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TECHNOLOGICAL

A smart token model for native digital assets

IAN HUNT

ARTIFICIAL INTELLIGENCE

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DEAR READER,

As the financial services industry continues to embrace transformation, advanced artificial intelligence models are already being utilized to drive superior customer experience, provide high-speed data analysis that generates meaningful insights, and to improve efficiency and cost-effectiveness.

Generative AI has made a significant early impact on the financial sector, and there is much more to come. The highly regulated nature of our industry, and the importance of data management mean that the huge potential of AI must be harnessed effectively – and safely. Solutions will need to address existing pain points – from knowledge management to software development and regulatory compliance – while also ensuring institutions can experiment and learn from GenAI.

This edition of the Capco Journal of Financial Transformation examines practical applications of AI across our industry, including banking and fintechs, asset management, investment advice, credit rating, software development and financial ecosystems. Contributions to this edition come from engineers, researchers, scientists, and business executives working at the leading edge of AI, as well as the subject matter experts here at Capco, who are developing innovative AI-powered solutions for our clients.

To realize the full benefits of artificial intelligence, business leaders need to have a robust AI governance model in place, that meets the needs of their organizations while mitigating the risks of new technology to trust, accuracy, fairness, inclusivity, and intellectual property. A new generation of software developers who place AI at the heart of their approach is also emerging. Both GenAI governance and these 'Developers 3.0' are examined in this edition.

This year Capco is celebrating its 25th anniversary, and our mission remains as clear today as a quarter century ago: to simplify complexity for our clients, leveraging disruptive thinking to deliver lasting change for our clients and their customers. By showcasing the very best industry expertise, independent thinking and strategic insight, our Journal is our commitment to bold transformation and looking beyond the status quo. I hope you find the latest edition to be timely and informative.

Thank you to all our contributors and readers.

Lance Levy, **Capco CEO**

A SMART TOKEN MODEL FOR NATIVE DIGITAL ASSETS

IAN HUNT[1] | Buy-Side Industry Consultant and Adviser

ABSTRACT

Digitalization is not about doing what we do now, but with slightly better technology. It is an opportunity to do something very different, which is much simpler, much cheaper, and much better. A number of factors are preventing us from taking, or even perceiving, that opportunity. We are held back by the popular perception that digital assets are questionable and shady, and by regulatory uncertainty over the treatment of digital assets, as well as by our own unwillingness to think beyond the current financial ecosystem: we find it hard to accommodate the degree of change that would enable us to maximize the benefits of digitalization. This paper explains the radical potential of native digital assets to create a single, simple issuance and transaction model across all financial assets. This would deliver a dramatic improvement in client outcomes and in the flexibility of investment products, along with an equally dramatic reduction in cost and risk in the way that we deliver those products. It would enable regulation to be far simpler, but more effective. It would allow us to roll back the surging tide of complexity in the infrastructure, management, and regulation of finance. This model will be adopted soon in a forward-thinking jurisdiction. All other markets, ploughing on with our current overweight, over-complex, and heavily regulated financial ecosystem, will become uncompetitive: they will have no choice but to follow.

1. INTRODUCTION

Forty or so years ago, Nasdaq was created by disaffected members of the New York Stock Exchange. They wanted an electronic market and had become impatient with the conservative management of the New York Stock Exchange, who clung onto the traditions of open outcry trading. Instead of persisting in their attempts to motivate change in the NYSE, the modernizers created a new venue. Nasdaq was an electronic market from day one, offered issuance and trading at a lower cost, was a more transparent venue, and was easier to integrate with participant platforms.[2] As a result, Nasdaq achieved critical mass, its volumes exploded, and it became a well-regarded and competitive trading venue. The NYSE had no choice but to react.

We are at this point again, but not just with trading. The traditional models of asset issuance, asset servicing, asset sourcing, transaction management, and trade settlement are ripe for reinvention. They now have a radical, and better alternative through native digital assets. We need another new venue, but this one will deliver a whole new way of representing assets and transactions, and a completely new market infrastructure. This paper describes the smart token model for native digital assets that delivers this transformation.

The press is full of stories about blockchain, crypto, decentralized finance, bitcoin, distributed ledgers, tokens, etc. Even the quality press often confounds these constructs, and creates an undifferentiated, shapeless mass that is loosely labeled as “digital”.

[1] In creating this paper, I have had the benefit of reviews from ten senior industry players with deep experience in investments: David Axson, Keith Bear, Rich Fox, Adrian Grimshaw, Ian Hutchinson, Mark Harrison, Ben Lucas, Keith MacDonald, Atul Manek, and Jason Webb. I am grateful to all of them all for their time, their insights, and their honest critique, as a result of which the paper has been much improved, and my excesses have been curbed to some extent.

[2] It is no coincidence that Nasdaq is now building an exchange for tokenized assets.

Regulators struggle to keep up, many taking differing views on how to categorize these new and threatening phenomena. Some jurisdictions, like Singapore, actively encourage innovation; others suppress the innovators. Some cultures pile in enthusiastically, like India into crypto, while others spectate nervously. The lack of global consistency and effective regulation gives the impression of a "Wild West" where anything goes. The digital market seems immature and chaotic.

This paper sets out to demystify the digital world, to give a straightforward account of its various components, and to show the enormous potential of digital ledgers[3] and smart tokens to deliver a much better and simpler financial ecosystem.

2. THE FINANCIAL WORLD AS WE KNOW IT

2.1 What are financial services for?

If we are to discuss the transformation of an industry, then it is a good idea to have a clear understanding of what that industry does before we start.

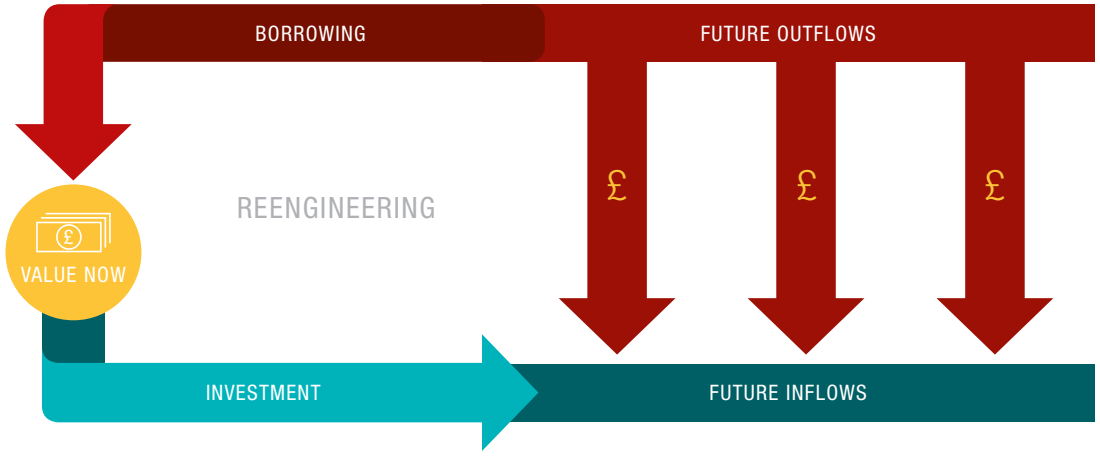
In 2021, the contribution of the financial services sector to the U.K. gross national product (GNP) was 8.3%.[4] In London, in 2020, it was 19% of economic output. There is a huge amount of activity behind this large contribution, and substantial related revenues accrue to banks, asset managers, service providers, etc. (£173.6 billion in 2021). There are also very substantial costs, driven by the extensive activity (and often wide profit margins) in the sector, which are borne by the consumers of financial services.

The range of outputs from the industry is very extensive: there are products in securities financing, collateral management, investment banking, payments, fund management, derivatives clearing, etc. The number of commercial entities is remarkable too: a small selection from our industry might include transfer agents, clearing houses, asset servicers, central counterparties, broker/dealers, asset managers, central settlement depositaries, custodians, fund accountants, market-makers, and authorized corporate directors. You could be forgiven for thinking that what we do in the finance services industry is extremely complex, requiring the most brilliant minds and the most sophisticated infrastructures. You would be wrong. Actually, the central purpose of what we do is very simple.

Financial services simply reengineer current pots of value into and out of future flows of value. And that is all that they do.

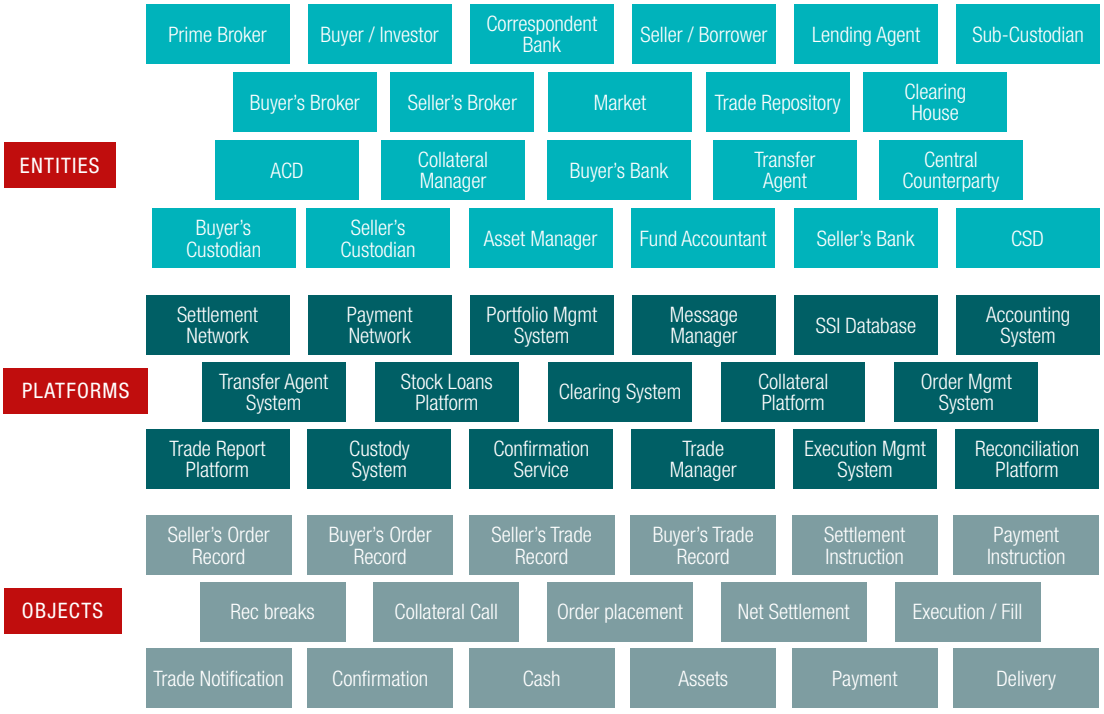
Investors are people or entities that have current value that they are willing to forego, in order to receive future flows at times when they need them more, and when (hopefully) they will be larger in total than the current value that they are prepared to give up. Borrowers are people who need current value, but do not have it, and are prepared to commit to deliver (probably larger) value flows in the future, at a time when they expect those value flows to be easier for them to deliver, in order to have value now.

Figure 1: What financial services do



[3] A digital ledger is a network of nodes, representing value, ownership, and transaction in a purely digital form. It is often implemented as a decentralized network, where data is replicated at each node.
[4] Financial Services: Contribution to the UK Economy – House of Commons Library, September 2022.

Figure 2: The entities that we have created for one asset class



It does not matter whether the borrowers are capital issuers raising finance for their businesses, or individuals taking mortgages to enable them to buy their homes. It does not matter if the investors are institutions seeking to fund future pension payments or individuals putting money aside for a rainy day. It is all about pots of value now, future flows of value, and the ability to turn one into the other.

The entities that actually matter are very explicit in this model too: there is the borrower, who commits to deliver future flows against the receipt of a current flow, and the investor, who agrees to receive future flows in consideration for the delivery of a current flow.

Every other entity only deserves its place in the ecosystem if it materially assists these primary participants to achieve their objectives more effectively and / or more efficiently.

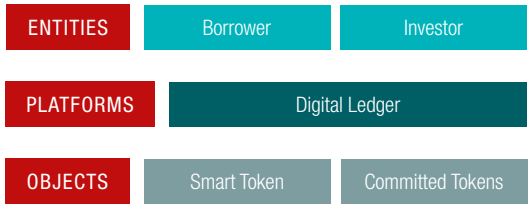
2.2 What conventional operating models look like

In the conventional world of financial services, every asset class has its own operating model, each of which involves a set of (often regulated) entities, multiple platforms, complex processes, heavy interactions, and burdensome regulations.

For example, in an equity operating model for a fund, depending on the nature of the investor and the nature of the trade, there may be well over 20 entities involved, each running their own platforms, and manipulating scores of data objects throughout the transaction lifecycle. Even a simplified picture is daunting: many capable industry professionals only ever comprehend a small part of it. If we added the processes that each entity carries out, and mapped the interactions between them, then the visualization would become too complex to be meaningful. And the really worrying fact is that there is one of these labyrinthine models for each conventional asset class. It is a mess.

By contrast, with native digital assets and smart tokens, we can build a single operating model that is strikingly simple, and requires far fewer entities, platforms, and objects. Even

Figure 3: The entities that we need in a digital ecosystem



better is that the simple operating model works for all asset classes, current and future, not just for one. In this paper, we will see how that is possible and how it is practical to achieve.

3. TOKENIZED ASSETS AND CASH

3.1 Tokenizing conventional assets

There is a lot of noise about tokenization. Multiple projects claim to create digital assets by tokenizing bonds, commercial paper, loans, and equities, as well as precious stones and real estate. They don't.

The truth is that there is nothing digital about a tokenized asset, except for the digital token itself that is the marker of ownership. Title to the asset is digital, and exists as a token on a digital ledger, but the underlying asset remains resolutely conventional. That includes its legal status, its terms and conditions, its cash flows, its operating model, the regulated entities required to manage it, the processes and interactions that those entities engage in, and the regulations that dictate what they do and how they do it.

R3,[5] in their own blog on tokenized securitization,[6] say that "Tokenization refers to converting an asset to a digital form represented by a token." Greengage similarly define tokenization as the "transformation of the rights to an asset into digital form (tokens)."[7] The obvious fact is that the words "conversion" and "transformation" imply that there is something to convert and transform in the first place: that something is a conventional asset, with all of its implications and baggage.

UBS recently issued a bond on the SIX Digital Exchange (SDX),[8] and issued the same bond in parallel on the SIX SIS, the conventional central settlement depositary (CSD) of the Swiss market. The dual listing was heralded as establishing "a migration path for the market to move from issuing traditional securities to issuing natively digital securities," and the SDX-issued security was described as a "native digital bond". It is nothing of the kind: it is just a bond whose existence is certified, and whose ownership is evidenced by a digital token, rather than by entries in the records of a CSD and a custodian. The conventional bond is collateral for the token, which has no inherent value without it.

This is not to say that tokenization is worthless, or that it is any kind of illusion. It is not, and tokenizing a conventional asset, whether or not it is a financial asset, has some demonstrable benefits. Tokens are generally easier to move around on a ledger than assets and cash in the conventional world. Tokens are easily fractionalized and traded, so ownership can be shared widely without too much pain. Having cash and assets tokenized on the same ledger enables "atomic settlement", where the payment (in cash tokens) and the benefit (in asset tokens) are locked together in the exchange: it is perfect delivery versus payment (DVP), and reduces settlement risk for both parties to a trade.

3.2 Tokenizing conventional cash

Tokenizing cash is similar to tokenizing assets: if the token is a marker of ownership of some conventional cash (or cash-like assets, such as Treasuries or Gilts) that exist outside of the ledger, then the token is just a claim, or an entitlement, to that pool of conventional cash. It is not anything like native digital cash.

Whether the token represents title to cash or title to assets, there is some conventional collateral, outside the ledger, that determines the value (and risk) of the token. This has implications for the parties and roles that have to be in place to ensure that the tokens have the value that we think they have. We need:

1. A safe-keeper of the off-ledger assets/cash. Obviously, collateralized tokens will lose value if the underlying collateral is lost, stolen, or turns out to be fictitious.

2. An issuer/redeemer of the tokens, charged with maintaining the relationship between the tokens and the collateral. The tokens will lose value if they are issued in excess, and gain value if issuance is short: the linkage between the value of the token and the value of the underlying is lost in either case. Someone needs to make sure that does not happen.

These parties are the equivalent of custodian and banking entities for assets and cash respectively. Hence, conventional intermediaries are required where tokens are backed by conventional collateral. Indeed, a recent paper from McKinsey & Co. highlighted just how many intermediaries can be required to operate collateralized tokens: they mention eight. [9]

[5] R3 are the developers of the Corda distributed ledger platform targeted on financial applications.
[6] https://tinyurl.com/38j4ec7x
[7] https://tinyurl.com/tjtmnj9y
[8] https://tinyurl.com/yck9yaj2
[9] https://tinyurl.com/hrc47shh

The truth is that tokenized assets are half-in, half-out of the digital world: they have digital ownership, but conventional underlying collateral. Their value and risk are derived from the off-ledger collateral, not from the digital part: the tokens themselves have no inherent value. Tokenized cash is the same: it takes the form of collateralized stablecoins (or tokenized deposits), which are tokens on a digital ledger, whose value is (or should be) pegged to an external currency or cash-like asset.

While they themselves are digital, the value of the tokens is generated by a pool of off-ledger, very conventional cash. The digital cash tokens are just evidence of entitlement to a scoop out of that conventional cash pool. The values of the tokens should be stabilized by the collateral, and track the collateral valuation precisely. However, this depends very much on the quality of the intermediaries, the rigor with which they perform their roles, and the market's confidence in them.

According to Deloitte, collateralized stablecoins will be accepted as a means of exchange by 75% of merchants by 2024.[10] The same is expected for their close relatives, tokenized deposits. According to the G7 finance ministers and the U.K. Government, collateralized stablecoins are going to be brought within the regulatory perimeter, and so are seen as officially respectable. PayPal clearly expect this to be the case, and have launched one: PayPal USD.

A recommendation from the All-Party Parliamentary Group Inquiry into Digital Assets and Crypto states that "the Regulators will need to insist that stablecoins are backed by high quality assets, and ideally by fiat currency, to provide trust and confidence in any new form of payment."[11] This insistence is a reaction to the collapse in value[12] of some prominent "algorithmic" stablecoins (like TerraUSD) that, rather than being collateralized by a pool of conventional cash, have their value controlled by a throttle on supply and demand. As the price rises above the reference currency, more tokens are issued to bring the price down, and vice versa as the price falls. These algorithmic stablecoins are not seen as reputable at all. This is understandable, but ironic, as the value of our familiar national currencies is controlled in more or less the same way.[13] The difference is that they are controlled by central banks, whom we supposedly trust, rather than by algorithms run by crypto firms, which we do not.

4. NATIVE DIGITAL ASSETS AND CASH

4.1 What "natively digital" means

Tokens do not have to be collateralized to have value: truly native digital assets are assets in token form on-ledger that are uncollateralized. Native digital cash similarly is cash that is not collateralized by any off-ledger conventional cash (or near-cash) assets. They both exist wholly and exclusively on the digital ledger, and their values and risks are not derived from anything outside the ledger.

Native digital cash is like conventional cash, in that it acts as a denomination of assets, as a means of exchange, and as a store of value. We are all familiar with cryptocurrencies, some of which are widely available and can act in these ways, but currently their volatility limits their usefulness. While they are widely held as a store of value (420 million people hold crypto globally)[14], their most common active use is for speculation.

Algorithmic stablecoins are another example of native digital cash, and were designed to address the problem of volatility. However, well-publicized failures have limited their popularity too. The white knight for native digital cash (subject to concerns on government surveillance and unlimited supply) is "central bank digital currency" (CBDC), which is uncollateralized, but as stable as the equivalent conventional currency.

Later, we will see what potential these assets and cash have in practice, how they behave, and what they enable us to do. They are much more interesting than their tokenized, collateralized relatives.

4.2 Why we like things to buy, sell, and hold

Laws and regulations wrap up our familiar asset types in concrete frameworks, and dictate how they are issued, owned, safekept, and traded. Each asset class has its own unique operating model (how we hold and trade them), and its own bespoke issuance model (how we create them). As a result, we have very fixed ideas about asset classes, and we see them as unique, distinct, and persistent.

The philosophy behind this is bizarre, but comfortable: we like things, and we like them to be sharp-edged. We are happy to think that, when we transact, we are buying a coherent thing. When we make a purchase, we want to have something tangible to keep, to put on our shelf, to hold in our portfolio.

[10] https://tinyurl.com/2me8fbea
[11] https://tinyurl.com/2hp6vj3n
[12] The industry term for a stablecoin losing its link to its reference currency is "unpegging".
[13] Clearly, central banks have other levers over the value of their currencies too, including interest rates.
[14] https://tinyurl.com/mv2cw3z6

When we sell, we are comfortable that we take the thing that we are selling off our shelf, and give it to the purchaser to put on theirs. We use the language of things, and talk about "delivery" from the seller to the buyer. The idea that we might be transacting without buying or selling anything coherent or tangible is very awkward. So we go along with the more comfortable allegory, and even in the context of digital assets, we cling onto the language associated with tangible, physical transaction.

There is a problem with this position: bonds, for example, are not coherent things at all. They are really no more than a fistful of promises – pledges to deliver flows of value at some points in future. The issuer commits to pay coupon at specified times and in specified amounts, and to make a redemption payment on maturity. All or any of these pledges may be fulfilled, or they may not be.

We treat bonds as if they are a single thing to own, have a single atomic value, represent a single exposure, and suffer from a single level of risk. They don't, even though it is what our systems, our laws, and our regulations tell us. Each pledge has a different probability of fulfillment, and, therefore, a different risk and a different value. The overall risk and value of a bond is a munge of these diverse pledges and their disparate probabilities. And that is before we even consider discount rates and the risk-free rate of return!

It is not just bonds that are like this. Loans are just clusters of commitments to make payments at a future date too. Swaps are commitments from two parties to make flows of value to the other party under pre-defined conditions. Options are contingent promises to deliver a flow of value to the option holder, or to accept one from the option holder. The flows of value could be, and will often be, in cash, but they may not be. For example, there are physically delivered options contracts in commodities, and equity options that deliver a flow of equities at a defined price, rather than a value delta in cash.

Any purely financial asset can be defined in terms of the flows that it commits to deliver, and is, therefore, definable as a set of contracts.[15] Each asset is just a collection of flows that the issuer has chosen to commit to, and that the recipient has chosen to receive. Hence, we can construct any conventional financial asset from flow commitments. However, looking at that the other way around, and starting from flows, rather than from conventional assets, we can clearly define whatever assets we like: the assets that we can construct are not limited to those that belong to any currently recognized asset class. We can build whatever assets are useful, and the asset class straitjacket dissolves away.

If we start from conventional assets and tokenize them, then we are stuck with our conventional assets. If we start from flow commitments, then we have the opportunity to define any asset that is useful, unconstrained by current asset classes. This presents a huge opportunity for innovation, increased asset flexibility and liquidity.

4.3 A single issuance and operating model across assets

In conventional finance, there is a separate issuance and transaction model for each asset type, along with a slew of regulated entities required to engage in issuance and to effect transactions for that asset. Law and regulation mirror and solidify the party lines between asset classes, and the volume of regulation is multiplied by the number of distinct asset classes. Systems tend to be asset class-specific too, and even where there are cross-asset platforms, their high complexity is driven by the need to accommodate the diverse practices and regulations of the different asset silos. This is both highly inefficient and costly.

We have established that the fundamental building blocks of financial assets are commitments to future flows (essentially pledges), that all purely financial assets are just clusters of pledges, and that the pledges allow us to dissolve the boundaries between asset classes.

This presents us with an outstanding opportunity: we can have a single issuance and operating model across all financial assets.

This fact has the most powerful possible consequences. Systems can be less complex and less disparate, as they only have to handle one operating model. Regulations can be simpler and less extensive, as what they are governing is simpler and less diverse. New flow commitments, and, therefore, new asset types can be created more quickly, more cheaply, and with lower risk: by definition, we will not need to develop new system capabilities to handle new flows, as they will be issued in accordance with the same issuance model, and processed in accordance with the same operating model, as all other flows. As asset classes are just clusters of standard flow commitments, the new classes can be defined and implemented without the need for system change.

[15] https://tinyurl.com/2p9mnyxe

Initiatives to date in digital finance have focused predominantly on the creation of isolated ledgers, supporting individual asset classes or products. This has created disparity and complexity, which, in turn, has led to an increasing clamor for inter-operation between ledgers. Recently, there have been some very constructive discussions on the potential for a "unified" or "universal ledger".[16] In particular, this has been seen as enabling a digital infrastructure for global payments: a "regulated liability network".[17]

The combination of a single operating model across all financial assets, with a universal ledger enabling global trading, is the most powerful possible objective: if it is practical and achievable, then it is an objective that we should pursue with all possible energy. This paper sets out to show that it is an eminently attainable goal, if we exploit to the full the potential of digitalization.

4.4 What is in and what is out

The potential attainment of a single operating model depends on the single issuance model for all financial assets: as clusters of future flow commitments. There is a lot of good news and there is some bad news here. Fixed income instruments and derivatives, equity derivatives, and structured products are all representable as clusters of flow commitments. Real estate, commodities, fine art, and jewelry are clearly not. Real estate may generate income, which can be represented as a set of flow commitments. However, the asset itself remains resolutely physical (unless it is in the Metaverse!). It can be tokenized, but the collateral stays physical, and exists distinctly outside of the digital ledger.

The holder of a bond (or a loan, or an option, or commercial paper, or a structured product, etc.) has a continuing relationship with the issuer that determines the risk of the asset, and, therefore, strongly drives its value. That relationship is one of pledge. The issuer makes the commitment to deliver flows of value to the holder; the value and risk are driven by the solidity of the issuer, and by the triggers, conditions, and timing of the flow.

Surprisingly, an equity is more like a piece of real estate, or a Picasso, than it is like a bond. An equity holding delivers a share of ownership in, and rights over, a company, and the company is not a digital entity. It is not exactly physical either, although it may have physical assets, but it is definitively not digital. The only ongoing commitment from the issuer of an equity to its owner is to pay dividends, at a loosely defined frequency, and in an amount specified by the dividend declarations of the company (which may be zero).

Beyond a flow of dividends (shareholder perks and voting rights notwithstanding), there is no continuing pledge relationship between an equity holder and its issuer. The main investment reason for holding an equity is the expectation of value growth. In reality, this is a hope, rather than an expectation. It is a hope of a future flow with an unknown probability, of an unknown magnitude, from an unknown party, at an unknown point in time. With an equity, no one promises you anything in respect of value realization: it is not a purely financial asset as a result.

Despite their very different and entity-heavy operating models, funds are often categorized as equities, but this is misleading. Their attributes as financial instruments result in conventional, principal-traded mutual funds being much more like bonds than like equities. Their values float with the value of the underlying assets (diluted by costs, profit margin, and liabilities), and (depending on the fund structure) the investor may own a slice of the assets. However, with a principal-traded fund, there is always a continuing relationship between the issuer and the holder. The issuer pledges redemption at whatever the fund price is at the time that the holder redeems, and it is the issuer that delivers that value flow. Sometimes, an income flow is pledged as well, and again it is the issuer that delivers the flow. Hence, a conventional, principal-traded fund can be viewed as a purely financial asset.

Additionally, and usefully, some other elements of financial services that we do not think of as assets can also be managed within the single issuance and operating model.

An order is just two pledged flows, back-to-back between two parties. Execution is just the delivery of those flows. An indication of interest in the market is just a pledge that an issuer would like to make, but has not made yet, and would like potential recipients to know about. Outside orders and trading, a corporate action is just a set of committed flows, contingent or otherwise, from the issuer of an asset. Income is a straightforward commitment made by the issuer to the recipient. No one needs to calculate entitlements – the commitments themselves evidence entitlement. Asset servicing, liquidity discovery, and order management are delivered by the same operating model as trading and settlement.

[16] https://tinyurl.com/mr4d335y. There is no implication that the universal or unified ledger is a single physical network.
[17] https://tinyurl.com/4b9n3xp2

4.5 A reprise on things

It is clear that there are some things that are physical, and that we can buy and put on our shelf. We have already discussed jewelry and fine art as examples that are definitely not digital. There are other things that we can buy, but that are immobile, like houses and office blocks: they are definitely physical things, but they do not come to us – we go to them. Then there are off-ledger things that are not physical, but are definitely not digital either, like companies, clubs, and governments. All of these things can be tokenized, to bring their ownership, or title, onto a digital ledger, but they cannot themselves be digitized: they are not purely financial entities.

Purely financial assets (and other financial elements), which comprise nothing but clusters of promises, are not coherent things at all, and we only confuse matters by trying to treat them or represent them as atomic entities. The fact that it is convenient from the perspective of property law and regulation is not a good enough reason to deform the representation of financial assets. We should represent them exactly as they are: as sets of commitments to future value flows. In this form, they can be represented on-ledger as wholly digital entities – in token form. These are native digital assets.

An immediately obvious advantage of a native digital asset is that it does not require the same intermediation as a tokenized conventional asset. It does not need a safe-keeper for the off-ledger reference asset, because there isn't one; and it does not need an intermediary to control issuance and redemption of tokens, because every participant can issue and burn their own.

"Things", and tokenization, are a last refuge, where a fully digital entity cannot be created. Wherever an asset can be created in a natively digital form, we should create it in that form – it is much, much more useful.

5. THE SMART TOKEN MODEL FOR NATIVE DIGITAL ASSETS

5.1 A fully digital ecosystem

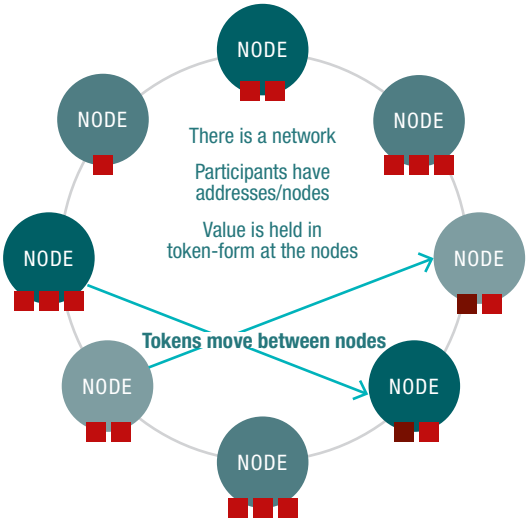
From the reasoning above, we can see what an appropriate representation of assets and transactions looks like: it is a model that closely reflects the true nature of assets, and of the flows that they commit. The transactions are the flows committed, or they are flows in the asset itself. But how would we implement that model in a purely digital ecosystem for financial services?

In a wholly digital financial ecosystem, all representations of value are in token form on a digital ledger. Tokenized assets and tokenized cash do exist on the ledger, but they are not the headline acts. Alongside the tokenized, collateralized forms of value, there are native digital assets and native digital cash, which are also tokens, but are wholly self-contained: they do not depend on anything external to the digital ledger to give them value or to determine their risk.

We have already seen that, wherever a native digital asset can be created, we should create it, rather than just tokenizing title to an off-ledger conventional asset. However, where an asset is physical or necessarily non-digital, like a building or an organization, then we should tokenize it in a collateralized form, to at least bring its ownership within the digital ecosystem. Hence, our purely digital ecosystem contains both collateralized tokens and uncollateralized, native tokens.

Every pot of value in a digital financial ecosystem takes the form of a set of tokens at an address (or "node", or "wallet") on the ledger. Every transaction is just a flow of tokens from one address to another address on the ledger.

Figure 4: Not much happening in a purely digital ecosystem



Early on in this paper, we established that the only real purpose of financial services is to reengineer pots of current value into and out of future flows of value. We have now seen that it is appropriate to represent purely financial assets as commitments to future flows of value, and to represent pots of value as addresses on the ledger where current value is held.

Both can be wholly digitized. In doing this, we have created a model that is not just true to the nature of financial assets, but also directly reflects the two objective deliverables of financial services: current value and future flows. The fit is remarkably close.

It does not matter what the tokens are that are held at a ledger address, or that flow between addresses: they can be tokenized conventional assets or cash or they can be native digital assets or native digital cash. Many trades will comprise a flow of asset tokens one way and cash tokens the other, in a conventional "cash for asset" transaction – but they do not have to be. Asset against asset trades, cash against cash trades, and free deliveries of assets or cash are all easy to represent in the fully digital world.

In this context, the nature of native digital cash is clear: it is a means of exchange and a store of value that is recognized and accepted within the ecosystem as such, and which has whatever value the participants in the ecosystem give it. We are familiar with true cryptocurrencies in this context.[18] There is no pool of conventional cash behind Litecoin or Bitcoin. More interestingly, central bank digital currency (CBDC) is also native digital cash, and is clearly coming down the track at us. There is no pool of collateral behind it.

The existence of CBDC, alongside regulated, collateralized stablecoins/tokenized deposits, will increase the frequency of digital trading (i.e., trades that are digital asset versus digital cash) by orders of magnitude. CBDC will be more acceptable as a means of exchange, as a store of value, and as a unit of account, because we will trust it for the same reason that we trust conventional cash.[19] CBDC is just a form of cash, and is managed and stabilized by a central bank: we have no more or less reason to trust it less than any other form of fiat currency. Stablecoins and tokenized deposits, similarly, if they are genuinely 100% collateralized, their underlying assets are safe-kept, and their issuance is controlled 1-to-1 with the collateral pool, are deserving of our trust as a means of exchange.

True cryptocurrencies are native digital cash too; however, being backed neither by collateral nor by a central bank, they are less likely to be trusted for widespread transactions. As we have already seen, their use is primarily, but not exclusively, for speculative investment, and seems likely to remain so. Other cryptos, known as "utility coins", have value only in a specific blockchain, and are useful exclusively in that context. They are forms of digital cash too, but not really relevant here. As they are "currencies" only within their own local ecosystems, they are like chips in a casino.

In a purely digital ecosystem, native digital assets can only be one of two things. The first is a non-cash asset that is purely digital and has whatever value the participants in the ecosystem give it. Good examples are "non-fungible tokens" (NFTs) that are purely digital artefacts and do not represent title to an off-ledger asset. Damian Hirst's notable collection of art "The Currency" originally comprised physical and digital artwork (i.e., NFTs) in parallel. After a year, the owners had to make a decision between the physical work and the NFT, and destroy the other. As a result, there are 4,851 Damien Hirst NFTs out there that are uncollateralized (or at least, not by physical artworks).

There is legitimate interest in NFTs and no particular reason why digital-only artefacts should not have value. However, uncollateralized NFTs are not going to transform the financial services world. The other form of native digital assets, which are tokens representing commitments to future flows, can, and will, change the world. These allow us to represent any purely financial asset as a collection of tokens. That is not just the financial assets that we are used to, and exist within current asset classes, but any financial asset the we find useful to hold or to trade now or in future. And this type of native digital asset also unlocks the door to a single issuance and operating model across all assets (and income, and corporate actions, and orders, and executions, and indications of interest, etc.).

Big step number one is to embrace what native digital assets really are – they represent entitlements to future flows of tokens, not rights to conventional assets.

5.2 What kinds of tokens do we need?

Summarizing the points above, it is clear that we need four kinds of tokens in our purely digital world. These reflect two fundamental dimensions: the dichotomy between tokens that are collateralized by off-ledger assets and those that are not; and the dichotomy between tokens that represent cash and those that represent assets. This quadrant, with examples, is presented in Figure 5.

[18] "True" implies that they are currencies that can be used for transaction generally, rather than just within a local blockchain environment. Hence, their ecosystem is widespread.

[19] There are concerns over the fact that CDBC is programmable, which could facilitate government control and surveillance. These concerns are genuine, but are beyond the scope of this paper.

Figure 5: The tokens that live in a purely digital ecosystem

	COLLATERALIZED	UNCOLLATERALIZED
CASH	**Tokenized cash** Stablecoins – cash-backed Stablecoins – near-cash-backed	**Native digital cash** True cryptocurrencies Central bank digital currencies
ASSETS	**Tokenized assets** NFTs – title to off-ledger assets Tokenized conventional assets	**Native digital assets** NFTs – native on-ledger Commitments to future flows

5.3 Making native digital assets smart

It is embedded in our mindset about technology that intelligence and capability lie in business systems. The functions, products, processes, and operations of each business are coded into their business systems, in all their complexity and variety. The business system does what it does, enforces workflow, makes computations happen, and pushes dumb data and messages around like a croupier raking chips on a casino table.

This idea is so embedded that we take it wholly for granted, and it is seldom, if ever questioned. Even modern platform developments, including distributed ledger platforms, follow the same pattern: they support "smart contracts" that self-execute on the ledger, but that are wrapped up in apps that sit at defined locations, and push dumb tokens around on the ledger. The tokens are generally assumed to represent a quantity of some conventional asset, and by implication are collateralized. The tokens themselves may be programmable, and carry their own rules, but being based on conventional assets, they can only deliver tweaks on existing operating models, not anything radically new.

The world changes significantly if we take the intelligence and power away from the immobile business systems, and put them instead on the tokens: we make them intelligent and potent. This may make it sound as if the smart token is a very complex entity, encapsulating the entire range of functions of a business system. But it is not. By definition, on the digital ledger there are only two things taking place: the holding of tokens at addresses, representing stores of value, and the movement of tokens between addresses, representing transfers of value. Nothing else is happening.

It follows that the only thing that a smart, potent token can possibly do is to move tokens between addresses on the ledger: this may be moving itself, or it may be moving other tokens in fulfillment of the commitment that the smart token represents. Flow commitments by smart tokens are just active contractual liabilities: they are IOUs with the power to make the committed transfers actually happen. We will call the other tokens that the pledge on a smart token commits to transfer "committed tokens". Committed tokens can be any of the four kinds of tokens that populate the ledger.

The smart token is a token, and, therefore, lives at an address on the ledger: that address is the address of the recipient. Hence, the beneficiary of the future flow holds the token that pledges the flow, just like holding an IOU. The difference between a smart token and an IOU is that the smart token is capable of making the committed flow of value happen, without intervention from the issuer or the recipient. Once the committed flow has been made to happen by the smart token, then the smart token itself, just like an IOU, can be returned to its issuer; it can then be torn up or used again at the discretion of the issuer. The difference between a smart token and a conventional IOU is that the smart token can send itself back.

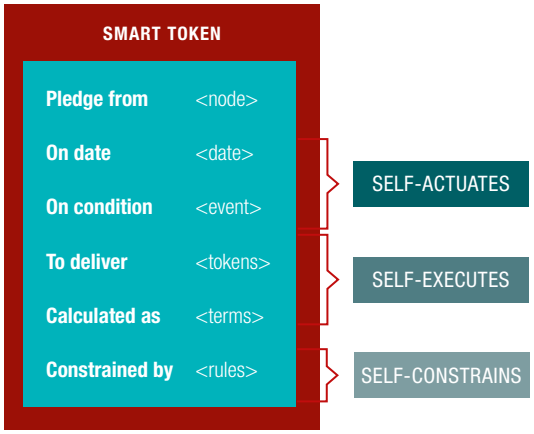
The smart token, as a token like any other, can be traded by the recipient, and can be fractionalized; so, the recipient has complete discretion over how much of it is traded on. The identity of the issuer is unchanged by the trade, and the issuer's aggregate commitment is unchanged by either fractionalization or by on-trading of the token.

If an issuer wants to issue, or a recipient wants to issue or trade a recognizable asset, like a bond or a loan, then they will pull together the tokens that represent that asset, and issue or trade them as a cluster. However, they do not have to: each token within a cluster can be traded individually,[20] as fractions, as part of the original cluster, or clustered with other tokens outside the original cluster. Hence, the resemblance to a conventional asset does not necessarily persist after its initial issuance, and the market is an order of magnitude more flexible as a result.

Each smart token only needs to have a basic set of conditions encoded to enable it to self-actuate and self-execute. It needs to know who the issuer is, what kind of tokens they have committed to deliver, how many of the tokens they have committed, when it needs to happen, and what constraints

[20] Like trading an individual future coupon with a conventional bond.

Figure 6: Smart tokens are surprisingly simple things



(if any) apply to the transfer. It can then do its job, kick itself into life, work out the terms of the commitment, and move the tokens. It does not need to know where to move the tokens to because, like an IOU, the token will always be held at the recipient's address.

When we make native digital asset tokens smart and potent, exciting things happen. Entitlements are not just represented in a self-maintaining form; they are implemented 100% automatically. Transactions happen when intended, in the agreed asset, in the quantity intended, and between the contracting parties, but without intervention or management from either party. The parties have already signaled their agreement to this: the issuer by issuing the token, and the recipient by accepting it. Settlement management, order management, and execution management dissolve away as a result. Asset servicing is shredded.

Every smart token is both an asset (to the recipient) and a liability (to the issuer). It can be thought of as a self-executing contractual liability, which is held as an asset by its beneficiary. As a result, asset and liability management can be much more precise, and both sides are naturally represented on the same ledger. Liability matching ceases to be an approximation of cash flows, implemented roughly in bonds and tuned with complex derivatives. Pension, insurance, and endowment managers do not need an asset platform, a liability platform, and an LDI platform to bridge the two.

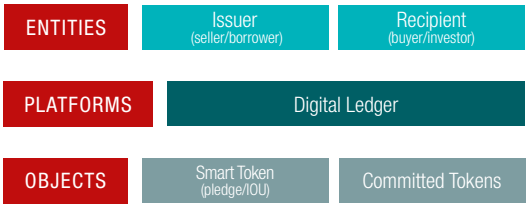
Big step number two is to realize that native digital asset tokens should be smart, potent, and capable of implementing the commitments that they represent.

5.4 What the single digital operating model looks like

When we create and work with tokens that are smart and potent, we can implement not just the single operating model that native digital assets facilitate, but we can also implement a model with self-execution at its core.

The only entities that we need in the smart token operating model for native digital assets are the issuer and the recipient of the tokens. The platform is provided by the digital ledger. The only objects required are the smart tokens themselves, and the tokens that they pledge to deliver. The difference from a conventional model for one asset class is stark and extreme.

Figure 7: Entities in the digital operating model



The processes required in the operating model are very limited too: six, if the smart token is issued as part of the transaction, and five if the token has already been issued and is just being traded.

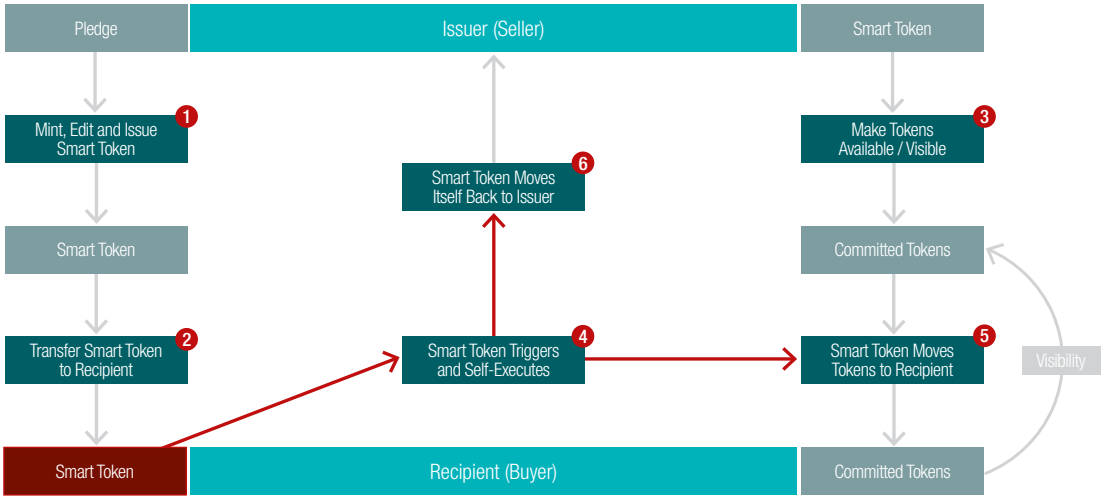
The steps are:

1. The issuance of the smart token (if the smart token is newly minted, rather than being sold on by a previous recipient).
2. The transfer of the smart token to its new recipient.
3. The earmarking of the committed tokens by the issuer, making them visible to the recipient.
4. The self-initiation of the smart token and the computation of its terms.
5. The transfer of the committed tokens from the issuer to the recipient.
6. The transfer of the smart token back to the issuer.

That is all.

Any financial asset that we issue or trade, and any derivative that we wish to represent, can be transacted by one or more instances of the same operating model. The model is largely self-executing, based on the capabilities of the smart tokens.

Figure 8: Not much happening in the smart token operating model



The extent of automation and simplification achieved is remarkable, and the consequences are orders of magnitude reductions in cost, operational risk, and regulation.

5.5 Rolling back the tide of regulation

The extent of regulation in any ecosystem is a function of the number of operating models in the ecosystem, and the number of entities, platforms, processes, and interactions required in each operating model. On top of this, we can add the sum total of the risks that these (and the infrastructure) pose to the participants, which is a function of the complexity of the system itself. In the conventional financial world, there are large numbers of each of these, and that results in a very large body of regulation. In the smart token ecosystem, there is one operating model, which is dead simple; there is only a handful of entity types, processes, and interactions, and one platform. Regulators only need to regulate what is there, and as a result, regulation shrinks from an encyclopedia to a pamphlet. It can also become much more focused and much more effective.

Some regulators and legislators argue (and flip-flop) about the classification of digital assets, desperately trying to tame the beast by locking it up in a familiar box: is crypto a currency, a security, a commodity, a digital property? A recent court ruling in the SEC's case against Coinbase and Binance has created further confusion, implying that a cryptocurrency is a security if it is sold with a contract to institutional buyers, but it is a commodity when it is traded on exchanges.[21] Others want to treat digital assets (and crypto) as a new asset class, in need of new entities, processes, controls, and regulations.[22] This is wholly wrong-headed: the opportunity presented by digitalization is to achieve a radical simplification, not an extension of complexity.

When we implement the smart token model, we will roll back the tide of complexity in regulation.

5.6 Smart tokens in funds, insurance, and pensions

Funds apparently offer choice to investors, because the choice of assets and strategies is extensive. However, in practice, their product is almost invariably the same: the value delta (net of liabilities, costs, and profit margins) between subscription and redemption by the investor. And conventional funds kick all of the risk over the fence from the fund to the investor.

If funds start to issue smart tokens instead of shares and units, then they can commit any flow that the fund can support on an asset/liability basis. Product choice and personalization become a reality, not through complex product structures, but as a direct and simple consequence of the model. If they are sufficiently capitalized, and have the appetite for risk, then funds and fund managers can use their own balance sheets to create products that their clients want. The allocation of risk and reward between the ultimate owners and users of capital can be tuned to meet their objectives and appetites, and the

[21] https://tinyurl.com/yemn9cxk
[22] https://tinyurl.com/5bjt4x3a

boundaries between the buy-side and sell-side, and between asset managers and banks can erode.

There is no need for rigid definitions of fund types – one structure suffices for all. Funds become outcome-focused, rather than just delivering whatever returns their underlying assets happen to generate. Every fund is both principal-traded and market-traded, and every fund product can be either open-ended or closed-ended within the same fund. If we apply the smart token model to funds, then every level in the fund value chain – from underlying asset management, through the fund entity, up to platforms and distributors, and into IFAs and their clients – operates under exactly the same operating model. The same relationship of outcome commitment exists at all levels.

Platforms can pass through the outcomes committed by their funds, or they can take a more active distribution role and reengineer them to create their own products to suit their clients' needs. With funds based on smart tokens, conventional collective investments, insurance, pensions, and endowments are all just different outcomes, delivered from the same structure and under the same operating model. The only difference between them are the pledges on the smart tokens held by their investors. If the pledge is a stable or inflation-adjusted flow, then it is a pension. If the flow is triggered by a loss event, then it is insurance. If the pledge is the value delta between investment and redemption, then it is a conventional collective investment.

5.7 What is left for business systems to do?

Growth in the scale and complexity of business systems has been inexorable, and seems inevitable. As further areas of business activity are automated, as workflows are mechanized, and as the scope of decision support and artificial intelligence spreads, so system platforms expand. The story has echoes of the universe itself, and of regulation – an ever-expanding cloud of complexity.

The smart token model transfers the work of end-to-end trade management from the business system to the tokens themselves. The tokens also take on all of the work of entitlements and asset servicing. Hence, business systems in finance lose some of their most central functions. However, the impact of a fully digital ecosystem, including smart tokens, is even much more profound than that: business systems in finance will become much smaller and much less diverse.

The root of this is the simplicity of the digital environment itself. To ensure the secure operation of the ledger as a whole, service providers will be required (among other roles) to run infrastructure, to validate digital identities, to verify that issuers can meet their committed flows, and to facilitate liquidity. However, the core entities are just the issuers and the recipients of tokens. And each participant can be both an issuer of some tokens and a recipient of others, so the core functions required to support each participant, and each address on the ledger, are the same. These are the services that center around the creation, issuance, receipt, holding, and trading of tokens. They are the services that the smart tokens cannot do for themselves: actions that require the participants to make decisions and to take responsibility.

It is a basic requirement that the owner of an address should be able to receive tokens at their address, to hold them securely, to have visibility of them at all times, and to appraise their risks and their values. They also need to aggregate these values and risks to achieve an overall view of their invested position and future inflows. However, the recipient must not be able to edit the received tokens in any way: like an IOU, the holder cannot arbitrarily change the commitment of the issuer.

The participant needs to be able to mint, edit, and issue their own smart tokens, and send them to their recipients. Those tokens may be on-traded by the recipients, and so may end up spread around the network.

Consequently, participants must be able to see all smart tokens that identify them as the issuer, wherever the tokens are, in order to verify that their aggregate commitment is what they know they have issued. This is a basic check on counterfeit or corrupted tokens.

Inevitably there is risk in coding and errors can be made: the ability to verify and audit smart tokens is critical and new systems of dispute resolution and redress will be needed. However, disputes will be much simpler to resolve: what a smart token did and why, along with liability and obligation, will be much clearer.

Tokens can be fractionalized and traded. Each participant needs the ability to trade-on the tokens that they hold, as a single token, in fractions, or in clusters, entirely at their discretion. Their business platform will support this process. The clusters do not need to reflect the shape in which they received the tokens, so they could buy a cluster representing a bond, but then sell a cluster in a wholly different shape, depending on market appetite for the tokens.

Both issuers and recipients of tokens need to identify the demand across the network for the tokens that they hold or that they may choose to issue. Issuers will invite trading by advertising flow pledges that they would like to make, exposing unissued pledges as "indications of interest"; similarly, recipients will expose the tokens that they are prepared to on-trade, so that they are visible to potential new recipients. Both parties need the capability to search the network for demand that matches their own trading objectives, to create order pledges from the matching tokens, and to issue those pledges.

Participant nodes hold only inbound tokens, but all participants can be both recipients and issuers. Many participants will, therefore, have issued tokens committing future flows, and these will be in circulation on the network. It is fundamental to the governance of the native digital asset model that the issuers of tokens should be capable of meeting the flow commitments that they have made (or have provision for alternative liquidity). There is, therefore, an asset/liability management responsibility on all issuers, and their platform will support this.

All business systems, for all participants, are of this form. Hence, in the digital ecosystem, we achieve a radical simplification, a material convergence, and a reduction in complexity for business systems. This is as beneficial as it is unusual.

When we implement the smart token model, we will roll back the complexity of business systems.

5.8 Who benefits and who loses from smart tokens?

Early initiatives in blockchain suffered from a tendency to bite the hand that fed them, threatening the business models of their own sponsors: generally, banks and custodians. The industry reaction has been to move to narrower use-cases, seeking tactical improvements within existing operating models. This has been more successful in its own terms, but will never change the world in any meaningful way.

The smart token model for native digital assets is the opposite. It is how it is, because it delivers a simple and efficient view of investment entities and market infrastructure. It is not a construct targeted at the elimination of specific existing entities in the financial ecosystem nor at disintermediation in general. It offers no tactical improvements to current operations. Inevitably, because it is so simple, there are fewer entities required to make it work, and its fundamental entities are just twofold: the issuer (i.e., the borrower) and the recipient (i.e., the investor/asset owner).

Most current roles just do not exist in the smart token operating model, but for new entrants or for existing businesses that reinvent themselves, there is much space to deliver services that enhance the operation of the ledger. This may be by operating market infrastructure, by running smart markets, by adding liquidity, by underwriting settlement, or by optimizing net flows, etc. The dramatic increase in efficiency offered by the model will lead to a broadening in participation and a growth in volume of financial markets. For those prepared to evolve their business models, there is a new and larger world of opportunity.

The losers are easy to identify. They will be the existing players who seek to obstruct change and to protect their current revenue flows, rather than working out what value they can add in a wholly different ecosystem.

The model is not just for business entities and institutions either. Anyone can be an issuer and/or a recipient, whether they are an individual, an institution, a club, or a business. They can all benefit from the move to outcome-focused products, from the democratization of investment, from low-cost granular trading, from improved liability matching, and from the rollback of complexity in systems and regulation. There is something in this for everyone.

5.9 The first step – we should create a native digital asset venue

Someone, somewhere, will be the first to do this.

Before jets swept aside piston-engined airliners, we spent fifty years incrementally improving the piston engine, adding more and more accessories and complexity to squeeze more performance out of an increasingly obsolete machine. When the jet engine was conceived, it was developed in parallel, while piston airliners continued to fly. No-one seriously tried to reengineer piston-engined airplanes into jets. Jets were much simpler, much quicker and more reliable, and new models were built from scratch to optimize the potential of the new power source. Once they became available, jets rapidly attracted the market away from piston-driven models. Piston-engined airliners are now seen for what they were – overly complex, under-performing, and now obsolete museum pieces.

The current model of financial assets and trades, and the infrastructure that supports it, has been incrementally improved over many years. It is now more performant than ever, but it is also bloated, complex, and expensive. It labors under a crushing weight of regulation, brought about by its own labyrinthine complexity and fragility. The idea that we can somehow migrate, in a controlled fashion, from this miasma into the clear air of a future state, is naïve. Vested interests will obstruct it, and the inertia of regulation and legislation will stifle it. It is a fool's errand, and we will all be dead before it happens.

What we need to do is to create something better, alongside and separate from the current model, and let it grow naturally. We can let the existing ecosystem wither over time: it will end up a museum piece too.

We need the creation of a new venue, in an ambitious and sympathetic jurisdiction. It will be a venue where native digital assets can be issued in smart token form, and where trades can be managed across assets through the common operating model. It will be quicker and cheaper to issue, quicker and cheaper to transact, and much quicker and cheaper to create new products and asset types. Transparency will grow; and while regulation will shrink, it will become more effective.

Such a venue can be created, if necessary, with a focus on a single asset class, and within a regulatory sandbox, if it has to be. But if it works for loans, it will work for swaps; if it works for options, it will work for bonds; if it works for collateral, it will work for corporate actions. Hence, the initial target is essentially irrelevant. It may grow from current token exchanges, like SDX or Archax, or it may be built by a new and innovative developer. Its creation requires just a jurisdiction that wants to facilitate change, a credible infrastructure provider, an initial issuer (so a sell-side participant), and an initial recipient (so a willing buy-side).

Liquidity cannot be created at a stroke, but like Nasdaq, the advantages of the new venue would attract issuance and trading volumes. Ultimately it would achieve critical mass, and become self-sustaining. At that point, again like Nasdaq, growth in the new model could become explosive, and other jurisdictions would have no choice but to react.

So, we have been there before. The difference is that smart tokens and native digital assets are more radical than Nasdaq, imply more fundamental change, and have deeper and more widespread benefits.

One jurisdiction will do it; the rest will follow.

Image generated by Adobe Firefly

6. CONCLUSION

The great thing about a purely digital ecosystem is that not much is going on: value is held at addresses on the digital ledger in token form. And value moves between the addresses on-ledger as flows of tokens. That is all; nothing else is happening. As a result of this radical simplicity, we can build operations and issuance models that are similarly and strikingly uncluttered.

If we start from commitments to future flows as the main form of native digital assets, then we can have a single, simple issuance model, and a single, simple operating model across all assets. We can represent familiar asset types, but we can also represent anything else that is useful to investors and to borrowers, to capital issuers and to asset owners. The hard boundaries between asset classes melt away.

When we make the tokens smart and potent, then the single operating model becomes self-executing. Settlement management, asset servicing, position management, and payments all cease to be activities that we need to resource and manage. We do not need registry or entitlement calculations either. The model accommodates assets and liabilities completely even-handedly; there is no need for separate asset and liability platforms.

New products and new asset types can be built just by coding new smart tokens. The same operating model (and, therefore, the same tech) will support whatever is issued, so change becomes very quick, very cheap, and very low risk. In the conventional world, introducing a new asset class takes years; with smart tokens, it can be done in less than a day.

The apparently inevitable growth in the scale and complexity of business systems and regulations can be rolled back. This is not a nirvana for reactionary players railing against regulation and automation: both can be more effective and more comprehensive because their context is much simpler, and their focus can be commensurately sharper. Better, more comprehensible regulation and smaller, more manageable applications will follow.

The impact on cost and time in the industry is profound. The traditional cost models for investment funds, insurance funds, pension funds, and other financial products are transformed and aligned. The costs of issuance, transaction, technology, regulation, and compliance come down by a quantum, with multiple cost-drivers eliminated altogether. Latency and friction are eradicated, while transparency and product choice are enhanced.

Digitalization is not about doing what we do now, but with slightly better technology. It is an opportunity to do something very different, which is much simpler, much cheaper, and much better. The smart token model shows us the way to take that opportunity and to yield its benefits to the full.

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