and deliver. We need messaging infrastructure to transmit these instructions to the banks and custodians. We need payment and asset transfer networks to reduce the cost and risk of making payments and deliveries. We need clearing houses to minimise the number and value of payments and deliveries because funding, payments and deliveries are still costly and risky. We need stock borrowing and contractual settlement because delivery might still fail[16]. We need CSDs because we need a secure location for assets, and a primary record to prove their existence and their ownership. We need reconciliations because so many different parties have maintained their own separate versions of the same events.

The multiple entities that we have introduced into the process are there to patch over the risks, costs and inefficiencies introduced by our own model of assets, cash and transactions. Each patch has been well-intentioned and implemented more or less effectively. The overall result, however, is a convoluted and complex mess. Between the asset owner and the capital issuer, there is a blizzard of intermediary entities and intervening processes, all of which add their own costs and risks. And if this was not bad enough, we then have expansive regulators and expensive regulations because all of this activity, and all of these entities, need to be regulated. We are in a well-intentioned hole of our own making.

Running Out of Road

Our current model of transactions and assets has developed over a long period of time. There has been an extended opportunity to improve it, and many improvements have indeed been implemented; most of these come under three headings.

1. The introduction of intermediaries to mitigate the inherent risk, volume and trust issues introduced by the nature of the current transaction and asset model;
2. The improvement of the processes and technologies deployed by those intermediaries[17]; and
3. The (attempted) reduction of resourcing costs through outsourcing and offshoring[18].

These approaches have delivered a stream of useful improvements in risk, cost and speed, but have now more or less run out of road. If we want to achieve the next step change in benefit to investors and issuers, it won't come from 'more of the same'. Digitisation is not more of the same, and presents us with the opportunity for radical change: if we get the model right.

[15] And in the case of derivative contracts and collateral agreements, necessarily continue over an extended period, rather than being completed in a single settlement.

[16] Stock borrowing also acts to enhance liquidity in some contexts.

[17] Some improvements have been made to enable settlement cycles to be shortened for some asset classes.

[18] Offshoring and outsourcing have a mixed track record in cost reduction, particularly when compared to pre-deal expectations. Surveys from global custodian banks (for example, from BNYM and State Street) show that many cost-cutting initiatives have fallen short of their forecast success.

How Should We Ensure That Digital Transactions Work Better?

To achieve the next step change, we need to replace, not tinker with, the model of assets and transactions that drives current complexity. This paper proposes five fundamental rules for transaction management, targeted to maximise the delivered benefit of digital investment. These are:

1. Have a single transaction record between the parties;
2. Fully immobilise conventional, off-ledger assets and cash[19];
3. Make capture, execution and settlement simultaneous;
4. Going further than (3), make the recording of the transaction and settlement of the transaction the same thing; and
5. Establish trust directly between the trading parties.

If we want a digital revolution, not a digital repetition, then we need to follow these five rules[20].

[19] For all tokenised assets – inevitably there will be a period of migration over which conventional, untokenised assets will not be immobilised.

[20] A reviewer, Roger Portnoy, has pointed out usefully that the implementation of these rules cannot be achieved in a 'Big Bang': we need to construct a highly effective migration strategy.

Tokenisation and Fractionalisation

Tokenisation is a simple idea: creating a digital label for an asset or a value. We can represent many different assets as tokens in this way, and trade the tokens in a standard way too. Tokenisation gives us the chance to divorce assets on-ledger from physical and corporate assets in the off-ledger world that we are used to, and make both ownership and trading simpler.

Holding a token is what ownership means in this context, and changing the location of one or more tokens is what trading means. The movement of the token is also the record of the trade, held permanently and immutably on-ledger, and it is the settlement of the trade too, as the token(s) end up at different addresses, and therefore owned by different parties.

Tokenisation is an efficient and generalised way of representing and trading assets, that does not have the baggage of conventional issuance: it is cheaper to trade tokens than shares or fund structures. Tokenisation can apply to conventional financial assets, like funds and bonds, but can also apply to assets which are generally not liquid, like works of fine art, or not investable at all, like community projects and footballers. Tokens can just represent other assets, like a cloakroom ticket represents a coat, or they can have value in themselves, like cash. In this paper, we will see how inherent value in tokens can be highly applicable to assets as well as to cash.

Tokenising assets makes both trading and ownership transparent. It is clear who owns what, as possession is given by the location of a token; trading is transparent too, as it is always represented by the transfer of a token from one node (or address) to another. The history of each token is held immutably on the ledger, and can be tracked back to validate the provenance and validity of the token itself. Trading in tokens is secure, and settlement failures are highly unlikely, as the right tokens have to exist at the appropriate nodes for a trade to take place, and the trade is the settlement of the trade[21]. All of this contributes strongly to the establishment of trust between trading parties, and makes oversight and regulation easier.

Fractionalising assets is the process whereby we are able to split tokens into arbitrarily small fragments, and thereby give investors the opportunity to trade in tokens of any size. This brings investment to a wider community, because there is no minimum size of investment. In making non-standard assets investable, and enabling micro-trades, tokenisation and fractionalisation both expand and democratise the investment universe[22].

Why Distributed Ledgers[23] Are Very Helpful

The five rules for transaction management could be implemented successfully in many different technologies[24]. Distributed Ledger Technology is not a necessity, but it is a sensible and appropriate platform, given our objectives. It is a good way to deliver tokenisation and enable immobilisation of off-ledger assets. It is a good way to establish trust, and an excellent way to share common records. It allows us to bring trades, trade recording and settlements together in a secure and immutable environment, and to make them visible to all relevant parties simultaneously and in real-time.

That's a strong set of characteristics, which means that digitisation and DLT are likely to get on well together. In the model definition that follows, we will assume implementation on a distributed ledger, like Corda[25], which has business functionality located at nodes, and moves tokens between them. Other ledgers, like Ethereum or Quorum[26], would be equally applicable, however.

[21] Avoiding settlement failures for future-dated tokenised net settlements requires a source of liquidity. Gross tokenised settlements are secure without such provision.

[22] It is arguable that ICOs could have a similar effect if holders were happy to realise value on-ledger.

[23] Often referred to as 'DLs' or just 'ledgers'.

[24] For example, a relational database structure with strong replication.

[25] Corda is R3's distributed ledger, developed mostly for financial applications.

[26] Quorum is a version of Ethereum, developed by JPMorgan to overcome privacy issues which limit Ethereum's applicability in finance, and now owned by ConsenSys.

Getting the Model Right

Defining a better model is generally a very good idea, irrespective of the subject being modelled. Astronomy moved forward apace after the geocentric model of Ptolemy was replaced by the much superior, heliocentric model of Galileo and Copernicus. Option trading became mainstream, and volumes mushroomed, after Black and Scholes created a more compelling model of options and their valuation. If we can get the model of digital issuance right, rewards will follow in business volumes, market participation, and product innovation.

To achieve this, we need to let go of some comfortable, and deeply ingrained ideas. The first is to move on from the idea of assets as the things that we buy, sell and hold. Most of the time, what we hold are promises or pledges of future flows of value, not tangible things in an inventory: 'assets' are just containers for those pledged flows. The second idea to retire is that intelligence is the province of business systems (and sometimes people), which push around data and messages that are essentially dumb: the things that move can hold the intelligence themselves, and are much better for it. The third idea to put to one side is that buyers and sellers need to initiate and manage settlements and transfers of value that have already been agreed between the parties: settlements can activate and manage themselves, in ways that are beyond useful. The fourth outdated idea is that when we trade, we trade assets, and they are indivisible: we can trade more productively at the level of pledged flows of value, and we can fractionalise those flows without limit. The fifth idea to relinquish is that value and risk apply to assets, and that they are aggregated up to portfolio level: value and risk apply better to pledged flows (that may or may not happen), and they are most usefully aggregated to entity level.

Making Tokens Smart

The basic building block of our model is a token that is 'smart', which means that the token itself knows when to initiate its own actions, knows what it can do to itself and to other tokens, and has the ability to self-execute. In the digital world, delivery is not payment or transfer of assets, it is a flow of tokens, and the main capability of smart tokens is to move tokens (including themselves) between nodes. This contrasts with conventional architectures, where the tokens are data, and intelligence is located within business applications (or smart contracts in a blockchain world): these operate on and control tokens, which are essentially dumb. In our model the tokens are smart and manage themselves.

At the simplest level, each smart token pledges one flow of value, from one issuer to one recipient, either conditionally or unconditionally[27]. It doesn't matter how big or small that flow is, there is just one smart token needed to represent it. However, if there are many recipients of similar flows from the same issuer (like a coupon payment from a bond to multiple bondholders, for example), then each recipient holds its own separate smart token. It is critical that the tokens are issued at the level of the individual pledge (and therefore flow), rather than at the asset level.

Each smart token fulfils key rules of digital transaction, because it is a single record (and a single set of computations), and it is both the record and the settlement of the pledge. The smart token is shared by both parties: the issuer and the recipient do not maintain their own versions.

A smart token operates, in effect, as an IOU: it is given by the issuer of the pledge to the recipient of the pledge. It is then held by the recipient until the issuer delivers the flow committed in the pledge, when it is transferred back to the issuer. When it gets the IOU back, the issuer can tear it up, or use it again to commit another pledge[28].

The nearest construct that we have to conventional assets in the smart token model is the ability to bundle smart tokens together in a cluster, and to attach a label to the cluster. This reflects the fact that financial assets are really just containers for flows of value: clustering lets us create an entity which mimics the behaviour of a conventional asset when it is traded. However, there is nothing to stop the recipient of the cluster from trading in or out at the individual token (or fraction of a token) level. After a few inbound and outbound trades, the 'asset' (and the label) loses all meaning and coherence. There is also nothing limiting the issuer's ability to bundle whatever pledges they choose into a cluster – so there is complete freedom in the creation of new asset types, albeit those 'new assets' will also be transient.

It is a tough ask to abandon our familiar ideas of assets and business systems, particularly if you are an asset manager or a business system vendor. It was a tough ask (and a serious threat to the human ego) to abandon the idea that the earth was the centre of the universe, but doing so liberated astronomy and enabled seismic progress. The same is true in investment: freeing ourselves from ideas that are comfortable and familiar, but wrong, enables us to progress to a model that transforms investment products, the investor experience, and the economics of investment. That model is based on the idea of tokenisation, with the added spice that the tokens are smart. In the distributed ledger world, that means embedding smart contracts on the tokens themselves.

[27] This echoes the Actus FRF standard, which reduces all financial assets to standard sets of cash flows governed by standard contracts. See https://www.actusfrf.org/about

[28] Some token models disallow the reuse of spent tokens, so in those models they would have to be torn up.

Rules for Optimal Digital Issuance

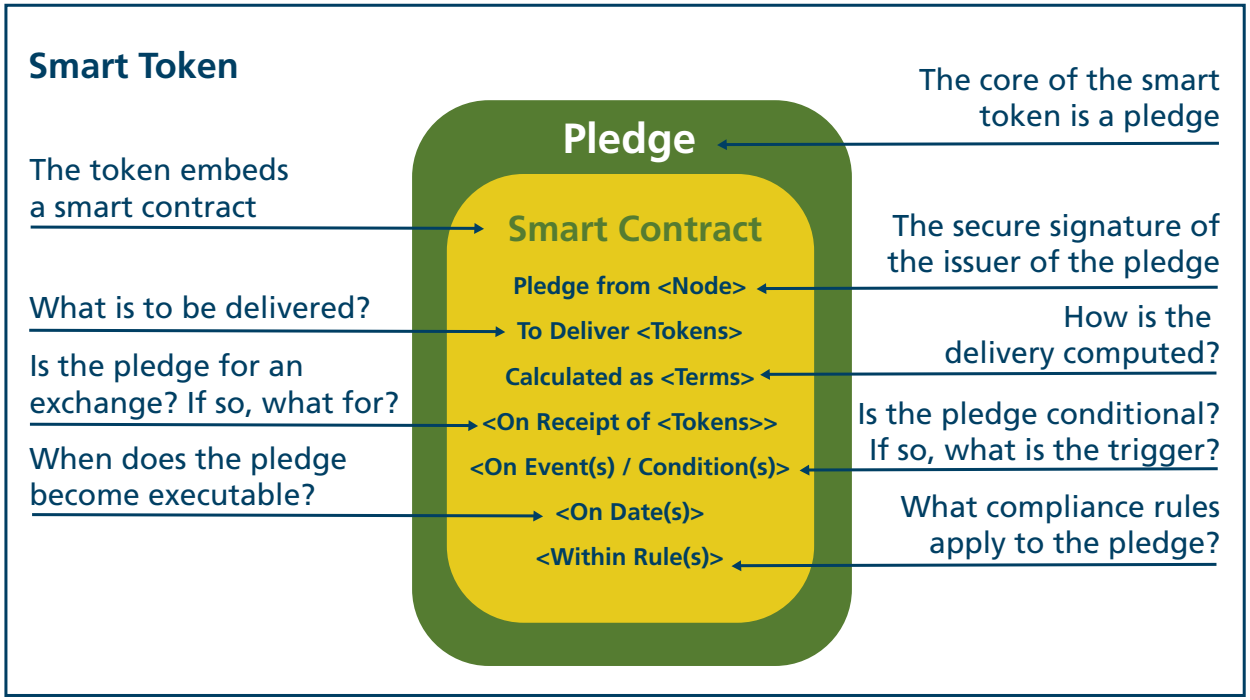
Just as for optimal digital transactions, there are five rules for optimal digital issuance:

1. Issue tokens at the flow level, not the asset level: represent digital assets as clusters of smart tokens pledging future flows of value;
2. Transfer intelligence from conventional business systems and conventional data structures onto the tokens: this makes them smart;
3. Make the smart tokens self-actuating, self-executing and self-controlling, such that their triggers, their capabilities and their constraints are all coded on the tokens;
4. Make the tokens individually tradeable and fractionalisable, so that trading can be at the individual flow level, and at the level of fractions within those flows; and
5. Measure value and risk at the level of the individual tokens, and therefore of the individual pledged flows, not of the assets.

It is a single flow (or fraction thereof) that defines the lowest level of trading; it is the flow that carries risk, as it may or may not happen; and it is the flow that holds value (as an asset or as a liability), as its completion conveys benefit (in committed tokens) from the issuer to the recipient. Trading, risk and value can be aggregated up to a higher level, where each apply to a cluster of smart tokens, and therefore to a summation of flows. The structure of that aggregation is up to the participants, not imposed on them by the definition of conventional assets.

Smart tokens self-activate in accordance with their triggering criteria, which may include a date, or a set of conditions, or a combination of these. Once activated, they evaluate the terms of the pledge that they contain (i.e. they work out what needs to be transferred), and then make the transfer happen, taking account of any constraints or compliance requirements encoded on the token. Assuming that the pledged flow is delivered in accordance with its terms (and they know that, because they are managing it), then they then transfer themselves back to their issuer. Neither the issuer nor the recipient needs to be engaged in this settlement process, as they agreed the terms of the pledge, the trigger criteria and the compliance constraints when they executed the trade. Their involvement is done.

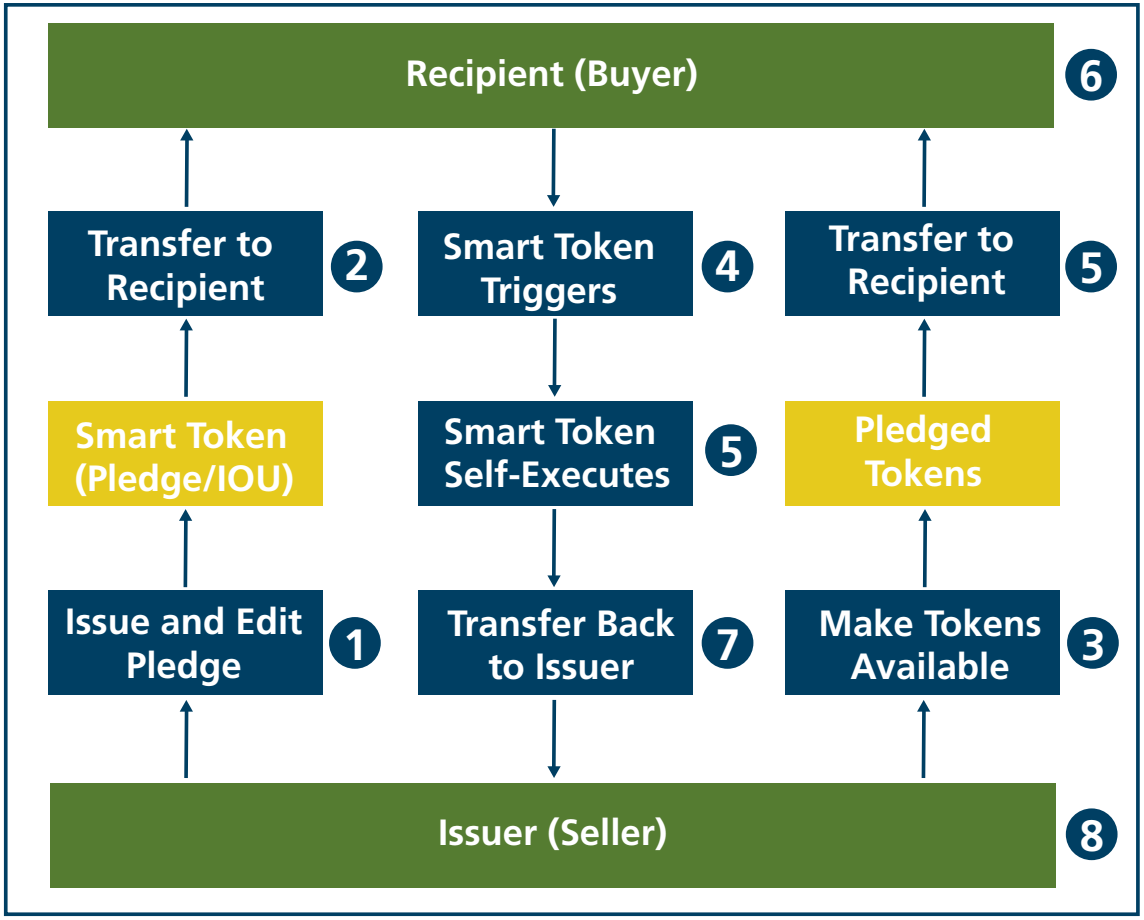
The standard form of smart token is illustrated below.



Smart Token Life-Cycle

Summarising the above perspectives on smart tokens, the 8 steps in their standard life-cycles are:

1. The issuer defines the pledged flow and creates / issues the smart token;
2. The issuer transfers the smart token, effectively as an IOU, to the recipient of the pledge;
3. The issuer ensures that it has the pledged tokens available at its node, pre-settlement;
4. The smart token self-actuates when its trigger date and / or conditions are met;
5. The smart token self-executes, evaluates the terms, and initiates the flow from the issuer;
6. The recipient now holds the pledged tokens at its node;
7. The smart token sends itself back to the issuer;
8. The issuer burns the smart token, in effect 'tearing up' the IOU.



In this lifecycle, there are no intermediaries between the issuer and the recipient, and the only entities are the issuer, the recipient, the smart token and the tokens committed by the pledge.[29]

If the smart token is part of a transaction, then there will be two instances of this life-cycle, back-to-back, the trigger conditions will be aligned, and the flow will be bi-directional. More complex transactions, representing the equivalent of conventional asset lifecycles, just deploy multiple lifecycles in parallel. The lifecycles will be identical, while the committed tokens and the trigger conditions may differ as required. There is therefore no difference in operating model required, no matter how apparently complex the 'asset' or the transaction appears to be.

[29] Contrast the simplicity of this picture, and the very small number of entities that it depends on, with the 'as-is' entity / relationship diagram on page 12.

What Kinds of Tokens Do We Need?

What is transferred in satisfaction of a pledge will itself be a set of tokens on-ledger, so the whole smart token model exists within the digital environment: nothing moves off-ledger. Often, the pledged transfers will be transfers of value, and so will be flows of cash tokens, but they don't have to be. The pledge could be a promise to transfer other pledges, or to deliver tokens representing title to assets off-ledger. The only requirement of the issuer is that they have the tokens ready to transfer at the point of settlement, and the primary concern of the recipient is that the issuer should have the tokens to transfer.

In total, there are four kinds of token that we need to exist on our ledger:

1. Cash title tokens – tokens giving title to fiat currency off-ledger, held either as a pool of cash, or as a liability against a bank balance sheet, i.e. forms of stablecoin;
2. Asset title tokens – tokens giving title to a tangible, non-digital asset off-ledger; this may, for example, be a building, a painting, some jewellery or a company;
3. Digital cash tokens – tokens with inherent value issued only on-ledger, of which a prime example will be Central Bank Digital Currency[30]; and
4. Smart tokens – digital asset tokens[31] which contain a pledge to a future flow of tokens, which self-activate and self-execute.

The values of token types (1) and (2) are given by their off-ledger reference assets. So the tokens, and the title that they represent, live on-ledger, but the assets don't. The values of token types (3) and (4) are inherent on-ledger, and have no reference to off-ledger assets of any kind. Valuation of smart tokens is driven by a set of considerations, primary among which are the terms of the pledge, the solidity of the party making the pledge, and the time to elapse before the pledge is delivered.

[30] CBDC will represent a liability against a central bank, but will be real spendable currency

[31] Clusters of smart tokens will represent entirely on-ledger assets.

Representation of Basic Instruments

Many familiar instruments are very straightforward to represent in a smart token model. As we have seen, a fixed rate, fixed term bond is a fistful of pledges held by each recipient, representing a sequence of coupons and a redemption payment. Fixed interest deposits are similar.

Representation of More Complex Assets

Floating rate securities are marginally more complex, as they require reference to a market rate in order for their terms to be evaluated by the smart token. Rates will be provided by an 'Oracle'[32], which is a special-purpose node on-ledger, agreed between the trading parties at the point of trade. Perpetual bonds are also marginally more complex, and can't be represented by a specific number of smart tokens, as they have unbounded payment cycles. In this case, a smart token represents the repeating coupon payments, and splits itself before each coupon date into a smart token representing the next payment, and another representing the remaining payment cycle[33].

Derivatives can be tough to represent and complex to manage in the conventional model, and the more exotic varieties are often seen as challenging and delinquent asset classes. In the smart token model, they fit admirably. Any derivative is just a promise (or a cluster of promises) to exchange assets or value, with terms evaluated prior to each point of exchange. As a result, swaps, options, barriers, futures etc., are represented and managed in exactly the same way as other digital issuance. Rate-relative terms can be delivered through reference to an Oracle, exactly as for floating rate instruments.

Pay-downs, callable and amortising instruments are at the hard end of conventional asset classes, but in the smart token model, they are straightforward both to model and to manage. The terms of their calls are embedded in smart tokens, held at the recipient nodes, and triggered at the option of the recipients. There is nothing special about them.

Securitisations could be described as easy, or as irrelevant, depending on the way you look at it. Any cluster of smart tokens (or fractions) can be bundled up, given a label, and sold, in the equivalent of securitisation. However, as a labelled cluster does not have the coherence or indivisibility of a security[34], then the result is just another set of pledged flows held at some or other node. It's not quite the same, but it doesn't need to be.

Settlement management does not exist in the smart token model, as all pledged transfers of value are self-executed. Income processing and entitlements also evaporate. An income event is self-executed by the smart tokens pledging the payments, and no entitlement calculation is necessary. The smart tokens held by the recipients evaluate and implement the terms of the income pledge, and the entitlement to income is defined by the location of the tokens. There is no need to record who owns what, to work out who is owed what, to make the payments or to reconcile them afterwards. Commitment to corporate actions, similarly, may be represented in the terms of a pledges held by recipients, and triggered by data from an Oracle[35]. Consequently, asset servicing ceases to be a major requirement in the smart token model.

Collateral agreements commit both parties to a contract to transfer value or assets periodically, depending on the valuation of an asset or liability, and the value of an existing collateral pool. In the smart token model, both the valuation and the transfer are self-actuated and executed by a smart token. The parties agree at the outset how the valuation and the required collateral move will be calculated, and any Oracle which they will use to facilitate that computation. There is no need for any parallel valuation, agreement or reconciliation between the parties.

[32] 'Oracle' is a standard term for an agreed source of external data in a Distributed Ledger context.

[33] The payment cycle may be terminated by a call, if the issuer has an option for this. If it does, then the terms of the call will be coded onto the smart token.

[34] A reviewer has raised a question whether indivisibility could be an attribute of a cluster, so that the 'asset' would persist. This is difficult, as it would imply a prohibition on trading into as well as out of the constituent flows of the cluster. It is not clear that this would add any value that would balance the loss of flexibility.

[35] Corporate actions can be very complex in the current model. There is no implication that agreement to all currently possible CAs will be pledged. However, the smart token model means that, for digital assets at least, CAs will be simpler and pre-commitment will be more practical.

Collateralised loans can be represented by a combination of pledges to make repayments and a terminal pledge, triggered by full redemption, to transfer back title to the collateral. Product features by which issuers allow early repayment, payment holidays or term extensions can themselves be represented as pledges from the issuer. Recipients can buy and / or sell their own pledges to reengineer the payment profile to suit their own financial planning objectives. Consequently, the flexibility for the issuer to define product, and for the recipient to tune it to their own objectives, is unlimited.

Visibility, Negotiation and Activation of Pledges

Any pledge held on an issuer's node is inactive, like an IOU in the hands of a borrower: the IOU only has force when held by a lender, and a smart token is only active when it is held by a recipient. However, a pledge (or a cluster of pledges) held on the issuer's node can, if it is visible to other nodes, advertise the issuer's interest in trading the cluster: it acts like an Indication of Interest (IoI). To control visibility, a strong permissioning schema is essential for the network, so that issuers can define what other nodes can see what data on the issuer's node.

Nodes can search other visible nodes to match the IoIs and identify trading opportunities. If they want to do this anonymously, nodes could route their IoIs to a special purpose matching node, which could match trading opportunities and act as a smart token market. This is an opportunity for existing market participants to create new competitive services for the digital world.

Matched IoIs, along with other negotiations, will lead to orders, and orders fit well into the smart token model too: they are just pledges to exchange. As a result, there is no need for a separate form of representation or management system for orders. They behave in the same way as any other pledge, and are both represented as, and self-executed by smart tokens. Generally (but not necessarily), orders will pledge an exchange of other smart tokens for cash tokens.

In the smart token model, anything which can exist entirely on-ledger, is represented only on ledger, and in exactly the same way, as a cluster of self-executing smart tokens. The value that they pledge to deliver is wholly represented on-ledger too. The only entities which can't be represented as wholly on-ledger digital entities are assets which are essentially tangible, like racehorses, office blocks, companies and Picassos. For these assets, we have to use title tokens to represent ownership, although their related income and costs can be represented by smart tokens in the same cluster. That includes equities.

Valuation of Pledges

The value of a flow, defined by the pledge contained in a smart token, is driven by a series of factors:

1. The evaluation of the terms of the pledge, including any Oracle-sourced rate;
2. The solidity of the issuer of the pledge;
3. The elapsed time between now and the expected self-execution of the pledge;
4. The probability that the trigger conditions of the pledge will be realised; and
5. The probability of the terms of the pledge being changed, if the issuer has that right.

Factors (2) and (3) are essentially the equivalents of counterparty risk, and may be supported by Oracle-delivered probabilities of default. From (3) to (5) above, we can see that securities with apparently bespoke valuation methods, like options, are not actually special at all. All realistic flow valuations must include considerations of risk, in both time and probability of execution.

The valuation of anything represented by a title token will be given by an off-ledger valuation, delivered through an Oracle. In a strict sense these are arbitrary values, derived from 'whatever the last traded price was' or 'whatever an expert says it is'. To be as consistent as possible with smart token valuations, liquidity should at least be taken account of in the valuation of title tokens.

Risk Measurement of Pledges

The smart token model has the major benefit of reducing complex and diverse assets and transactions to common flows managed through a single operating model. This dramatically reduces the number and diversity of risks to which participants are exposed. However, there are still material risks, and we need strong mitigants to address these, especially because the model does not have the luxury of multiple intermediaries, acting as verifiers and validators of activity.

The primary risk to a recipient (i.e. a holder) of a smart token is that the issuer will not have the committed tokens available on their node at the point of settlement. This is the reflection of the primary obligation of the issuer to have the right tokens available in the right quantity when the smart token self-activates.

The primary risk to the issuer of a smart token is the fraudulent minting of tokens purporting to pledge flows from them, or the corruption of smart tokens to commit more demanding flows. The recipient has a reciprocal risk, that smart tokens that they hold may be corruptly changed to reduce the value of the committed flows.

To guard against these risks, the network technology needs to ensure that only issuers can edit pledges, and that they can only be edited when they are held on the issuer's node: once a smart token is held by a recipient, then editing must not be possible. These are absolute requirements of any underlying platform for smart tokens. The only change to the terms of a smart token should come about through a pledged right for the issuer to impose (or propose) a terms change.

As we have seen, the network also needs to ensure that issuers have visibility of all their outbound pledges, irrespective of where they have ended up following trading activity. This will enable issuers to confirm that there are no counterfeit, or corrupted tokens, committing them to future flows. Recipients will aways have visibility of inbound pledges, as they hold them on their own nodes; they also need visibility of the committed tokens on the issuer's node, for assurance prior to settlement.

There is an equivalent of interest rate and spread risk: adverse changes to the rates referenced in pledge terms, or to the probabilities of default of issuers, could mean that they have overpaid for their forward flows. Issuers may have been underpaid if the rates and default probabilities go the other way. The technical platform will not guard against these risks, but the participants can create trades whose terms protect them, in a smart token equivalent of hedging.

All participants need to see the full picture of flow risk, in the equivalent of an asset / liability analysis. With risk attaching to flows, rather than to assets, all participants can aggregate their inbound and outbound flow risks in any structure that suits them. This is unlikely to include an 'asset' level, as 'assets' are not persistent or coherent within the smart token schema.

What's Left for Business Systems to Do?

We are used to the idea that a business platform (or set of platforms) is the central controlling system for a business, and lives at a fixed location. It defines what the business can do, supports its workflow, maintains and moves its data around and communicates with other systems as necessary. The smart token model turns this on its head: the tokens carry the intelligence, they self-actuate, they know what they can and can't do, and they move themselves and other tokens between nodes.

As a result, business platforms become much simpler, much less heavyweight and largely undifferentiated: all nodes, and the business platforms that exist at them, act as receptacles for tokens, have the capability to mint and edit their own pledges. In addition, business systems at the nodes will have the capability to consolidate a full picture of inbound and outbound flows for their owners, including their risks and their valuations.

New product initiatives and the introduction of new asset classes take significant time in the conventional world, while systems and data structures are upgraded to accommodate and support the new initiative. This often acts as a constraint on business development. With smart tokens, all that needs to happen is the minting and coding of a new token type. The underlying architecture stays unchanged. Business development can accelerate significantly as a result, and the cost and risk of change reduce commensurately.

Objections

There is a range of generic objections which may be put forward against the smart token proposal for digital issuance. Among these, the most predictable negatives include:

1. This is all very radical; radical change takes a long time to deliver and is painful. (i.e. We'll all be dead by the time this happens).
2. There is a huge amount invested in the current infrastructure, and overhauling it will be a massive challenge logistically and financially. (i.e. It's too hard and will never happen).
3. Entities under threat of disintermediation will be strongly opposed to it, and they include major, influential institutions. (i.e. The big boys will oppose it, so it will never happen).
4. There is a huge weight of regulation and law, which enshrines the current model of transactions, assets and entities. (i.e. The new model doesn't fit the rulebook, so it will never happen).
5. Distributed Ledger Technology is still maturing and unproven at very high volumes, and inter-operation of ledgers is embryonic[36]. (i.e. It'll never work).

Refutations

Simple counters to the generic objections are:

- The prize is demonstrably worth the time and the pain of transition (objections 1 & 2);
- While there will be losers, there is much to be gained by parties who get on board with digitisation: the market can be expected to grow significantly, and there will be wide-ranging new product and network service opportunities (objection 3);
- There is the opportunity to simplify regulation, and, if they are to deliver to their own missions, then regulators will have to evolve regulation to facilitate digitisation. The law will catch up, as it generally does (objection 4);
- Distributed Ledger Technology is developing apace, and attracting very significant investment; issues with scale and maturity are likely to be temporary. Painless inter-operation between ledgers is mandatory if the technology is to succeed (objection 5).

In addition to the generic objections, there are more specific objections which we may anticipate. These include concerns over security and operational resilience, and the establishment of trust without trusted intermediaries. While we undoubtedly need to ensure that there is governance and responsibility for the operational security within any network carrying smart tokens, we inherit the very significant trust and security strengths which blockchain and distributed ledgers deliver. Because our context is a private ledge[37], then there is no requirement for heavyweight 'proof of work' or 'proof of stake' computations to establish trust. What is proposed may not be perfect or impregnable, but it does represent a material step-up in resilience over current technology. We should not let perfection be the enemy of improvement.

Other concerns may be expressed over the volume of transactions implied by flow-level and fractionalised trading, and the complexity of compliance rules and contract terms that may need to be encoded on the tokens. In responding to these objections, we should bear in mind the simple fact that smart tokens reduce all trading to single pledged flows of value from one issuer to one recipient. What a smart token can do is limited to moving itself and other tokens around, and splitting itself into fractions.

If there is a large volume of entities, it is a large volume of simple entities; if there is high volume of trades, it is a high volume of simple transfers of value. Compliance and contract rules will therefore govern something much simpler than the wide range of asset and transaction types that we process today. Our volumes will be high, but nothing like the level commonly managed in, for example, telecoms systems or meteorology systems, and what is represented will be much simpler.

[36] Without question, the speed and scalability of current Distributed Ledger networks need to improve. Inter-operability between DL networks needs to mature and standardise.

[37] A downside of private networks is that non-members have to trade through members, acting as intermediaries.

Benefits of the Smart Token Model

The consequences of the smart token model proposed for digital issuance are radical, and hugely beneficial, on both sides of the P&L account. A single, universal model of issuance and transaction can be applied to all asset classes and flows, underpinned by a single operating model that is secure, low-cost, scalable, flexible and transparent.

In more detail, the key impacts for investors / asset owners and borrowers / capital issuers include:

- Allowing asset owners and capital issuers to interact freely and directly;
- Much easier and quicker delivery of new and more flexible financial products;
- A wider market of investors and borrowers to sell to, and products to sell;
- A common means of representation across all digital issuance and all digital transactions;
- Radical simplification of the entities and processes engaged in delivering financial products;
- Improved liquidity, alongside more flexible, more granular trading;
- More granular risk management and more realistic valuation of flows;
- Visibility of all assets and liabilities at all times on the same platform;
- More precise matching of assets and liabilities, with a much lower cost of hedging; and
- Elimination of order management as a separate platform.

The benefits of the smart token model, in some cases, apply to service providers, as well as to investors and borrowers; these wider benefits include:

- The opportunity to deliver a new range of services at network level;
- A single operating model across asset classes;
- An order of magnitude reduction in operational costs and complexity;
- Elimination of registry and position maintenance;
- Elimination of settlement management;
- Elimination of income entitlement calculation, payments and reconciliations;
- Radical simplification of corporate actions;
- Radical simplification of cash management and elimination of payments;
- Radically simplified and standardised business system architecture; and
- Elimination of the need for a security master and its associated demands for maintenance and data sourcing.

This is a big list of high value benefits. Together, they more than justify the considerable cost and disruption of a transition to the smart token model for digital issuance.

The constructive actions that need to be taken to move us to an optimised model of digital issuance and transaction depend on who you are. So this call-to-action asks for different actions from each of the main players.

Financial Market Infrastructures, CSDs, SSI Databases, Order-Routing Networks, Payments Utilities

Recognise that the new model does not require services that have been essential staples in the conventional world of assets and transactions. Explore and refine the opportunities presented for new value-add services at network level, including as operator of a settlement node and as secure network administrator.

None of this is rocket science, and (cultural stiction notwithstanding), none of it is particularly hard to move on. However, it is unquestionably hard to shift our world-view from the current, familiar paradigm, and fully to embrace the model proposed in this paper. While it may be hard, it is incumbent on all of us in the investment industry to educate ourselves about this opportunity, and to test its claims to offer a superior outcome. If much of the above happens, and the participants act with energy and commitment, then we will start to gain real momentum for radical change.

Asset Owners

Work with capital issuers to establish the best way to communicate your demand for assets which more precisely and efficiently meet your flow requirements. Pressure your asset managers to go beyond conventional LDI, matching your inbound and outbound flows, and structuring fractional trades around these, rather than just running asset inventories on your behalf.

Capital Issuers

Make a start on the issuance of digital assets in an optimal form, purely on-ledger, rather than in conventional form or as title tokens. Be enthusiastic about the opportunity for issuance which meets more precisely the requirements of your asset owner counterparties. Band together to agree standards for digital issuance, and work with the regulators to ensure that these assets are as secure, or more secure than their conventional equivalents.

Central / Commercial Banks

Get on with CBDC. There has been lots of talk and consultation (and a few naysayers[38]), but we need to get away from off-ledger referenced stablecoins, with their requirement for tokenisation and encashment, and deliver real digital value on-ledger. We don't want the volatility of crypto-currencies, or the potentially disruptive effect of stablecoins, so this means CBDC, or at least commercial bank-issued e-money. Cash needs to be, and stay on-ledger.

Custodian / Corporate Banks

Investigate the opportunity to deliver secure digital custody services to the network, both as private key management and off-ledger storage. Plan to deliver liquidity on-ledger, both as a liquidity-enhancing service to investors, and as a network-level service underwriting settlements. Consider the impact of flow-level transactions and smart tokens on securities financing transactions and collateral.

Outsourced Service Providers

Recognise that asset servicing, income, cash management and transaction management services will diminish. Investigate the many new opportunities for value-add services at both network and node level. These include digital identities, federated KYC / AML, the facilitation of on-ledger collateral transfer, the operation of nodes on behalf of issuers, investors and funds, and the management of a settlement node.

Payment Banks

Develop services around non-CBDC cash-on-ledger, pending the introduction of CBDC. Establish a regulated model for the operation of a cash exchange, tokenising and de-tokenising fiat currency into and out of stable tokens, as an alternative to native cash on-ledger. Work out a regulatorily safe approach to yield enhancement for clients who chose to retain fiat currency as a preferred medium, through short-term deposits, rehypothecation or another technique.

[38] See "House of Lords Committee Sees 'No Convincing Case' for UK CBDC" - CoinDesk Jan 2022: https://www.coindesk.com/policy/2022/01/13/house-of-lords-committee-sees-no-convincing-case-for-uk-cbdc/

Business System Vendors

Examine the consequences of the smart token model for fundamental systems architecture. Instigate designs for the templating, editing, issuance, transmission and burning of smart tokens, including compliance and triggering conditions. Determine the architecture required for self-actuation of smart tokens, and the interaction between smart tokens and other tokens whose movements they control. Design facilities for 'seeing the full picture', for finding liquidity, for the forward matching of inbound and outbound flows, for risk aggregation, and for the valuation of flows.

Broker / Dealers / Investment Banks

Investigate the delivery of a network service as the provider of a smart matching / market node. Seek consensus on the best mechanism for price formation in this context. Work with primary market capital issuers and asset managers to design optimal assets, and to develop efficient approaches to asset-sourcing and demand matching at flow level. Work with peers to develop standards for IoIs and advertisements in a smart token context.

Regulators

Move beyond the current conviction that digital assets should behave in the same way as conventional assets, be managed by the same entities, and be subject to the same rules and controls. Set out to evolve regulation which is appropriate to the optimal, flow-based model of digital assets and digital transactions set out in this paper. Become enthusiastic about the prospect of significant regulatory simplification as a result of a radical reduction in the number and entities and complexity of processes involved in financial products. Initiate design work on direct network access as an alternative to regulatory reporting, and consider becoming a participant in digital networks. Define the regulatory treatment of federated KYC / AML services, operating at network level, as an alternative to the prescribed responsibilities of individual regulated participants.

Asset Managers

Work with issuers (and their advisers) in the primary market to design optimal digital assets; put pressure on regulators to evolve regulation to facilitate optimal digital issuance; put pressure on central banks and governments to deliver CBDC. Start planning for new investment products which take advantage of the opportunities presented by digitisation, focusing on products which meet your clients' specific flow requirements, and encompassing hybrid market / principal-traded, digital funds.

Distributed Ledger Platform Providers

Address the changes needed to your platforms to accommodate and support the capabilities defined in this paper. In particular, consider strengthening your approach to smart contracts, token management and fractionalisation, so that smart contracts can be attached to tokens, tokens can self-actuate and self-execute, and tokens can split themselves into fractions on a zero-value exchange basis.

Industry Associations

Create working groups to investigate the impact of digital issuance, and to reach consensus on the most appropriate issuance model and underlying operating model. Actively seek to promote debate on the form of digital assets, encourage publications, and organise round-tables and conference events focused on the subject. Provide facilities for early technical prototyping.

End Investors

Demand of your financial product providers that they articulate how they will deliver digital products that maximise choice and minimise cost for you as consumer. Write to your MP, demanding that the opportunity of digitisation is exploited to the full in our market, and to the benefit of end-investors.

Conclusion

This paper has put forward a radical model for digital issuance which delivers standardisation of the representation of assets and the management of transactions across asset classes, unlimited trading flexibility for both issuers and investors, and a transformation in the economics of investment.

To deliver this radical model, we need to follow ten fundamental rules of digital investment set out in this paper. The rules are:

Digital Transaction Rules

1. Have a single transaction record between the parties;
2. Immobilise conventional, off-ledger assets and cash;
3. Make capture, execution and settlement simultaneous;
4. Make the record and the settlement of a transaction the same thing;
5. Establish trust directly between the trading parties;

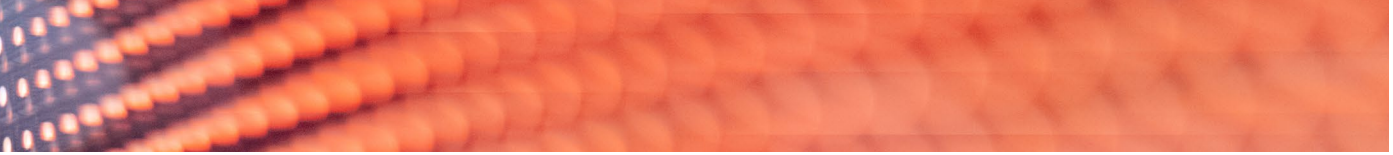
Digital Asset / Issuance Rules

6. Issue tokens at pledged flow-level, and represent digital assets as clusters of tokens;
7. Transfer intelligence from business systems onto the tokens: make them smart;
8. Make the smart tokens self-actuating, self-executing and self-constraining;
9. Make the tokens individually tradeable and fractionalisable; and
10. Measure the value and risk of the individual tokens, and therefore of future flows.

Following these rules requires that we let go of familiar and comfortable ideas about assets, transactions and business systems. However, the prize is high: if we follow all of these rules in our implementation of digital issuance, then we can optimise the benefit of digitisation, and achieve the next step-change in the efficiency and accessibility of investment. We will break down the artificial barriers between instrument classes, and eliminate their bespoke operating models. A wider population will gain access to investment, and a wider set of assets will be investible. Capital issuers will come closer to asset owners, and more flexible, more appropriate investment products will be easier to launch. It's well worth ditching some old ideas for.

If we don't collaborate across industry participants to ensure that these rules (or something like them) are followed, then we risk missing the generational opportunity presented by digitisation. We could very easily end up with a proliferation of approaches to digital issuance, hard-wiring boundaries between asset classes, and maintaining the current plethora of asset-specific operating models. We could perpetuate the current blizzard of intermediaries, and have to carry on living with the cost, complexity and extensive regulation that they entail. In other words, we are quite likely to end up in a digital version of exactly where we are now. And we just might lose the whole market to Decentralised Finance. That's well worth avoiding.

This paper presents the opportunity of digitisation, shows how and why we should grasp that opportunity, and provides a call to arms to all participants to create the right legacy of digital issuance for future investors.



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