# Enterprise Digital Assets

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# Foreword by
## Antony Welfare

We are delighted to work with the UCL Centre for Blockchain Technologies on this groundbreaking report on the world of enterprise digital assets. Distributed Ledger and Blockchain Technology's power is becoming critical to enterprises, governments, and citizens.

Back in 2019, I worked with the UCL CBT team on my book "Commercializing Blockchain: Strategic Applications in the Real World", where we gave examples of the rise of DLT technology and its "coming of age" for business and citizens. We are now in 2022, and that realisation is becoming more cemented in reality, with many real world applications now in many enterprises globally. This report will help you understand the current state of digital assets in an enterprise context and help you explore what these assets can provide for your enterprise and how they can improve your future success.

You will hear lots of references to "tokens" and "tokenisation", which is, of course, the representation of a digital asset - we all know the original blockchain token of Bitcoin, which has taken several years to grow, adapt and has now become an important part of private, corporate and government financial systems.
We are in a world where you can literally "tokenise anything" from commodities to financial assets, real estate, wine, cars, art, and many more... dare I mention NFT's? We are even exploring tokenising "time" and tokenising "expertise."

The enterprises' adoption of digital assets will grow significantly over the next few years and will open opportunities for all enterprises, governments, and citizens to become more efficient, flexible and profitable. Once you tokenise an asset, it becomes more agile and you can do a lot with it efficiently and quickly, like lending it, collateralising it, sending it, confirming it, etc. 24/7/365.

For further information and support on how you can benefit from digital assets in your enterprise, please do not hesitate to contact us.

**Antony Welfare**
**European CBDC Lead and Global Partnerships**
**Author, Commercializing Blockchain**

# Preface by
# UCL CBT

A report on Enterprise Digital Assets must start somewhere, and the best place to start is with the original digital asset - Bitcoin and its fellow cryptocurrencies. At the height of ICO Mania (Initial Coin Offering - where thousands of new tokens were launched) in 2017 and 2018, many new token business models emerged. They were often novel business ideas, and at the same time, appeared strange and esoteric. Who could have imagined that these token business models could disrupt, gain mass adoption and ever be adopted by the enterprise in the future?

Fast-forward to today, in as little as four years, we see Bitcoin breaking unimaginable new heights, with its fiat denominated price, and blockchain technology being considered as a core technology for the future of money. If central banks are considering using blockchain for Central Bank Digital Currencies – shouldn't enterprises think about this?

Blockchain is maturing as a technology. There is a renewed interest in tokens, token business models and blockchain. This time, this comes from institutional and corporate players, as their understanding of the technology and its impact improves. Greater regulatory clarity also paves the way for lower-risk adoption in the future.

This report's motivation is to explore the use cases that are currently relevant and will develop for institutions and corporations when using blockchain technologies. This report explores what digital assets are and how they could be used in the corporate environment in financial and non-financial use cases.

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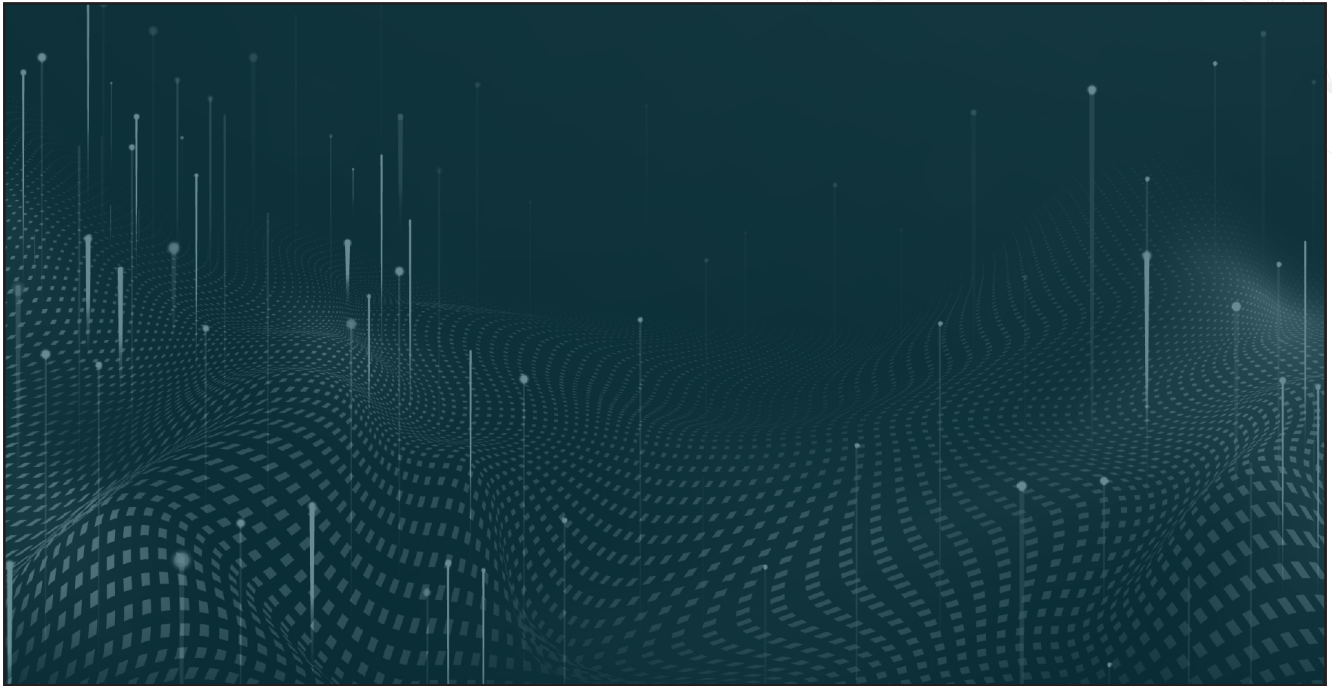
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**Following blockchains for their participation**

# Executive Summary

Blockchain as a foundational technology is creating disruptive innovation beyond the Internet in almost all areas of our business life and our society. Some have defined the new paradigm in creation as the "Internet of Value." The Internet's major limitation is that only information exchange has been fully possible, with workarounds for other functionalities. Blockchain is solving this problem and finally opening up the Internet of Value era, in which people and businesses can exchange not only information but also financial value.

We have written a book titled "The Internet of Value," which contains a collection of articles from the UCL CBT Research and Industry Associate Community on how Blockchain and DLT are enabling the new Internet of Value, including contributions from our partner, Ripple, who have also posted some insight into the Internet of Value in their paper "The Internet of Value: What It Means and How It Benefits Everyone."

The Internet was developed to create disruptive innovation with ambitious values such as decentralisation, individual's data sovereignty, and democratic governance. However, it ultimately resulted in becoming a complementary technology for improving communication and data transmission methods without fundamental change. In this context, blockchain establishes itself as a foundational technology that realises the dream of the original disruptive innovation that the Internet could not achieve. Blockchain's disruptive innovations in logistics, healthcare, finance, and government are fully proving this potential.

What are the core competencies that organisations, governments, and international organisations must have to realise such a blockchain-based disruptive innovation? This report suggests the answer can be found in utilising tokens or digital assets issued on blockchain technology.

A digital asset can be defined as any representation of information tracked on a blockchain that confers ownership, access rights, representation, voting rights or utility. Typically, digital assets are referred to as tokens, which are broken down into payment (digital currencies), utility (including governance and access) and security tokens (including equity, debt and other financial assets). In the context of the enterprise setting, digital asset use cases can relate to tracking of information assets, utilising tokens for payments as stablecoins and transactionally (internally), accessing products and services, paying for them, raising financing, and the tokenised representation of assets.

Tokens can be defined slightly differently depending on the individual's point of view and according to different regulations. In this report, our aim is not to present a new perspective on this but to bring awareness back to token business models, many of which fell by the wayside post the ICO boom. As opposed to the first peak in the hype with blockchain, adoption has currently become much wider, regulation has become clearer (although still not as clear as some would like), and institutions from all industries are beginning to see the true utility that blockchain and digital assets will bring to bear. For this reason, this report is written in a more pragmatic style to help inform the reader about the various use cases, broken down into non-financial and financial areas with examples of projects that are active in the market.

**Some of the use cases presented here include how:**

- The tokenisation of intellectual property will enable split ownership of items, whether these items be unique digital assets or collectibles.

- Tokens in the realm of licensing can enable usage of software cross-domain between the two-dimensional and three-dimensional versions of the Internet. Additionally, tokenised licenses could assist in the reselling of licensed software, enabling the automated process of license verification while preventing license misuse.

- Utilising tokens to create a digital link to a physical product can help ensure supply chain transparency for a variety of use-cases, whether mandated through principles like halal fundamentals or offering ethical sourcing options for consumers.

- Timestamp-based tokenisation could see use ranging from enabling the commoditisation of time which, in conjunction with smart contracts, can be used to measure workplace output in the digital realm. Additionally, timestamps can help provide immutability to revisioning on a B2B and B2C-level basis, with the easiest analogous example in the current day being revisions of a particular article hosted on Wikipedia.

- Sustainability and carbon emissions can also benefit from tokenisation, specifically through a digital twin that reveals how much of a specific area absorbs carbon dioxide and retains biodiversity. These types of tokens can then be used to measure against the actual CO2 footprint, allowing a more measurable way to address sustainability and carbon emissions.

- Triple-entry accounting applications may provide greater efficiency for financial reporting, financial planning, invoicing, real-time tax reporting, financial auditing and financing in the sectors of logistics and supply chain management with or without tokens.

- Tokens could also play a significant role in cloud computing, enabling traditionally-closed network systems like Supervisory Control and Data Acquisition (SCADA) systems to move into the digital realm, because of blockchain's immutability and verifiability providing security to these platforms.

- Identity tokens can enable individuals to prove their identity with a token without revealing personally identifying information (PII). The safeguarding of PII is especially important given the concerns over data privacy in the metaverse.

- Decentralised Finance (DeFi) is growing, seeing more interest from institutional players. Indeed there is an emergence of players who are straddling both the traditional financial services and DeFi world in the form of Centralised Finance Crypto Banks. Enterprise use cases with stablecoins, governance tokens, security tokens and NFTs will become more important as the DeFi environment matures.

- CBDCs also have a place within the metaverse, providing an avenue of connection from traditional fiat currencies into the metaverse, with digital purchases having the capacity to be purchased seamlessly through CBDC/metaverse integration.

We also present a token taxonomy to help the reader think about the level of regulation that may be involved in applying one of the use cases we discuss. As we will see, creative use of blockchain tokens can lead to innovation in various fields and create a better society for all. For this creative use of tokens, a convergent approach to technology, law, and management will also be required.

The enterprise is at an ideal point to take advantage of new token business models. This, of course, does not mean that every enterprise needs to build a brand new blockchain. Instead, enterprises should be prepared to embrace new blockchain infrastructures that may affect their interaction with payment systems or and could lead to new business opportunities.

This report serves as a starting point for an investigation into how the enterprise may apply digital assets. Indeed, one new concept that is gaining attention is that of the metaverse. This has been increasingly prevalent among fast technology adopters throughout the world, with many motivations driving this desire to participate in a modern, three-dimensional Internet experience. Do we know how the metaverse will change the world? One individual certainly does not have the answers to these questions. However, through the exploration of the use-cases presented in this report, we can better understand how a token-based taxonomy can impact the world. Throughout, where a reader has a further interest, there are links and resources pointed to where further information may be found.
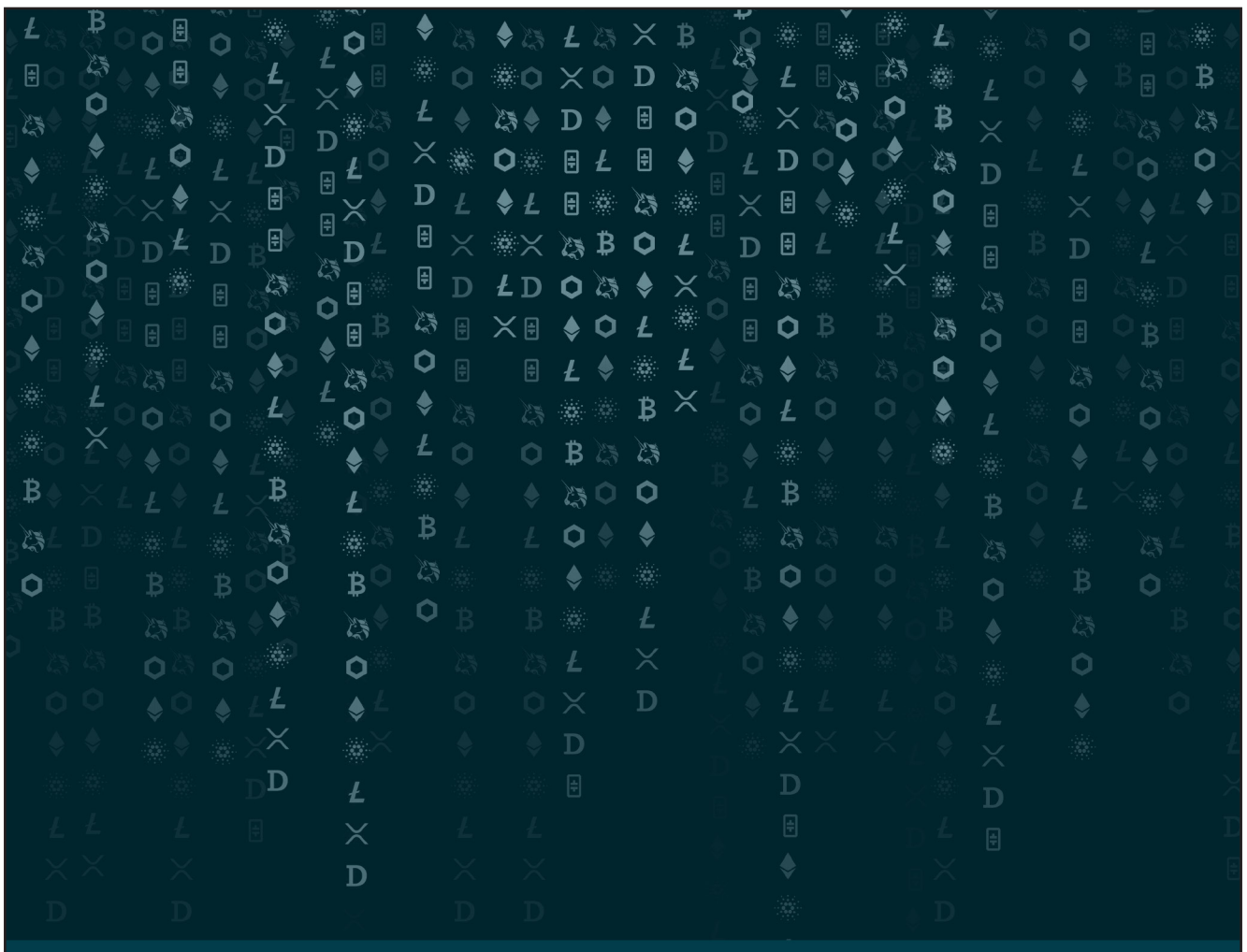
# Enterprise Digital Asset Use Cases

## Non-Financial Digital Assets

In this section, we explore non-financial digital asset use cases that comprise tokenised digital representations of intellectual property, physical goods and materials for supply chain and track and trace purposes, the management of digital documents in general and documentation, timestamping and signing in particular, digitising and accounting for time, and more.

### Tokenisation of IP

Intellectual property (IP) rights are rights over creations of the human mind, usually sanctioned by a state authority. This is done with the purpose of facilitating the exploitation of this intellectual creation by the creator. Roughly explained, IP prevents free-riders from profiting from it without the consent of the creator, which generates a need to pay the creator to obtain this consent. Although there is some economic debate in this regard (because IP rights can be seen as monopoly rights creating inefficiencies), IP rights are often thought to stimulate innovation, through the encouragement of inventions and product differentiation through higher quality. In turn, the absence of IP rights is believed to result in the opposite.

The main types of IP are patents (protection of an idea consisting of an invention or a useful improvement), copyright (protection of works of authorship), and trademarks (prohibition of unauthorised usage of unique, distinctive signs). These rights are usually obtained by registering the IP in a government IP agency although, in principle, contractual arrangements with private platforms could achieve similar results.

As established, IP rights enable profit for the rightsholder. The rightsholder may be the author/creator, but rights may also be transferred. This allows for mutually beneficial transactions between two parties with different time preferences. In other words, investors can pay the creator in the present to transfer to them the right to receive royalty payments in the future.

Today, many firms rely on IP. However, IP often has to be managed manually due to low levels of digitisation and media consolidation. IP management in firms involves operating and checking across different media and IT systems (e.g. paper, ERP systems, digital documents), thereby creating friction and efficiency loss due to media discontinuity. Also, keeping track of and documenting updates, sharing across different parties, and legacy IT and management systems hinder speedy proof of origin. Moreover, IP registration with official central authorities can be lengthy and cumbersome.

Tokens can be designed to constitute digital representations of these rights. In essence, a content creator may sell its IP tokens to investors in exchange for present funding. Tokens can be transferred and, when the earnings emerge, a smart contract may distribute them to the tokenholders, as shown in *Figure 1*.

| IP management<br>company / Smart<br>contract | IP creator | Investors /<br>Tokenholders |
|---|---|---|

Register IP with
the authorities

Is assigned
with the IP

Mints tokens
granting the rights
to future earnings

Receives funding
in the present

Tokens are sold
to investors

Enterprise is
undertaken

Investors can
transfer their tokens

Earnings ensue

Tokenholders receive
the earnings when
they are due

*Figure 1: A simplified scheme displaying the tokenisation of IP.*

This allows IP creators to obtain funding without large intermediation fees, to obtain more funding by making positions in IP more liquid and thus more attractive, and to make the market more competitive by lowering the entry barriers for small IP creators. Some of the main challenges concern how to inform the authorities of the transfer of IP rights (token sales) in real-time, and how to find the purchasing party's identity to either inform the authorities or exert their rights when there is a violation.

Creating digital IP assets by tokenisation generates opportunities to digitise IP and enter a new digital rights management era. These digital IP assets can then be used as "smart property" so that content creators can track, enforce, and collaborate on IP products.[1] Once a piece of IP is represented as a digital token, its provenance can

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[1] Dutra, A., Tumasjan, A., & Welpe, I. M. (2018). Blockchain is changing how media and entertainment companies compete. MIT Sloan Management Review, 59(1), 39-45.

be documented, updates can be tracked, and the token can be traded and used for collaboration (e.g., a melody added to a song text) in a frictionless way.

For example, Bernstein.io is an illustrative project that points into the direction of these potential IP digital assets and digital rights management developments. Bernstein's application enables content creators to document the provenance and development of any IP-based digital asset, be it patents, trademarks, books, design, music, movies or art. The IP is registered on the Bitcoin blockchain, creating a unique and publicly verifiable provenance certificate. Multiple updated versions of this digital asset can be created and traced by chaining the versions together. Concurrently to registering the IP on the Bitcoin blockchain, Bernstein also offers timestamping by EU and China central authorities for official recognition.

As a future next step, such digital assets could be generally transformed into unique (so-called "Non-Fungible Tokens" (NFTs) tokens and be traded or rented on different blockchain systems, thereby becoming a more liquid asset. This is in itself an enterprise application, as it provides beneficiaries with ways to leverage their own image with a view to obtaining a larger revenue stream.

Other examples of IP tokenisation projects are IPCG, an Ethereum-based blockchain for patent-holders, and Lexit, which purports to use the metaverse to tokenise IP as well as other digital assets.

## Licensing

Tokens can also be of help to the enterprise in dealing with inefficiencies in the handling of software. When an individual or corporation purchases the right to use particular software, how it can be used or shared may be limited. This can be the result of IP law but may also be governed by contract law (terms of use). To avoid free-riding, software companies give users a license only if they have appropriately paid and design the software to check that the user and the license-holder are the same individual or corporation.

This is done at some cost. It is hard to resell software licenses that are unused or only used for a fraction of the period of time licensed, as the new users may not pass this screening. This is aggravated with a potential "double-spending problem:" Software may be transferred more than once, and it is difficult to single out the one valid transaction. This prevents the emergence of a secondary market, which would benefit consumers who would not need to "sink" as much cost in software licenses as in the current situation. In turn, software companies would benefit from an increased user base (as software license purchases would be prospectively cheaper, with the relative benefit of software piracy further falling). However, the presence of a secondary market might dilute some of the rents derived from market power and "irrational" consumer biases.

Therefore, there are inefficiencies in the market for software. In the case of companies demanding software licenses, it is difficult to predict how much usage of a given software and by how many people it is going to be needed. This causes a risk of purchasing insufficient licenses (creating bottlenecks in production, which are aggravated by the difficulty of sharing licenses tied to individual users). Also, there is the risk of overspending on licenses and being stuck with an excessive and illiquid stock. On the supply side, companies face operational problems in tracking the validity of the licenses, in tracking the correspondence between the user and the licensee, and of a restricted consumer base (due to the higher perceived cost of the licenses, because of their illiquidity).

To address this, tokens can be built to hold software licences. A pool of tokens which allows the re-sale of unused tokens would reduce the risk of larger purchases, increasing flexibility, the competitiveness of the market and efficiency. This process can be seen in *Figure 2.*

The Token-as-a-License or TaaL model relies on tokenisation to enable the aforementioned secondary market. In short, TaaL consists of identifying each software license with a token, allowing the validity of used licenses to be easily verified against the blockchain while solving the double-spending problem. This can even allow selling used software out of insolvency, bettering intangible assets' liquidation in the bankruptcy process.

It is even argued that Ethereum's Ether, although perceived mainly as a currency, is also a use case of TaaL tokens.[2] In this case, Ether would constitute an example of pure-play consumptive tokens or a "use it up" model, which is transaction-oriented. However, other license models exist and are compatible with TaaL.

The main way that is put forward for TaaL is "token pools" for companies or other organisations representing many final users. For these organisations, it is difficult to precisely predict how much usage of a given software and by how many people it is going to be needed. A pool of tokens that allows the re-sale of unused tokens would reduce the risk of larger purchases, increasing flexibility, the competitiveness of the market and efficiency.

According to Petrovcic:[3]

> *"From the perspective of the software vendor, it's also an effective way to fortress a market position against point-tool competitors. The token software license model makes it financially easy for the customer to utilise the entire portfolio of software, and not try to buy the best-of-breed for every part of a work flow."*



License is issued

License is tokenised

User purchases tokens

User consumes some tokens

User resells unused tokens

Blockchain verifies the validity of the tokens transferred

New user is allowed to use the software

A TaaL use case is License.Rocks, a German start-up focused on enabling users to value and sell used software, as done in "the largest insolvency case in Europe."[4]

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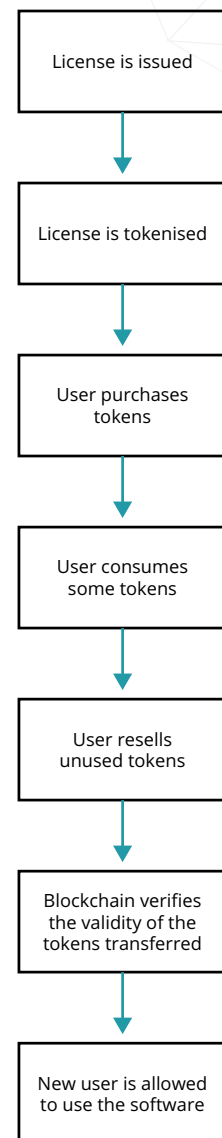
[2] Petrovcic, D. (2017) "Blockchain: Token as a License (TaaL)." Hackernoon. Available at https://medium.com/hackernoon/blockchain-token-as-a-license-taal-ba5d173e4ad6

[3] Ibid.

[4] https://license.rocks/use-case-sell-your-used-software-out-of-an-insolvency

## Track & trace

In the 21st century, upholding quality, ecological and ethical standards is required by both consumers (and thus, private certification bodies) and public authorities. However, proving that standards are being abided by is difficult. This is because it ultimately requires the identifiability of both the inputs and the details of the transformation they undergo throughout the supply chain, i.e. product traceability.

Product traceability refers to mapping the "path" that a product and its components make upstream or downstream throughout the supply chain. While the product physically goes through a multitude of steps, it is very challenging to build a digital map of the entire set of them, due to their sheer number and the complexity of the supply chains.

Information is stored throughout different, isolated information management systems. The communication of this data across systems is challenging because of trust issues, diverging communication standards, the lack of comprehensible information from previous steps, and the absence of a system in which this information can be inputted and handled. This is even more complicated if the intention is to identify each product or component on the map and its position on the map in real-time. Tokenisation can address this.

NFT's can be created for every item or batch of items, either final product or components. By mirroring each step of the production chain with a corresponding step on the blockchain, it can digitally represent the supply chain. In this way, the system can be designed such that, if two inputs must be combined to create a certain output, the tokens corresponding to each input must be burned for the system to produce the token corresponding to the output. This itself is a requisite to submit the physical output downstream.

As a result, it is possible to identify the exact path undergone by each particular item, granularly and even in real-time. Information, such as each token's geographical origin, issuance date and transaction data allows organisations to understand (and control) the product's life-cycle, enabling smart pricing, targeted sustainability policies, preventing malicious use and identifying bottlenecks. Furthermore, by introducing third-party certifiers in a supply chain underpinned such a system, it is possible to provide quality or impact assurance. Finally, integration with IoT devices can provide information supporting new business models that optimise multi-stage production cycles.

*Figure 3* shows how tokens can be utilised in creating a blockchain based digital supply chain.
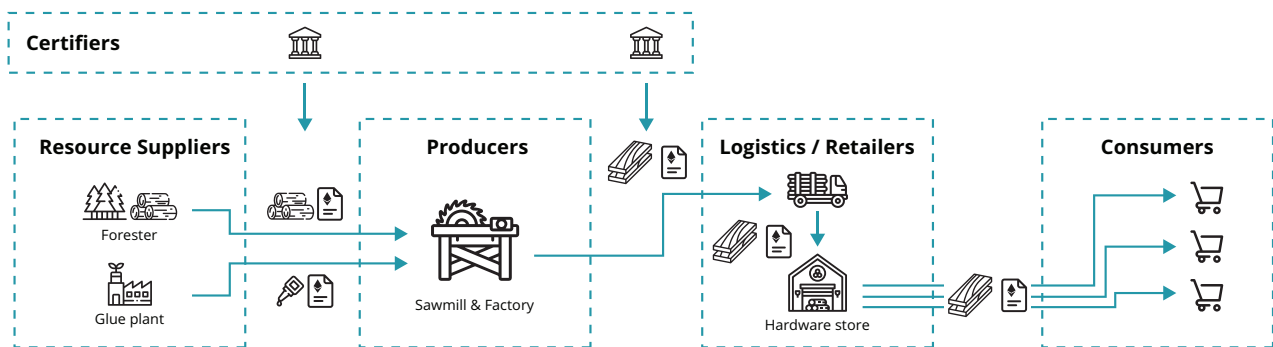


*Figure 3: Tokenisation and the supply chain.[5]*

As an example, Everledger is a Hyperledger Fabric-based project focused on providing evidence of origin, authenticity, ownership, and characteristics of the products in their system. Use cases within Everledger presumably benefit much from transparency in supply chains and provenance assurance, such as diamonds, gemstones, wines & spirits, luxury goods, apparel, art and batteries. The industry of insurance and reinsurance, in turn, can benefit from this information as well.

The enterprise application in this case is threefold: increasing credibility of claims to consumers, recording the movement of goods and meeting compliance requirements. Emerging legislation such as the EU Sustainable Finance Disclosures Regulation (SFRD),[6] the EU Taxonomy Regulation[7] and the proposed EU Corporate Sustainability Reporting Directive (CSRD)[8] could rapidly increase the relevance of these platforms to the enterprise. These regulations signal a new trend of increasing the stringency of non-financial disclosure requirements and punishing "greenwashing," raising the bar to the point where only properly set-up traceability systems may enable full compliance.

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[5] Westerkamp, M.; Victor, F.; Kupper, A. (2019) "Tracing manufacturing processes using blockchain-based token compositions." Digital Communications and Networks, 6(2), 167-176.

[6] https://eur-lex.europa.eu/eli/reg/2019/2088/oj

[7] https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en

[8] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0189

# Timestamping and time tokenisation

Blockchain-based tokenisation also opens up new ways to deal with time. One of these ways pertains to timestamping. A timestamp is a mark of the moment in which a given event occurred, ensuring that certain data existed at that time (PoE or "Proof of Existence"). Timestamps are fundamental in blockchains' designs, making it impossible to repeat a block in the future and prevent double-spending.

Timestamps have many uses. Timestamps enable the identification of when data was edited, allowing the identification of data breaches and alterations. OpenTimestamps constitutes a use case of the usage of blockchain for timestamping. Timestamp tokens stored in a tamper-proof ledger without the need to rely on a centralised timestamping authority can also allow spotting alterations in news articles, which can aid in the fight against fake news even in contexts of low trust. This is done through tracking versioning because, as the unique hash changes when content is changed, a reader can see when, how and by whom a document version has been changed. For instance, LKS claimed to launch one such solution.

This has implications for copyright disputes, as the original work can be found in the blockchain and even for search engine optimisation (SEO) since "timestamping is considered structured data, which helps search engines rank a website."[9]

Another time-related token application is the tokenisation of *time itself*. This is achieved by creating a token representing a number of work hours for a given worker or set of workers. Tokens can then be exchanged freely in the market, giving buyers (or whomever they choose to give it to if they make a gift out of the token) access to, e.g. an hour of the issuer's time during a certain period. This allows people to secure somebody's time even before explaining to the issuer the exact tasks they are needed for (within the token mandate parameters).

This also provides liquidity to the freelance worker and access to a wider job market, with its implications in employability and salary. Furthermore, just as financial markets are assumed to allocate capital more efficiently (to the benefit of both capital raisers and investors), the commodification of time could entail a more efficient allocation of personpower. Simultaneously stimulating efficient allocation of labour resources and widening workers' employability (and salary) prospects is particularly appealing for those industries experimenting with remote and casual working during the COVID-19 pandemic.

TIMERSnetwork, for instance, introduced an "IncomePerMinute" (IPM) Token representing a person's time and skills (using "Proof of value creation" in TVM or "timed verification minting processes"), which can be offered in a forum and traded in an app.

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[9] Van der Lans, S. (2021) "How we can use timestamping content on the blockchain to fight fake news and fraud." Cryptoslate. Available at https://cryptoslate.com/how-we-can-use-timestamping-content-on-the-blockchain-to-fight-fake-news-and-fraud/

**Timestamp tokens**

- Content is created and token with unique hash is generated
- Content is altered
- Hash changes
- User can spot the alternations without need to trust the platform

**Tokenisation of time**

- Frelance worker offers (and verifies) a given set of person-hours and skills
- Tokens are issued and purchased in the primary market
- Freelance worker obtains a payment in advance
- Tokens are trade in the secondary market
- Tokenholder can redeem the token for e.g. a work-hour of the freelance worker
- Freelance worker gains access to a large job market; companies and clients gain access to a large pool of professionals to choose from
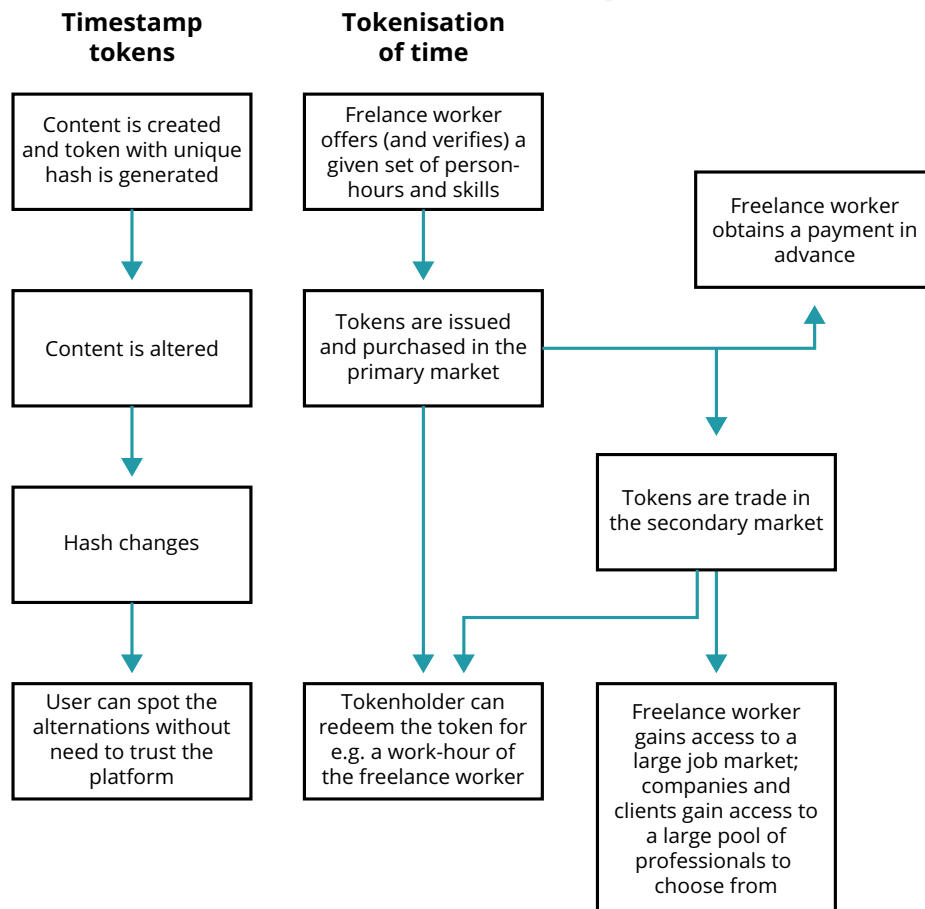
*Figure 4: Time and tokenisation.*

Overall, token-based timestamping allows enterprises to get a handle on the chaotic news flux of the 21st century, which benefits both companies trying to protect and control their public relations and news outlets seeking to avoid "falling" in fake news, deep fakes and image doctoring while keeping up with current events. It also enables access to more organic traffic to company websites through improved SEO. Finally, it facilitates copyright complaints, reducing attorney costs and delays by minimising the effort needed to collect evidence and build a case.

The tokenisation of time, in turn, gives enterprises access to a larger pool of professionals, not restricted by international borders, local regulatory rigidities, nor the need for full-time contracts. This gives firms tools to keep up with the pace of the Fourth Industrial Revolution.

## Sustainability, carbon emissions and energy

Tokenisation can also aid improved sustainability practices. We previously discussed that track and trace solutions can add transparency to supply chains. The implications for sustainability are apparent, as providing evidence of origin can attest that a particular product was manufactured in a certified sustainable establishment. Similarly, tokenised representations of the supply chain can enable the verification of the sustainability of the

conditions in which raw materials are produced and processed. Some projects applying this sort of approach are Circularise, TextileGenesis and TrustTrace.

Another token-based path to sustainability consists of carbon tokens. Tokens may represent either positive or negative carbon emissions, that is, a quantity of pollution or pollution averted.

As described by *Figure 5*, specialised assurers may verify either Greenhouse Gas Emissions (GHG) or GHG aversion, resulting in tokens that can be traded in a secondary market. This combines the public policy goals of limiting carbon emissions with the private goals of improving organisational reputation and avoiding penalties.

Moss and UPCO2 are two projects applying this concept for voluntary carbon offsetting. Richardson and Xu (2020)[10] describe a model for legally mandated carbon trading systems. Finally, KWHcoin and GreenToken[11] constitute an attempt to apply a model similar to having tokens represent a given amount of kWh produced from renewable sources or services related to renewable energy transactions, respectively.

More effective ways to handle carbon offsetting projects allow firms to improve their reputation and make their efforts in the field of sustainability more worth their while. Efforts (and success) in sustainability are not just a part of CSR, but also of brand-building, which ultimately constitutes a factor contributing to profit. Nevertheless, these efforts and their effectiveness need to be communicated to the consumer, which is complicated and further made difficult by the consumer's limited interest, time, and ability to process the large amounts of information that this would need. This task is nearly impossible if the measures of the efforts and their effectiveness are incomparable.[12] However, if comparability is achieved, private actors can readily process the information and make it easily available to the consumers, unleashing the full potential for sustainable brand-building.[13]

Holding a certain number of CO2e-averting tokens or green kWh-equivalent tokens within a large network achieves precisely this, making sustainability efforts comparable and easy to communicate. On top of this, it allows easily verifiable legal compliance. Finally, both GHG tokens and sustainability tracing tokens allow "to
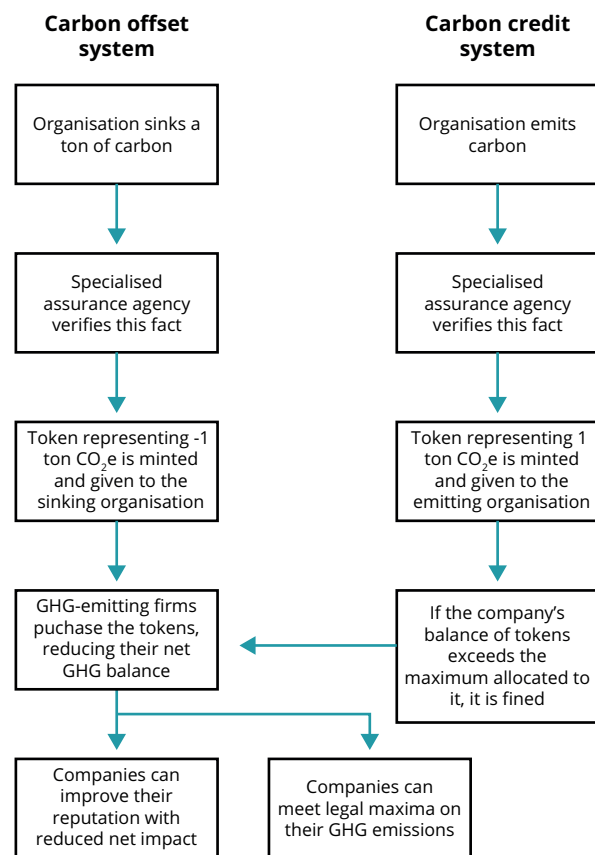
**Carbon offset system** | **Carbon credit system**

Organisation sinks a ton of carbon → Specialised assurance agency verifies this fact → Token representing -1 ton $CO_2e$ is minted and given to the sinking organisation → GHG-emitting firms puchase the tokens, reducing their net GHG balance → Companies can improve their reputation with reduced net impact

Organisation emits carbon → Specialised assurance agency verifies this fact → Token representing 1 ton $CO_2e$ is minted and given to the emitting organisation → If the company's balance of tokens exceeds the maximum allocated to it, it is fined → Companies can meet legal maxima on their GHG emissions

*Figure 5: Carbon trading and tokenisation*

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[10] Richardson, A.; Xu, J. (2020) "Carbon Trading with Blockchain." *Mathematical Research for Blockchain Economy*, 105-124.

[11] These projects have not successfully gone to market at the time of the writing of this report.

[12] Ibañez, J. I.; Bayer, C. N.; Xu, J.; Cooper, A. (2020) "Devoir de Vigilance: Reforming Corporate Risk Engagement." Development International e.V.

[13] Bayer, C. N.; Ibañez, J. I.; Xu, J. (2019) "A New Responsibility for Sustainability: Corporate Non-Financial Reporting in Austria." Development International e.V.

create new revenue streams, avoid greenwashing, make validated claims about their materials and products, and track the CO2 footprints and other sustainability metrics like water savings."[14]

## Triple-entry Accounting

One of the greatest achievements of the 21st century is the materialisation of shared ledger systems. Shared ledgers, both for multiple departments of the same organisation and multiple parties, offer substantial economic and organisational benefits in that there is intrinsic reconciliation of data relevant to two users. Many positive effects may spillover from this, including eliminating inconsistencies, minimising the need for reconciliation and many dispute resolution processes, faster invoicing and payments, the subsequently reduced need for invoice financing and financial intermediation, and much more.[15]

Historically, however, shared ledgers have been challenging to build because, unless it is possible to build a system that requires trust in nothing but the system itself, it is necessary to delegate bookkeeping to the other party or a third party, both of which need to be trusted. This is unfeasible in many business environments. Triple-entry bookkeeping first and blockchain later were two models to implement approximations to such trustless systems.

Triple-entry bookkeeping is a specific proposal for shared ledgers as a recordkeeping mechanism through digitally signed messages between two parties and a validator (or a community of validators). One party proposes a transaction draft or offer (by signing), the potential counterparty responds to this message with another message in which they accept (by signing) if they wish to and, finally, a third party checks that everything is in order and validates the transaction (by signing). The result is a triple-signed receipt which, due to the very nature of cryptographic signing, ensures that the three parties are looking at the exact same data they agreed to. Blockchain technology offers a way to execute this model, replacing the third party with a community of third parties.[16, 17]

If on top of this shared triple-signed record, accounting applications are built, this is triple-entry accounting or TEA.[18] These applications may include tools for financial reporting, financial planning, invoicing, real-time tax reporting, financial auditing, financing, etc. Blockchain-based TEA is regarded to be particularly suitable for the sectors of logistics and supply chain management,[19] revealing a considerable deal of overlap with enterprise blockchains.

TEA applications often resort to tokenisation to achieve their goals. For instance, Ledgerium allows to tokenise invoices, which in turn enables their trading in a more competitive secondary market, making the tokens more liquid (and thus, more valuable) assets than the typical invoice. Furthermore, this increases transparency,

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[14] https://www.circularise.com/

[15] Ibañez, J. I.; Bayer, C. N.; Tasca, P.; Xu, J. (2021) "The Efficiency of Single Truth: Triple-entry Accounting." Social Science Research Network (SSRN). Available at http://dx.doi.org/10.2139/ssrn.3770034

[16] Grigg, I. (2005). "Triple Entry Accounting." Financial Cryptography. Available at https://www.financialcryptography.com/mt/archives/000501.html

[17] Ibañez, J. I.; Bayer, C. N.; Tasca, P.; Xu, J. (2020) "REA, Triple-entry Accounting and Blockchain: Converging Paths to Shared Ledger Systems." Social Science Research Network (SSRN). Available at https://dx.doi.org/10.2139/ssrn.3602207

[18] Ibañez, J. I. (2022) "Triple-entry Accounting with Blockchain." In Porras, E. (ed.) Blockchain Technology: Advances in Research and Applications. Nova: New York. (in press)

[19] Ibañez, Bayer, Tasca and Xu, "The Efficiency of Single Truth."

whereas the usage of smart contracts reduces transaction delays and costs.[20] Request, a network that powers a TEA system, also uses tokens to request payment fees to avoid spam in the network, as well as to facilitate migration to other blockchains. These REQ tokens are also governance tokens.
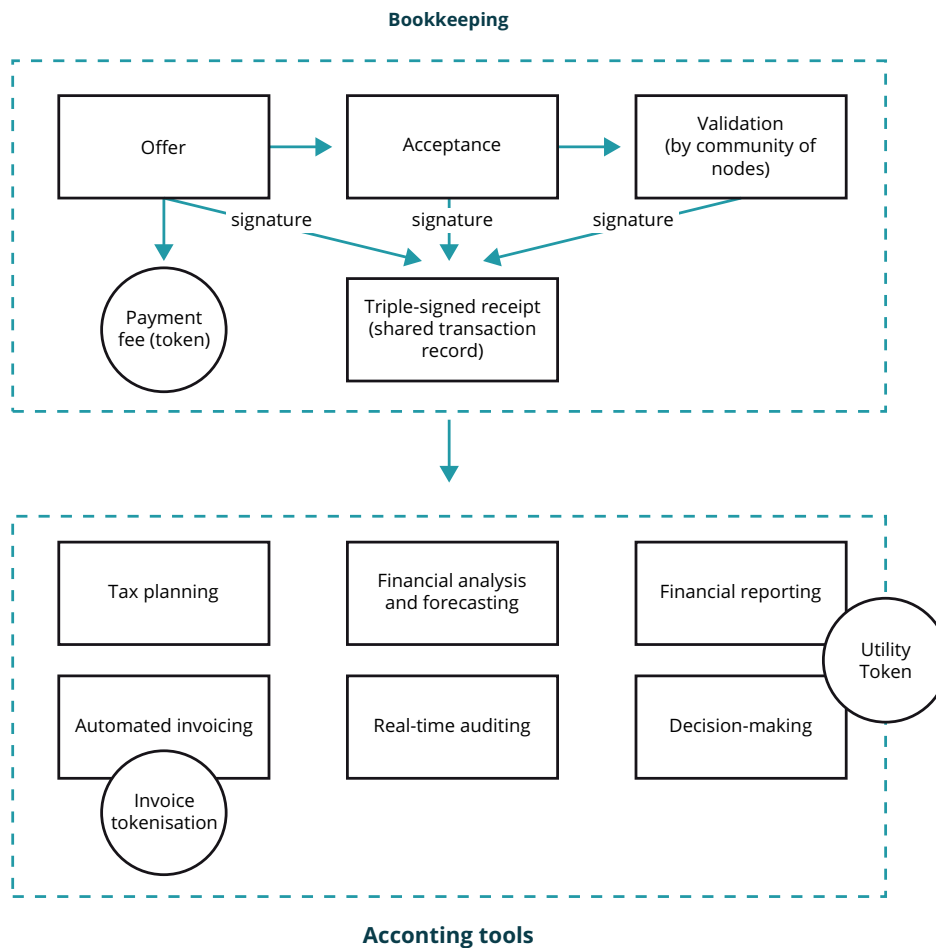
**Bookkeeping**



*Figure 6: Triple-entry Accounting Use Case.*

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[20] https://whitepaper.ledgerium.io/use-cases/invoice-tokenisation

# Individual Identity

Identity is a social construct emerging from individuals' interactions with the rest of society. It is a dispersed set of data points, which is a key part of modern life. In our interconnected digital world, identity must be proven. This results in an unfortunately burdensome, repetitive and inefficient process that requires sharing private data with others, giving others the responsibility of properly storing this data and exposing it to the risk of breaches. With the rise of blockchain, the tokenisation of identity is an alternative to allow people to identify themselves while keeping identity private, portable and secure.

The tokenisation of identity consists of the substitution of sensitive personal information (e.g. an unique ID number) with a token, which itself is not sensitive as it has "no extrinsic or exploitable meaning or value" and cannot be reverse-engineered to the original sensitive data.[21] Sensitive information needs to be provided only once to a trusted provider, which stores the sensitive information in a vault with additional layers of security protection against data breaches. The trusted provider then issues a token equivalent for that identity instead.

As a consequence, other companies need not only store user information themselves but only retrieve a token, which eases the burden for the firm. Customer journey is also improved, as they need not undergo a complex KYC process. Furthermore, the risk of stolen information is reduced, and its consequences are minimised, given that the breacher can only access tokens that do not contain sensitive information nor lead to it. At worst, tokens need to be only re-issued.
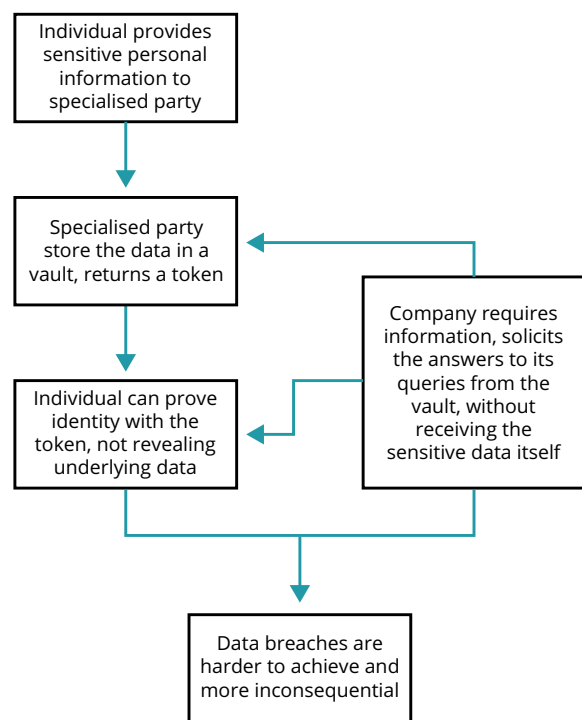


*Figure 7: Tokenisation of identity.*

A key concept in this matter is the *preservation of referential integrity*. In other words, if a company needs to connect two sets of data points with a common element, but the common element is sensitive personally identifiable information, the element needs to be retained as a connector without revealing its content.[22]

This theoretical model, however, suffers from a number of problems in practice. First, it requires relinquishing control over personal data (i.e. trusting) to a party who substitutes the data in the vault. This is usually a corporation or a government, both of which the user may not want to know – let alone use or monetise – one's (no longer) private data. Second, it often means that the user is sharing more information than is really necessary. For instance, if a user wants to prove that she is not under-age, she is often required to disclose her birth date, despite the two not being the same: knowing somebody's birth date involves a higher degree of disclosure (loss of privacy) than just knowing that somebody is an adult. Third, the risk of data breaches, data theft and even data destruction still exist.

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[21] World Bank (2019) "ID4D Practitioner' Guide: Version 1.0." Washington, DC: World Bank.

[22] Kulshrestha, A.; Ellis, S. (2019) "Take charge of your data: How tokenization makes data usable without sacrificing privacy." Google. Available at https://cloud.google.com/blog/products/identity-security/take-charge-of-your-data-how-tokenization-makes-data-usable-without-sacrificing-privacy

Blockchain/DLT technology in combination with zero knowledge proofs (ZKPs) provide an alternative to this. Given that DLT essentially enables tamper-proof storage in decentralized databases, it allows individuals to prove identity in a peer-to-peer manner while maintaining control of the information and not requiring multiple passwords: self-sovereign identity (SSI).

Selective disclosure of data empowers users, restoring their privacy and even allowing them to monetise their personal data. Nevertheless, this does not mean that SSI entails a mere transfer of surplus from corporations to customers. Rather, it involves a joint creation of value for both of them.

Reluctance to share data on the consumer's side results in foregone transactions, with mutual value lost. Moreover, other transactions are undertaken, but in a "siloed"[23] way, resulting in redundant storage, management and compliance costs and risks (breaches, liability, fines, etc.) on the companies' side. These are all "transaction costs" or inefficiencies that SSI eliminates, together with single points of failure.

However, the tokenisation of identity is not merely about monetising data. One of its most important potential applications lies in the healthcare sector, with implications both on the enterprise and the consumer side. Healthcare is a fragmented sector, also characterised by its high degree of opacity and intermediation. Distrust among players in the industry and the need to share sensitive personal information in interactions that are privacy-preserving currently results in siloed data-processing infrastructures. Interactions among healthcare stakeholders without trust results in the need to build separate data-processing infrastructures. A trustless distributed ledger, where identity is tokenised and referential integrity is preserved, however, constitutes a superior alternative.

Overall, the tokenisation of identity offers potential gains to both consumers and companies, in the ways described above and more, such as the mitigation of the problems of identity theft and identity fraud, the lowering of the barriers to financial inclusion, and much more. Other companies and projects seeking to make this a reality, such as Serto (formerly uPort), GlobaliD, Hyperledger Indy and Proof of Humanity, deserve attention as they attempt to approach this goal.

## Cloud Services, Blockchain, and ERP

At first glance, blockchain and cloud computing seem to be difficult to combine. This is because blockchain pursues decentralisation while the cloud is centralised. However, these differences secure each other's weaknesses and create synergies.

Blockchain and cloud systems can be fused through an innovative approach called BaaS (Blockchain as a Service). BaaS refers to a cloud-based blockchain service. BaaS allows companies that want to adopt blockchain to efficiently develop blockchain services without paying large upfront costs. Furthermore, it makes it easy to develop nodes that constitute the blockchain network (BaaI: Blockchain as an Infrastructure) and facilitates the development of a blockchain platform (BaaP: Blockchain as a Platform). From a different point of view, the introduction of blockchain can help overcome the shortcomings of centralised cloud networks. In the event of network failure, rapid recovery is possible, which can dramatically improve the security level of the data.

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[23] Tykn (2020) "Self-Sovereign Identity." Tykn. Available at https://tykn.tech/self-sovereign-identity/#Decentralized_Identifiers

For example, AWS (Amazon Web Service) can reduce the time to build a blockchain network by about 60% by utilising the Hyperledger Fabric Framework. In fact, about 25% of Ethereum nodes in the world already use AWS. Well-known Hyperledger Fabric customers include Nestle, Sony Music and BMW. SAP is also enabling customers and partners to build and expand applications using blockchain technology through the SAP Cloud Platform blockchain (SCP blockchain). Microsoft's cloud service, Azure, enables customers to easily build and manage blockchain infrastructure and utilise various blockchain-based applications.

As explained above, the focus of the combination between cloud service and blockchain is on building and managing blockchain systems more efficiently and enabling related applications to be used with scalability. In the context of issuing and facilitating token related business models, cloud based technologies can be seen as facilitators of digital assets.

The next thing to look at will be the changes expected when ERP (Enterprise Resource Planning) systems are built on cloud service-based blockchain systems. In this case, it is expected that the existing advantages of blockchain technology will further enhance the performance of ERP. For example, it is expected to significantly improve the reliability of transactions, transparency of value chains across industries, trust on partners, security of data processing, data quality, and accuracy of predictions. Accordingly, ERP vendors such as SAP are trying to improve the performance of ERP to another level through the combination of blockchain and ERP. On the other hand, like the case of Microsoft Project Bletchley, the effort to develop a middleware to effectively connect blockchain and ERP together has been very active.



*Figure 8: Blockchain, Clouds, ERP and tokens.*

As summarised in *Figure 8*, synergies can be achieved when integration between the blockchain network, cloud service, and ERP system occurs. Cloud services will make it easier to develop and manage blockchain networks and use apps. Blockchains based on cloud services are expected to raise the capabilities of ERP systems to another level. Although it is still in its infancy, it is expected that ERP services linked to more cloud service-based blockchains will be developed and widely applied in the near future. ERP systems themselves can have multiple token implementations within them with respect to facilitating payments, securing access to data, verifying identity and so on.

# Financial Assets

In this section of this report, we discuss financial digital asset use cases that will include digital currencies, payment tokens, stablecoins, utility tokens and security tokens.

## Digital Currencies

**WHAT ARE THEY?**

Digital currencies are alternative forms of currency on blockchain and DLT systems that can be used to facilitate payment. Many examples exist, with Bitcoin as the progenitor. New forms of digital currency overcome some of the problems with Bitcoin, such as scalability, speed, privacy and energy efficiency. Examples of these are XRP, Litecoin, Monero and Zcash. The most well-known and widely used digital currency is Bitcoin, and this section will focus on Bitcoin and its utility for the enterprise.

Created by the mysterious Satoshi Nakamoto, Bitcoin's whitepaper titled "Bitcoin: a peer to peer electronic cash system"[24] outlined the Bitcoin protocol and established bitcoin as the first native digital currency powered by a decentralised ledger. The whitepaper introduced new advancements in computing, most notably the application of a decentralised consensus mechanism called Proof-of-Work to secure and maintain the network.

Bitcoin was launched to act as an alternative to traditional fiat currency. As highlighted in the whitepaper, the idea of Bitcoin was to become a "peer-to-peer version of electronic cash that would allow online payments to be sent directly from one party to another without going through a financial institution". Whilst the digital currency was launched as a payment system, due to the current technological challenges (block size, transaction speed, etc.) and the asset's volatility and price appreciation over the past decade, the asset's status evolved to become a digital store of value, a new asset class even different from gold.

Recently, bitcoin's status as a digital store of value further evolved, accelerated by the Covid-19 pandemic and unprecedented global monetary stimulus in parallel to Bitcoin's third halving event, leading to the increased participation of institutional investors. There are more than $80bn in bitcoin owned by publicly traded companies or funds, and several high-profile private investment funds, endowment funds and other institutional investors have allocated significant capital to bitcoin and to the digital asset ecosystem.[25]

The main factors and pre-requisites that led to this institutional shift, supported by the abovementioned key drivers throughout 2020, were the initial growth of regulated and institutional-grade market infrastructure, the increased regulatory clarity and the improved business and technological understanding at the executive level of these corporations. The year 2020 created a new wave of global interest, attracting new users, developers, investors to this space who will further strengthen Bitcoin's network effect and drive adoption, developments and growth. Whilst the digital asset industry and overall ecosystem is still in an early growth phase, the required infrastructure to support increased institutional adoption over the coming years has already been established.

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[24] Nakamoto, S. (2008) "Bitcoin: A Peer-to-peer Electronic Cash System." Bitcoin.org. Available at https://bitcoin.org/bitcoin.pdf

[25] https://bitcointreasuries.org

Bitcoin has established a social network around money, thereby creating what some would argue constitutes the strongest network of all time. In that regard, one could apply Metcalfe's law of network effects to Bitcoin, stating that the effect of a telecommunications network is proportional to the square of the number of connected users of the system. As a financial network, Bitcoin's network effect is stronger compared to social networks such as Facebook, as when the network scales, so does the price and value to adopters, creating a circular effect driving further enthusiasm and adoption.

## HOW IS THIS RELEVANT TO THE ENTERPRISE?

Bitcoin as a digital currency, although not finding yet its true utility as a means of payment, has tremendous utility as a new kind of financial asset for its properties of risk and return. If one included Bitcoin in a traditional 60/40 portfolio (60% equity, 40% debt), allocations of between 1% and 5% of the asset result in superior returns to the traditional portfolio. According to Bitwise's calculations,[26] a 2.5% allocation to bitcoin in a traditional portfolio results in a 45% return vs 26% return from a traditional portfolio.

Institutional investors who have gained exposure to bitcoin as a digital store of value with no intention to use the digital asset as a payment tool, but rather as an investable asset, further support the change of narrative to bitcoin becoming a digital version of gold from a financial standpoint. Many believers in bitcoin compare it to gold because of bitcoin's underlying properties making it a scarce, portable and durable asset, akin to gold; some even refer to bitcoin as an advanced form of gold (gold 2.0) because bitcoin's underlying properties also make it a more divisible, traceable and portable asset compared to gold. Indeed, bitcoin has utility in its properties



Spearman: BTC-SP500 / ReferenceRateNewYork0400pm
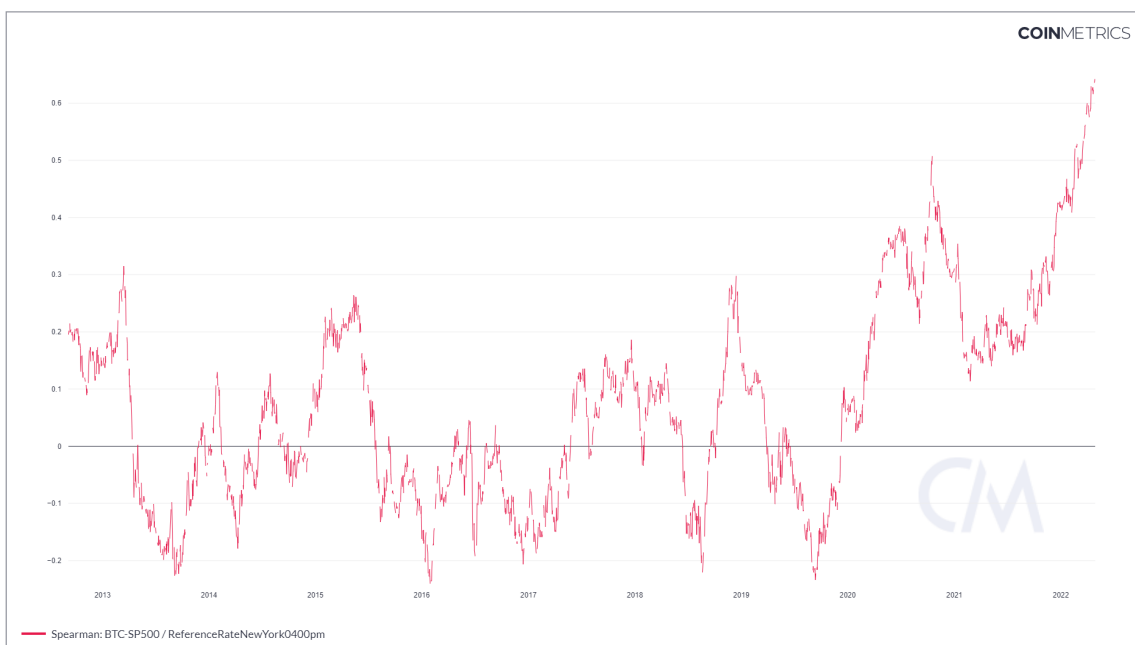
of diversification, with its correlation to traditional commodities, such as gold and equity markets being low in general, see Figure 9 and 10.

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[26] Lawant, B.; Hougan, D. (2020) The Case for Crypto in an Institutional Portfolio. Bitwise Asset Management. Available at https://static.bitwiseinvestments.com/Research/Bitwise-The-Case-For-Crypto-In-An-Institutional-Portfolio.pdf
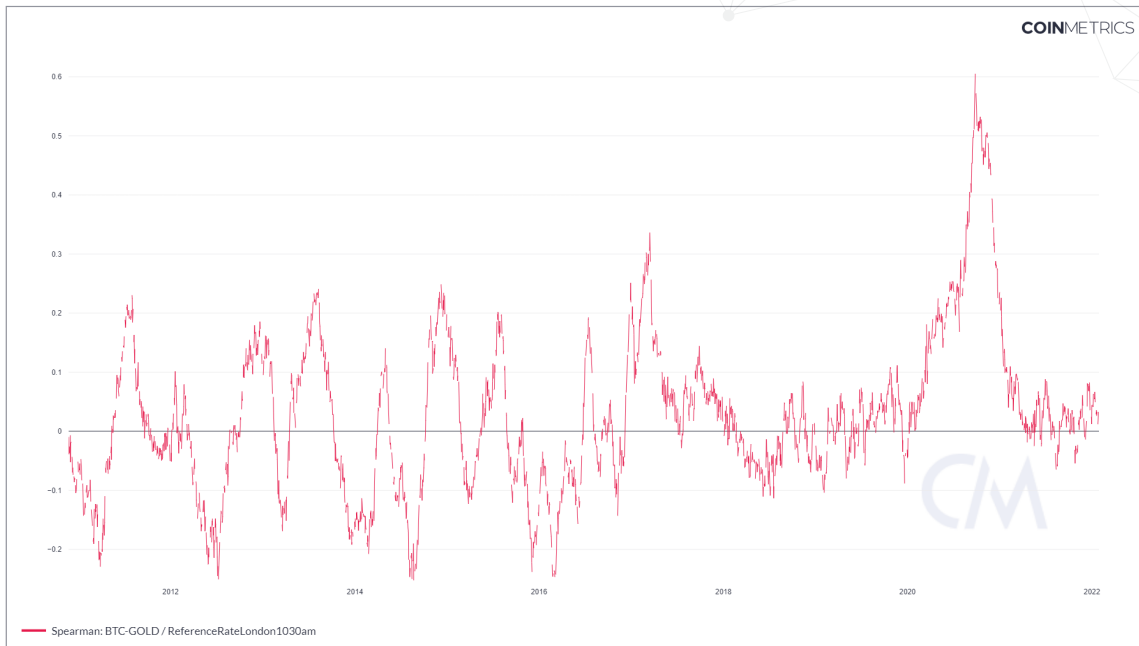
*Figure 9: Bitcoin correlation vs S&P.*[27]
*Figure 10: Bitcoin correlation vs Gold.*[28]

As the narrative of "bitcoin as digital gold" continues to evolve, bitcoin's use case as a store of value is reinforced - with many experienced investors already allocating capital to the asset as a hedge for inflation. In 2020 specifically, we have seen an increased number of traditional institutions gaining exposure in this asset class, either by directly investing in bitcoin, or by gaining exposure through derivative products, including exchange traded products and futures, which make it easier for traditional financial institutions to gain exposure in a regulated way without some of the underlying complexities and security risks. However, one can argue that only early-moving institutions have gained exposure to date and, for most institutions, it is still challenging to gain any meaningful exposure to bitcoin because of evolving regulatory frameworks, increased requirements for institutional and regulated infrastructure, and broader understanding of the asset class.

## OUTLOOK FOR DIGITAL CURRENCIES

The largest incumbents have, to date, not gained meaningful exposure to bitcoin directly. However, these incumbents have deployed meaningful human and financial resources to create regulated and secure financial market infrastructure to support bitcoin and other digital assets throughout the entire value chain, from mining and issuance through to execution, custody and settlement. In the meantime, many regulated institutions are gaining exposure through futures and exchange-traded products that give them access to Bitcoin price exposure without creating risks around regulation and custody.

To see the widespread adoption of bitcoin as an institutional digital asset, you need the market and respective market infrastructure to further evolve and become fully institutionalised and regulated, from initial mining or

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[27] Source: https://coinmetrics.io/ (March 2022)

[28] Ibid.

issuance through to trade execution/exchange and custody. Table 1 shows the current value chain for digital currencies, showing what players in each part do and their function. Mainly traditional institutional players have been cited who are now getting involved within this arena.

| Value Chain Part | Function | What do they do | Traditional Institutional Player Involvement |
|---|---|---|---|
| **Primary** | Miners | Support the underlying Bitcoin network infrastructure, process transactions, create new bitcoins | • Fidelity<br>• Galaxy Digital Assets<br>• Digital Currency Group Foundry |
| | Products | Create bitcoin-related financial products | • Bakkt<br>• Grayscale Capital<br>• 21 Shares<br>• JPMorgan |
| **Secondary** | OTC/Brokers | Facilitate trade execution and market making | • Fidelity<br>• Coinbase<br>• B2C2 (SBI)<br>• Goldman Sachs |
| | Exchanges | Facilitate liquidity provision of assets | • DBS<br>• LMAX<br>• SIX & SBI |
| **Post-Trade** | Custody & Settlement | Ensure the safe-keeping of holdings and proper settlement of trades | • Nomura<br>• Standard Chartered<br>• Fidelity |

*Table 1: Digital Asset Value Chain.*

Once the institutional digital asset value chain is completed and regulatory standards adopted, the current trend of institutional adoption of bitcoin as a digital store of value will be further accelerated. The outlook for digital currency usage by the enterprise will be a function of regulatory clarity, increased and improved infrastructure and increased participation and adoption. Certainly, for the enterprise, bitcoin and other digital assets present a diversification opportunity for their corporate treasury functions and potentially for payments.

## Stablecoins & CBDCs

### WHAT ARE THEY?

Stablecoins are digital currencies that are designed to manage volatility by being backed by a different asset to stabilise their price. There are different types of stablecoins based on stabilisation mechanism and issuer. They leverage all the benefits of digital currencies without the price volatility.

Stablecoins can be designed to maintain a real-world asset price, such as a traditional fiat currency or a commodity, a combination of assets in the form of a multi-collateralised stablecoin or a digital currency (e.g. bitcoin). There are also stablecoins that algorithmically track an external reference price and manage a reserve of assets to maintain that price. Table 2 shows different types of stablecoins and their properties.

| Type of stablecoin | Example | Issuer | Backing Asset | Stabilisation mechanism |
|---|---|---|---|---|
| Fiat Collateralised | USDC | Centralised | Fiat Currency (USD) | 1 USDC is pegged to 1 USD. Every USDC in circulation is backed by $1 held in reserve as cash and short term US paper. |
| Central Bank Issued | DCEP | Centralised | Government Debt (RMB) | Sovereign confidence |
| Commodity Collateralized | PAX Gold | Decentralised | Gold | Each token maintains a peg with 1 ounce of gold (USD) |
| Crypto Collateralized | DAI | Decentralised | Ether & ERC20 tokens | DAI aims to maintain a peg of 1 USD to 1 DAI. DAI are issued as Ether or ERC20 tokens locked as collateral on the Maker platform, and supply and demand of DAI are controlled via the MKR token. |
| Algorithmic | AMPLEFORTH | Decentralised | None | Ampleforth aims to maintain a peg of 1 USD to 1 Ampleforth, and maintains this through algorithmically increasing and decreasing the supply of Ampleforth proportionally for all holders |

*Table 2: Types of stablecoin.*

Stablecoins can be issued by private institutions (e.g. USDC), decentralised autonomous organisations (e.g. Maker) or central banks in the form of central bank digital currency. Stablecoins which leverage blockchain technology can create new payment rails offering cheaper, faster and better payments than existing means. Stablecoins also establish programmable digital money and therefore have the potential to introduce new use cases to the financial services industry.

## HOW IS THIS RELEVANT FOR THE ENTERPRISE?

Stablecoins can benefit the enterprise as a new means of facilitating payment, both for the enterprise to utilise and for their customers. Benefits and use cases of stablecoins include:

- **Accessible and portable store of value**
  - Stablecoins are more secure and portable than traditional fiat currency. Furthermore, stablecoins can support financial inclusion by reducing the barriers to accessing electronic payments.
- **Faster payments**
  - Stablecoins offer an alternative to traditional payment rails, with the potential to remove intermediaries and create low-cost, transparent and secure payment rails.
- **Low-cost remittances**
  - By creating a decentralised payment rail, stablecoins can act as low-cost alternatives to existing cross-border remittance services. Anyone with an internet connection can create a digital wallet and receive or send stablecoins across borders without any additional fees.
- **Instant settlement**
  - Stablecoins supported by blockchain protocols settle in near real-time and automate delivery versus payment, eliminating settlement risk in transactions.
- **Programmable money**
  - Stablecoins can enable new automated and decentralised use cases such as DeFi applications.

Global cash usage has been declining, most recently at an accelerated trend due to the Covid-19 pandemic whilst, on the other side, electronic payments have been significantly growing. Differences in cash usage globally are dramatically different. For instance, China stands ahead of other nations in terms of mobile payments, with the total mobile payments volume expected to reach $26T by 2026.[29] In China, two large payment providers, Alipay and WeChat, cover 50% and 40% of the mobile payments market. This movement to digital payments supports the stance that blockchain-based payment methods will only increase in adoption.

Some large corporations are also launching stablecoin projects. Facebook announced the Diem (former "Libra") initiative, which initially planned to issue a multi-currency backed stablecoin. The announcement of the Diem initiative and the potential for a technology company with the largest global user base to own a privately issued currency raised concerns by central banks and global regulators. The motivation for private companies to launch stablecoins is to control the payment value chain, improve customer experience, and take advantage of the data that can be acquired.

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29 Business Wire (2020) "Global and Chinese Mobile Payment Industry 2020-2026: With Move to Mobile Payment to Fight COVID-19, Mobile Payment Transactions Set to Reach $26.341 Trillion by 2026." Business Wire. Available at https://www.businesswire.com/news/home/20200528005429/en/Global-and-Chinese-Mobile-Payment-Industry-2020-2026-With-Move-to-Mobile-Payment-to-Fight-COVID-19-Mobile-Payment-Transactions-Set-to-Reach-26.341-Trillion-by-2026---ResearchAndMarkets.com

## Looking more deeply at Central Bank Digital Currencies

Regulators have to innovate with the current digitalisation trend and either accommodate private stablecoins in their regulatory frameworks and/or provide a central bank digital currency as an alternative. The increased use of electronic payments and the rise of digital assets has acted as a catalyst for central banks globally to review existing regulatory frameworks and start exploring (and, in some cases, even testing) their versions of digital currency in the form of central bank digital currency.

CBDC offers an innovation on traditional cash not seen for hundreds of years and would represent a tremendous shift for payments within an economy - something which enterprises must prepare for.

To give an idea on the scale of CBDC globally, over 80 central banks are researching and exploring CBDC issuance and its role in the financial system. Thirty-six central banks are actively exploring retail and wholesale CBDC (the difference being whether the end-users are business and individuals or commercial banks). Eighteen central banks are focusing solely on retail CBDC. The People's Bank of China has made the most notable progress, having launched the Digital Yuan ("DCEP") in several regions and currently conducting extensive testing with end-users and merchants in various areas of the country.

Central banks have to weigh the risks of issuing a digital currency with the potential benefits of its issuance. Different approaches central banks can take in issuing a CBDC, which will have different impacts on the existing financial infrastructure and key market participants.

For more information on CBDCs, there is extensive literature on the topic, and suggestions include those in this footnote.[30] Moreover, although blockchain is a leading technology being considered for use in the design and implementation of CBDC with many projects utilising it, some do not, including the domestic version of China's DCEP.



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[30] Digital GBP paper, BIS latest piece etc

# ripple

## Ripple CBDC Whitepaper

Ripple has written a whitepaper which provides central banks with the framework for implementing CBDCs and guidance for ensuring global interoperability — the cornerstone of success for CBDCs. A summary follows:

***What Is a Central Bank Digital Currency?***
A CBDC is the sovereign equivalent of private cryptocurrencies and digital assets like Bitcoin, Ethereum and XRP. It will be issued and controlled by a country's central bank and used by people and businesses for retail payments, much like cash but in digital form. CBDCs will also be used for wholesale settlements in the interbank market.

***CBDCs: The Future of Fiat***
Central Banks issuing their own digital currencies constitute a natural evolution in how we exchange value. But that does not mean that CBDC development should simply follow the old pathways. Our existing currencies were created in a much less globalized world and are not designed for efficient exchange in the current setting.

While most markets are exploring CBDCs that solve specific domestic challenges, each central bank also needs to implement a holistic strategy that enables their CBDC to interact in the global market efficiently, and ensure it can scale and evolve to meet future requirements.

**The Main Benefits of CBDCs**

- **Enhance existing payments infrastructure:**
  Increase the speed and efficiency of payments, while reducing costs and failure rates.

- **Promote financial inclusion:**
  Increase access to financial services for under and unbanked populations and enhance direct person-to-person payments.

- **Encourage greater competition:**
  Reduce barriers to entry and boost access to global markets through interoperability.

- **Foster innovation:**
  Use advanced digital features like smart contracts and programmable money that will be the basis of new financial services.

- **Maintain control:**
  Ensure central banks retain sovereignty over monetary policy and not allow alternative currencies to dominate the market.

The whitepaper is available at https://ripple.com/lp/cbdc-whitepaper.

## OUTLOOK FOR STABLECOINS AND CBDCs

Although the benefits of stablecoins are many, and CBDCs will fulfil a dramatic step forward in payments innovation, challenges still remain both technologically, from the perspective of regulation and widespread adoption. Some of these challenges are:

- **AML / KYC**
  - Due to the decentralised nature of some stablecoin protocols, any user can have access and participate in the ecosystem without any approvals or background checks completed. Stablecoins can allow for large sums to be transferred internationally without any control and therefore pose a risk of being used for money laundering and/or terrorist financing activities.

- **Privacy**
  - While stablecoins created a decentralised payment rail, their public-private key infrastructure can create privacy issues for end-users. In permissioned or proprietary blockchain protocols, privacy issues are created as central banks will be able to track every transaction of individual users. The PBoC is said to adopt a "managed anonymity" framework whereby it wants to ensure users that their identity is only available to the central bank, whilst their transactions are private.

- **Fees**
  - Blockchain technologies are in their early days and often still face technical hurdles limiting their potential short term adoption. Most stablecoins to date are issued on the Ethereum blockchain, which has experienced congestion and fee issues.

- **Governance**
  - Governance challenges will have to be solved by private institutions, decentralised protocols and central banks to facilitate the adoption of stablecoins.

- **Security**
  - Stablecoins offer security by being hosted on a blockchain, thereby creating security threats for users if their private keys or public wallets are compromised. By having stablecoins instead of cash, a user increases his cybersecurity risk exposure.

- **Systemic challenges**
  - Private stablecoins that multinational corporations may issue, such as Diem, can pose systemic challenges to the traditional financial system and central banks. If users adopt a stablecoin or basket of stablecoins instead of commercial banking accounts, it may create a "run on the bank" scenario limiting governmental monetary policy effectiveness.

- **Citizen and business adoption**
  - Stablecoins or CBDC need citizens and businesses to adopt and trust them.  This is a big challenge for unknown providers of a stablecoin.  A CBDC, being central bank-backed, is much more trusted, but there are still privacy challenges within this.

Regulation will be the key driver of stablecoins, and central bank digital currency adoption and recent trends in regulatory advancements are promising for stablecoin adoption. For example, in the USA, the OCC recently

announced that national banks can provide services to stablecoin issuers. Within the EU, new guidance was released, paving the way for stablecoins to exist alongside a digital Euro. In Singapore, a new Singapore dollar-backed stablecoin was approved and, in China, although private stablecoins are banned, the government is actively working on its proprietary DCEP project with live pilots underway.

With the establishment of clear regulatory frameworks around the issuance and servicing of stablecoins, a combination of privately issued and regulated stablecoins and central bank digital currency will likely be present in the future.

Enterprises should be ready to make use of the new, improved features of these payment rails, incorporate them into their existing business models and innovate with new business models. This is not only through utilising new payment infrastructure provided by central governments but also innovating themselves with stablecoins for their purposes - particularly with utility-based tokens elaborated in the next section.

# Financial Utility Tokens

## WHAT ARE THEY?

Financial utility tokens have primarily been used in the Decentralised Finance (DeFi) arena. These new utility tokens have been created particularly around new decentralised financial infrastructure and related governance tokens.

Predominantly, these tokens are built on top of the Ethereum blockchain. The Ethereum environment has been foundational for this market's development and is considered the main primitive that has fuelled its growth, acting as a building block. Unlike Bitcoin, Ethereum has enabled users to develop tokens for their purposes and projects, primarily through smart contracting. Furthermore, token standards such as ERC-20 and ERC-721 have enabled users to build knowing that what they are creating will be compatible with the developing ecosystem infrastructure.

Along with Ethereum, many new finance-focused blockchains are emerging to fuel the decentralised finance arena. Growth for these financial utility tokens has been measured by value locked within these different products, termed as "Total Value Locked" (TVL). The TVL within Ethereum-based products has increased over 50 times between 2020 and the first quarter of 2021, and can be seen in figure 12. The majority of this growth has
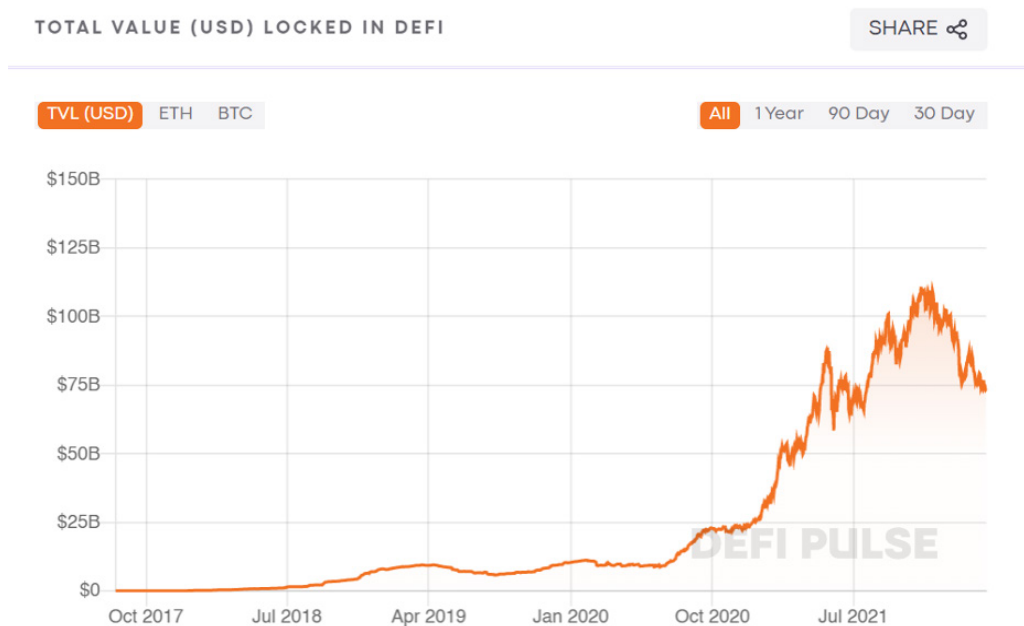


been in the lending arena.

*Figure 11: Growth of DeFi market measured by TVL.*[31]

Growth and experimentation within the DeFi arena has been rapid recently with new projects emerging, rising,

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[31] https://www.defipulse.com/ (March 2022)

breaking and evolving in as little as six to eight weeks. The speed of innovation within this market, not only with respect to technology but also questions of ethical behaviour over financial products, is extraordinary (for instance, see Sushiswap vs Uniswap).

## HOW IS THIS RELEVANT TO THE ENTERPRISE?

The top use cases for these tokens can be broken down into the areas of lending, governance, decentralised exchanges and digital collectibles. In the enterprise context, this is relevant because of the enhanced return opportunities with digital assets, new exchange mechanisms and new business models that can be facilitated. Below we look into more detail into each of these four areas.

**Lending:** Lending markets are amongst the largest in the world and encompass consumer loans, student loans, corporate debt, government bonds and mortgages. The world's debt markets are estimated to be worth more than three times the world's annual output, or also nearly $32,500 of debt assigned to each of the world's 7.7 billion people. Lending markets can be recognised as important fuel for growth in our economies, but they remain quite inefficient.

Indeed, there are many issues with financial inclusion, whereby many SMEs face borrowing problems due to thin credit files. Passthrough issues are also present, whereby rates from central banks and emergency lending schemes seen during the Covid-19 pandemic have not been effectively passed through to borrowers. Intermediary costs remain high, and there are issues with subprime and fraud, all on top of the legacy infrastructure that services these markets.

New blockchain-backed lending mechanisms function by enabling new lending markets for digital assets. These mechanisms differ from our existing subjective-based lending frameworks to codified collateral evaluation.

Typically, lending mechanisms operate such that a user locks up tokens as collateral, and is issued an IOU token that can be redeemed against the deposit in the future. Based on supply and demand, there is an interest rate associated with how much of the IOU token must be repaid and, to protect the lender, the deposit is overcollateralised (typically by as much as 150%). If the value of the collateral falls below a threshold figure, it can be liquidated in order to ensure the lender does not lose funds. A governance token is often associated with the lending protocol, and it can be used to vote on changes with a lending platform, usually on issues related to interest and collateral.

DeFi lending markets are characterised by being transparent: everything concerning a lending transaction is public information. They are democratic, as governance tokenholders vote on aspects related to lending. They are agile, as markets can algorithmically respond in real-time to the supply-demand nature of the market. Fundamentally, they are trustless, as they do not require an intermediary to ensure trust between borrower and lender.

For the enterprise, new lending mechanisms present opportunities to find novel sources of yield, present opportunities for their treasuries and potentially lead to new business models for end customers. *Figure 12* showcases some of the lending markets available on the Compound platform. Here one can see that, even with USDC, a USD stablecoin, lenders are able to earn a rate of 3.28%, far greater then the interest that can be earned with fiat USD in a typical current account.

## All Markets

| Market | | Total Supply | Supply APY | Total Borrow | Borrow APY |
|---|---|---|---|---|---|
| Ether | ETH | $3,087.44M <br> -0.07% | 0.05% <br> – | $74.43M <br> +0.47% | 2.59% <br> – |
| USD Coin | USDC | $1,925.09M <br> -0.72% | 2.42% <br> +0.03 | $1,295.56M <br> -0.06% | 3.91% <br> +0.03 |
| Dai | DAI | $1,601.35M <br> -1.91% | 2.75% <br> +0.05 | $1,197.24M <br> -0.93% | 4.36% <br> +0.04 |
| Wrapped BTC | WBTC | $1,457.49M <br> -0.02% | 0.08% <br> – | $48.91M <br> +0.01% | 3.19% <br> – |
| Tether | USDT | $722.77M <br> -0.24% | 2.64% <br> -0.05 | $508.43M <br> -1.15% | 4.09% <br> -0.04 |
| Basic Attention Token | BAT | $105.56M <br> – | 0.12% <br> – | $4.53M <br> +0.03% | 3.79% <br> – |
| Uniswap | UNI | $96.55M <br> – | 0.18% <br> – | $5.16M <br> +0.01% | 4.51% <br> – |
| Compound Governance Token | COMP | $96.10M <br> -0.02% | 0.02% <br> – | $908k <br> +1.04% | 2.56% <br> – |
| TrueUSD | TUSD | $88.42M <br> – | 1.56% <br> – | $47.94M <br> – | 3.14% <br> – |
| 0x | ZRX | $75.73M <br> – | 0.13% <br> – | $3.36M <br> +0.02% | 3.85% <br> – |
| Wrapped BTC (Legacy) | WBTC | $59.24M <br> – | 0.00% <br> – | $20k <br> – | 2.32% <br> – |
| ChainLink Token | LINK | $30.33M <br> – | 0.43% <br> – | $3.38M <br> +0.01% | 5.28% <br> – |
| Maker | MKR | $19.81M <br> +0.18% | 0.00% <br> – | $3k <br> – | 2.31% <br> – |
| Fei USD | FEI | $5.00M <br> – | 0.08% <br> – | $692k <br> – | 0.79% <br> – |

*Figure 12: Lending and borrowing market rates by coin (March 2022 - Compound Finance).*[32]

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[32] https://compound.finance/

Table 3 shows the most popular digital asset lending platforms by Total Value Locked and their respective IOU and governance tokens.

| Platform | Total Value Locked (USD) | IOU Token | Governance Token |
|---|---|---|---|
| Maker | 15B | DAI | MKR |
| Compound | 6B | cTokens | COMP |
| Aave | 8B | aTokens | AAVE |

*Table 3: Largest DeFi lending platforms by TVL (March 2022 - DeFi Pulse).*[33]

**Governance:** Governance tokens are tokens that grant their holders permission to participate and influence protocol and other platform-related decisions, with the weight of their influence being proportional to the share of tokens held. Changes to a protocol can be proposed, after which they are vetted and voted. In the case of Decentralized Autonomous Organizations (DAOs), decision making is facilitated by executing smart contracts, which lead to the acceptance or rejection of proposals put forth.

One prime example of governance tokens in a DAO is the Maker Protocol or MCD (Multi-Collateral DAI) system in the MakerDAO project. This project allows users to generate the stablecoin DAI, which is soft-pegged to the US dollar and was one of the first DeFi (decentralised finance) applications with wide adoption. The governance rules of this dApp on the Ethereum blockchain are imprinted in its voting contract, DSChief, which assigns voting weight proportionally to the amount of the MKR token that each voter stakes. The Compound.Finance project constitutes another salient use case of usage of governance tokens in DeFi.

A major difference between this and owning stock (equity), which also constitutes a way of getting involved in organisational governance, is that individual decisions can be voted on, in contrast with a board of directors electing a management board that takes care of individual decisions.

The answer to why governance tokens matter to enterprises is manifold. Firstly, off-chain governance is costlier than on-chain governance (and entails a higher risk of hard forks).[34] Secondly,
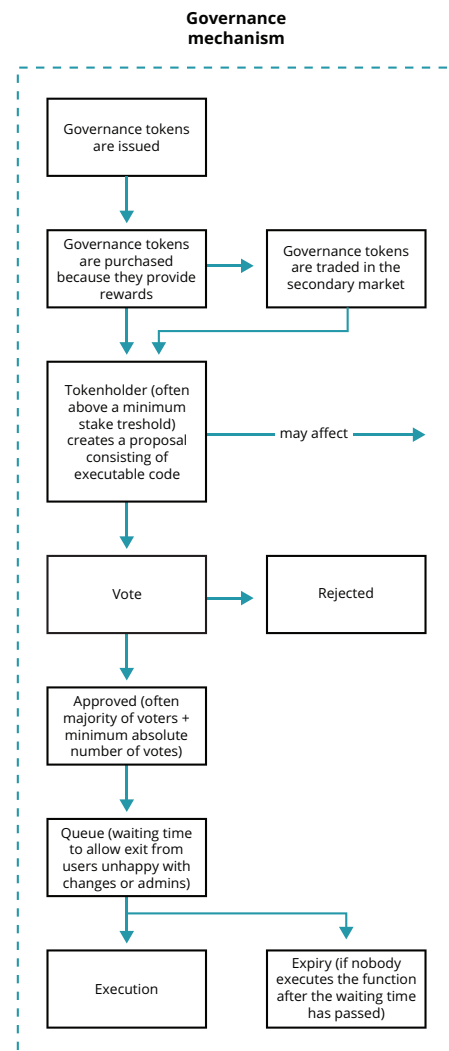
**Governance mechanism**



*Figure 13. Governance tokens*

[33] https://www.defipulse.com/

[34] Kothe, P. (2021) "Governance Tokens – The New Medium Of Power?" Datarella. Available at https://datarella.com/governance-tokens-the-new-medium-of-power/

governance tokens are a tool to increase the user base of a business. This is because users may find added value in the prospect of participating directly in decision-making for personal, business and/or ideological reasons. Thirdly, governance tokens lead to more involved communities,[35] which is something often sought. Fourthly, they are a necessary component in DeFi, allowing to claim membership to a novel and innovative group of undertakings. Finally, they bring about the actual benefits of decentralisation, such as collecting disperse knowledge through democratic discussion and decision-making. Risks exist, however, such as the dilution of accountability in the group and the possibility of "whales" (those with control over a large number of governance tokens) taking over the decision-making process.[36] Figure 13 shows how governance tokens can work.

**Decentralised Exchanges:** As the number of digital assets has grown, the need to facilitate fair exchange has increased. In traditional financial markets, exchanges of different financial products, currencies, stocks and bonds with fiat currency and as cross-product exchanges for mainstream products have deep and liquid markets. These are all run on and facilitated on centralised exchanges and have issues with inefficiency, settlement time, and transparency.

Exchanges for digital assets are both centralised and decentralised. Taking centralised exchanges first, examples are Coinbase (due to list at the time of writing) and Binance, which have a large number of tokens and facilitate digital asset to digital asset and digital asset to fiat exchange. But these exchanges themselves are not publishing all trades to the blockchain, hence are not fully transparent and control which projects can be listed. In many cases, they also charge large listing fees.

Decentralised exchanges (DEXs) seek to enable any project to be able to facilitate the liquid exchange of a token with respect to another token through the provision of liquidity pools. To make a market between two tokens, one deploys two pools of these tokens, attracts other users to deposit those pairs of tokens and enables automated market-making functions to price the exchange of these two assets algorithmically.

DEXs differ from centralised, conventional order book exchanges. Instead of orders and market makers facilitating liquidity through price, algorithmic functions control this, allowing the exchange rates to move along predefined trajectories. This type of exchange mechanism is defined as Automated Market Maker functions.

Users can be incentivised to contribute to liquidity pools and add tokens by earning reward tokens from the protocols for participation and earning exchange fees. *Table 4* shows some of the most popular DEXs based on liquidity, reward tokens, pairs and trading volume.

| Platform | Liquidity (USD) | Reward Token | Volume (24hr) | Pairs |
|----------|-----------------|--------------|---------------|-------|
| Uniswap | Uniswap | UNI | 1B | 924 |
| Sushiswap | Sushiswap | Sushi | 83M | 785 |
| Curve | Curve | CRV | 120M | 69 |

*Table 4: Largest DEX based on liquidity (March 2022).*[37]

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[35] Mihajlović, M. (2022) "What Are Governance Tokens?" Shrimp Academy. Available at https://blog.shrimpy.io/blog/what-are-governance-tokens-defi-decentralization-explained

[36] Ibid.

[37] https://www.coingecko.com/en/dex

DEXs offer enterprises the generation of liquidity with any digital asset they create, and exchange digital assets easily without relying on any centralised operator to facilitate liquidity. This is useful when seeking liquidity for the token projects that they create, and for facilitating liquidity on any token holdings that they may have, particularly in their treasuries. Another benefit are the reward tokens that can be earned by participating in a pool in a DEX, which themselves have value in the market.

**Digital collectibles and in-game assets:** Digital collectibles have primarily come through in the form of NFTs. These are digital assets that are unique and cannot be subdivided, and there ownership can easily be proven. In the case of digital collectibles and in-game assets, the uniqueness of these is paramount and a perfect example of a blockchain token use case. NFTs development initially gained popularity on the Ethereum blockchain, with its ERC-721 standard, but many new platforms are also offering NFT tokens. For example, the Symbol blockchain with its Mosaics, as part of its Smart Asset system enable creation of tokens, NFTs and digital collectibles, but also collections of more specialized assets such as reward points, shares of stock, signatures, status flags, votes or even other currencies. For the enterprise, Mosaics present a unique and flexible solution to tokenisation in any form.

Digital collectibles and NFTs started most famously with CryptoKitties, simply digital representations of cats that could be traded and bred with each other. When CryptoKitties initially came out, trading of these NFTs became extremely popular (nearly bringing the Ethereum blockchain to a standstill), with one of the most expensive Cryptokitties being sold for 600 ETH (approx $1.3m).

Decentraland is an example of an in-game asset. Decentraland is a decentralised world that is built on top of ERC-20 tokens. Users within this gaming environment can use MANA tokens to buy goods, services and virtual land. Decentraland has parallels with Minecraft, and the game environment supports multiple NFTs within it for different items bought.

NFT interest has most recently focused on the sports and art worlds. Within the sporting arena, NFT collectibles have gained considerable interest in the basketball and football worlds. Sorare recently raised $50m in Series A funding to expand its NFT fantasy football environment, with over 126 officially licensed clubs on its platform.[38] Users can collect and trade limited edition digital cards, build up their teams and earn points based on real-life performances. Users can also earn rewards for making the right decisions and progressing in the fantasy football league. Soare is connecting fans within the digital environment to the real world. Socios is another example of an NFT being linked with football clubs. Here fans of each club are issued with digital collectibles, and fans can participate in club decision making through ownership of FAN tokens from each club. FAN token holders can decide decisions such as how to decorate the team bus, version of logos, and even what song playlists to feature during player warmups.

NBA Top Shot is another example of NFTs, but for which confer ownership of digital clips, or moments, within games by certain players. Currently, the platform offers over 7.6 million different moments that users can purchase and trade and boasts over 340,000 different users. Certain moments (clips) have sold for hundreds of thousands of dollars.

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[38] Partz, H. (2021) "Blockchain Soccer Gaming Startup Sorare Raises $50M." CoinTelegraph. Available at https://cointelegraph.com/news/blockchain-soccer-gaming-startup-sorare-raises-50m

Finally, NFTs have also come to the world of art. Digital art automatically gains significant utility from having NFTs and being placed on a blockchain. The uniqueness, provenance and ownership of the artwork can be transparently traced and verified by all. In March 2021, a digital artwork called "Everydays: The first 5000 days" sold for $69m by Christies.[39] This was for an NFT jpeg of 319,168,313 bytes and of 21,069 x 21,069 pixels in dimension. The digital art market now has an outlet for artists to sell their work with the provenance tracked uniquely. This uniqueness of the asset is enabling new markets to emerge.

All of these different markets can be seen in *Figure 14*. For the enterprise, digital collectibles and NFTs represent a means for creating scarcity and uniqueness to any property that they wish to elucidate - not only for purely digital information but also for any physical asset they wish to assign create a token for.

NFT usage is not only restricted to collectibles and art, but are also available for access rights, IP, certification, qualifications, identity and so on. Many of these use cases have been discussed in the prior sections.
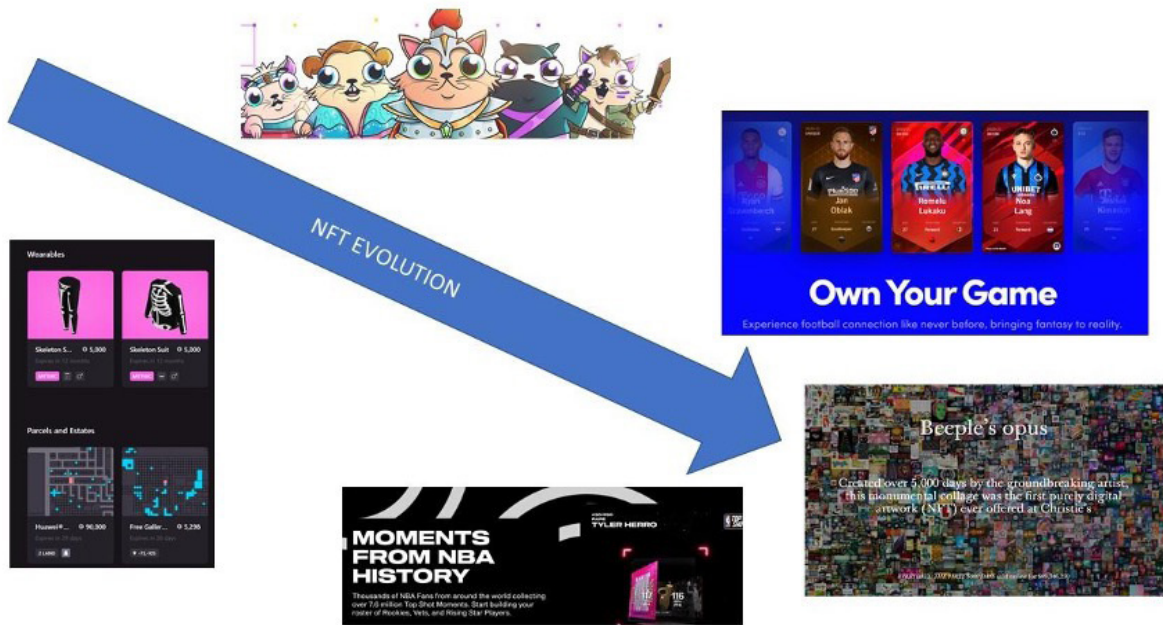


*Figure 14: Evolution of the NFT market.*

[39] Kastrenakes, J. (2021) "Beeple sold an NFT for $69 million." The Verge. Available at https://www.theverge.com/2021/3/11/22325054/beeple-christies-nft-sale-cost-everydays-69-million

## OUTLOOK?

Currently, the DeFi arena and financial utility tokens are still extremely new and emerging. Relevant business models that use utility tokens for the enterprise may still be some time away. Nonetheless, the use cases previously mentioned should be experimented with. For example, DeFi lending protocols can offer yield many times greater than interest rates in traditional financial markets, without seemingly requiring a commensurate increase in risk. These markets are still young, have not seen periods of market stress, and therefore have not had appropriate risk mitigating control measures put in place.

Furthermore, looking at *Figure 15*, there are various degrees of decentralisation in lending when digital assets are used. As with traditional lending and traditional fiat markets, different degrees of centralisation exists between central, commercial and peer to peer lenders. Here this experimentation for movement from traditional to peer to peer (P2P) lending has not seen the success that was expected (the majority of P2P lenders are not profitable, and share prices post IPO have fallen considerably). In the context of blockchain and digital assets, this spectrum of decentralisation also exits from CeFi Crypto banks with various financial products to the aforementioned DeFi lending protocols. DeFi lending markets also currently face an issue with actual utility. The main usage appears to be that of leverage trading rather than true traditional lending utility to fuel business growth through spending - but this would be expected to change as the markets and utility of digital assets gain wider adoption.

*Figure 15: Degrees of decentralisation in lending markets.*[40]



Looking at decentralised exchanges and AMM's despite their apparent advantages with automation, decentralisation, and on-demand continuous liquidity, there can be significant slippage with limited pool depth. New protocols are being researched and designed that will aim to tackle this as the market evolves. Evolution and experimentation are extremely fast and accompanied by immaturity and naivety with projects.

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40 Xu, J., Vadgama, N. (2022) "From banks to DeFi: the evolution of the lending market." In Enabling the Internet of Value (pp. 53-66). Springer, Cham..

With respect to NFTs and digital collectibles, one must understand that uniqueness does not necessitate that there cannot be copies or other versions. Uniqueness comes from the ability to track ownership, not controlling who can create a token or not. Similarly, regulation has not reared its head within the digital collectible arena but surely will be coming soon. Many of these NFT platforms are centralised and, as a result, may be subject to anti-money laundering regulation, more akin to traditional financial markets. There are still issues of interoperability: NFTs on one platform cannot be placed in a wallet for another platform or cross these barriers.

Many of the older NFT issues, such as network congestion due to transaction volume (as in the case of Cryptokitties bringing the Ethereum network to a standstill), scaling issues and transaction fee costs, have solutions from next-generation blockchain platforms. For sure, the technology within this area is ready, only the regulation is missing, and already as discussed above, is coming and moving towards that of the traditional financial markets.

# ripple

## NFT future thoughts from Ripple

Since day one, we have viewed crypto and blockchain as powerful levelers, unlocking access and equity for everyone. The growth of NFTs is an important part of that vision, helping build a tokenised future that will allow new business models to prosper and people to engage more deeply with the communities and things they care most about.

That vision is fast becoming a reality. In fact, the World Economic Forum projects that 10% of the world's GDP will be tokenised by 2027. Just five short years from now!

*Solving NFT Pain Points*
Unfortunately, today, many creators are still hesitant to engage with NFTs because of technical concerns about NFT platforms or for fear that their NFTs will not gain traction. Developers can also be turned off by clunky user experiences, high transaction fees and environmental impact concerns with minting on many other platforms.

*XRPL: Built for Tokenisation*
The XRP Ledger, as an open-source, decentralised blockchain, supports the tokenisation of any asset, including NFTs, with a clear set of existing and proposed NFT standards. It delivers a seamless NFT experience that offers creators a powerful way to monetize their works, and gives developers all the functionality they need — including speed, low cost and built-in royalties — to efficiently and sustainably move value at scale, and without the need for Layer-2 protocols.

Its built-in decentralised exchange (DEX) has enabled the issuance or trading of more than 5,400 different tokens since its inception. Creators minting and creating NFTs on the XRPL can also benefit from its deep liquidity and near real-time settlement for tokenised assets.

Further, the XRPL's consensus mechanism powers low-cost transactions, compared to the huge fees sometimes required on some other blockchains. Carbon-neutral and up to 120,000x more efficient than leading proof-of-work blockchains, the XRP Ledger provides developers with the unique capability to run highly sustainable NFT apps and marketplaces.

Blockchain technologies can also be applied to create digital forms (tokens) of traditional financial securities, creating digital assets that leverage the underlying properties of DLT to create efficiencies throughout the securities life cycle. In the coming decade, digital assets will become ubiquitous in the financial services industry, and the full value chain of these assets, from issuance to custody, will be digital and run on some form of distributed ledger technology.

In practice, tokenisation refers to the creation of digital contracts held in distributed ledger systems in the form of smart contracts that underpin real-world assets. Security tokens can act as instruments that provide the right of ownership and entitlement to a share of future profits or cash flows of the underlying asset. As an example, a token can represent partial ownership of a specific property or financial instruments such as a government bond or private debt security. By owning the token, the tokenholder has the same rights to future profit shares and cash flows by holding the paper-based security as done in the current financial system.

One could state that tokenisation allows the creation of a new financial system — one that is more democratic, more efficient and greater in scope than anything before. However, whilst Security Tokens promised to be the most compelling use case driving institutional adoption of blockchain technologies, their adoption to date has been limited.

Overall, security tokens in circulation amount to c. $350bn in market value,[41] only a fraction of the multi-trillion dollar value locked in traditional equity and debt capital markets, and illiquid markets such as real estates, art and other collectibles. Before we see the widespread adoption of security tokens, financial services institutions will have to fully transform the traditional security value chain, which includes establishing technological and regulatory standards across the industry.

Most financial services institutions looking at digital assets in 2017 and 2018 neglected Bitcoin but understood the pain points of traditional financial securities and the potential for blockchain technology to upgrade the traditional financial services market infrastructure as a whole. Therefore, whilst many traditional financial services institutions neglected the increased interest in Bitcoin, they started researching and experimenting with the tokenisation of traditional financial assets.

Incumbents have deployed human and financial resources in the digital asset ecosystem to evaluate and be able to reap the potential benefits of asset tokenisation, aimed at reducing the cost and time in the issuance process and automating and improving the overall securities lifecycle.

So, how does tokenisation work? The infrastructure that supports security tokens is based on DLT and, therefore, not all too different from the digital asset value chain we looked at in earlier parts of this report.

Depending on the type of issuance, the security token issuance process can differ. However, generally speaking, key participants in the security token issuance process include: issuing entity, issuance platform, security token exchange, custodian and settlor. This is further elucidated on in *Table 5*.

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[41] PwC (2020) "6th ICO / STO Report: A Strategic Perspective." PricewaterhouseCoopers. Available at https://www.pwc.com/ee/et/publications/pub/Strategy&_ICO_STO_Study_Version_Spring_2020.pdf

| Lifecycle Stage | Stage | Description |
|---|---|---|
| 1 | Issuing Entity | The issuing entity can either be a corporate institution wishing to issue tokenised equity or debt directly or through the support of a traditional financial services institution involved in the traditional capital markets. The issuing entity sets the key requirements for the token offering, jurisdiction, counterparties, exchange and custodian. |
| 2 | Issuing Platform | The issuing entity, either independently or supported by a financial services institution, selects an issuance platform to create the tokenised product. The issuance platform - often referred to as a security token platform - provides a technology solution that handles investor accreditation, KYC/AML requirements, capital raising taxations, and other things related to shareholder provision (e.g. specific token rights, etc.). Such solutions can be provided by emerging technology start-ups or financial services institutions with proprietary tokenisation platforms. They can provide a digital tool that helps automate traditionally manual processes, reducing human error and increasing speed. Once a security token issuance platform has been selected by the issuing entity and all details specific to the token issuance have been decided, a security token is issued and sold off to the accredited investors to raise funds. |
| 3 | Security Token Exchange | Whilst the process of issuing a token through a security token platform can create significant efficiency benefits for the issuing entity through the automation of various manual tasks, the real benefits of security tokens, including 24/7 trading & settlement and increased liquidity, are reaped at the secondary market trading layer and enabled through security token exchanges. As their name suggests, security token exchanges are regulated digital asset exchanges that support the listing and trading of security tokens. Exchanges specialised for security tokens list the issued tokens and allow onboarded investors to seamlessly trade the asset on a 24/7 basis with instant settlement confirmations, offering significant benefits to traditional exchanges that support limited trading hours and T+2 settlement of securities. |
| 4 | Custody & Settlement | Lastly, as part of the issuance process, a digital asset custody solution is also selected to provide secure custody of the issued asset depending on the regulatory requirements. The custodian is also involved in ensuring that the assets - including stock certificate, property title deed, or physical painting (in the case of art tokenisation) - are held in a secure location, with the rights of the token-holder clearly defined and legally binding. Due to the digitally native characteristics of security tokens and the digital asset value chain, custodians have also started to offer auxiliary services in prime brokerage, including lending/borrowing of tokens, trade execution services and value-adding services such as reporting and corporate events. |

*Table 5: Security token issuance life-cycle.*

## HOW IS THIS RELEVANT TO ENTERPRISE?

Potential benefits of tokenisation to the enterprise are manifold and include:

- **Saving time:** reducing the time from issuance decision to cash in the bank. By creating a digital contract that replicates a traditional asset contract, several processes and intermediaries are no longer required, significantly speeding up a deal to completion.

- **Automation:** manual processes in securities lifecycle through the use of smart contracts, whereby, for example, an issuer can automate the payment of recurring coupon payments to a digital bondholder without the need for back-office operations

- **Increased availability/accessibility:** Security tokens that run on distributed ledgers offer the same properties as digital currencies that makes them available 24/7 without the need for specific operating hours.

- **Reduced cost** - Reductions in securities issuance costs.

- **Fractionalisation of assets:** security tokens have the potential of significantly increasing the liquidity of illiquid or hard assets, thereby potentially removing the "illiquidity discount" in financial transactions. For example, in today's financial markets, collectibles like art or vintage cars offer interesting investment opportunities. However, the capital required to participate in this financial segment is often prohibitive to the mainstream investor. Tokenisation of these assets allows the issuer to make hard assets fully divisible and thereby increase potential liquidity in the market.

- **Interoperability / Inter-exchangeability:** as soon as traditional financial products are tokenised, these become inter-exchangeable with each other, significantly improving efficiency and reducing costs in cross-asset trades. Moreover, if these security tokens are issued on public or open distributed ledger protocols, they become interoperable and therefore further inter-exchangeable with other digital assets, including cryptocurrencies.

Because of these benefits, several financial services institutions are researching and piloting blockchain technologies for the issuance of security tokens of various forms. Several startups are also creating new platforms focusing on specific areas of the securities value chain (issuance, trading, custody, etc.) and partnering with incumbent financial services institutions to complete trials and put initiatives into production.

There are various use cases for the tokenisation of assets based on the type of asset to be tokenised. The following are current use cases and projects that have been implemented.

**Real-Estate Emaar Tokenisation:** Real estate is an interesting use case for tokenisation. It is seen as a generally safe investment. Nevertheless, in most cases it requires high initial capital to gain any meaningful exposure to the asset class. Emaar, the UAE-headquartered global real estate development company, is looking to tokenise parts of their real-estate portfolio, creating a new way for the firm to raise capital, as well as giving access to attractive investment opportunities to a broader set of investors. Furthermore, Emaar has already launched the EMR token to act as a utility token for the group, allowing clients to store and spend their loyalty and reward points throughout the Emaar group of hotels and residences.[42]

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[42] Premchand Kasi, C. A. (2020) "EMAAR To Tokenize Real Estate Using DLT." Global Fin X. Available at https://globalfinx.in/emaar-to-tokenize-real-estate-using-dlt/

Bimtrazer[43] is another example of a project in the real estate domain. Utilising the Symbol blockchain, Bimtrazer is adding relevant real estate supply and construction information onto the blockchain. This information can also be contained in the ownership information for real estate, powerfully supplementing ownership with historical information regarding a property, which is currently disparate and fragmented - thereby increasing the efficiency of this illiquid market.

**Commodities - Coinshares DGLD Consortium:** Coinshares, one of the leading digital asset managers to date, has recently launched the DGLD Consortium and the Digital Gold (DGLD) token,[44] to give gold investors the convenience and security of a digital asset and the stability of gold, whilst removing certain intermediaries and reducing costs for the investor. DGLD Tokens represent digital proof of ownership of "allocated gold" physically held in a Swiss vault and secured through the blockchain protocol, rendering gold digitally usable and physically redeemable.

**Collectibles - Curio Invest Car Tokenisation:** Collectibles, such as art, vintage items, cards, etc. can also be tokenised to create investable and liquid products. A company focusing on the tokenisation of collectibles, and more specifically luxury cars, is Curio Invest. Curio Invest identified a niche in the luxury car marketplace, realising that several modern sports cars see a significant increase in value over the years and therefore can act as attractive investment opportunities. Through tokenisation, Curio Invest is democratising the investment process for luxury items, allowing smaller investors to gain exposure to a fraction of these assets, thereby removing the capital constraints and risks of owning the full asset.

Another example is also the Wave Financial who are tokenising Kentucky bourbon, making fractionalised investment into these collectibles more affordable to the wider market. This project utilises the Symbol blockchain.

**Debt - World Bank Bond-i:** The use case with the highest potential is the tokenisation of debt offerings, which in the traditional market involve a lot of legal documentation and manual processing. Through the tokenisation of these assets, issuers hope to reduce the time to issuance and improve the overall bond lifecycle by automating coupon payments.

**Equity - Securities / Tokeny - tokenised fund:** Security tokens of equity are being explored. However, they have not gained wide adoption mainly because of the regulatory requirements and consideration. An early mover in this space is Overstock, a US-based internet retailer, who launched the tZero tokenisation platform and secondary exchange and then tokenised the companies share capital.

Propine is an example of a full end-to-end securities issuance platform with fully compliant custody services to ensure safe token maintenance and delivery. They utilise the Symbol blockchain and are currently working with a number of institutional clients to manage risk and compliance for digital assets by tokenising capital market products as well as the vehicles to access them.

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[43] Unlock Media (2020) "Bimtrazer to Use NEM Blockchain Platform to Oversee FIFA 2022 Construction Project." Unlock Media. Available at https://www.unlock-bc.com/news/2020-02-05/bimtrazer-to-use-nem-blockchain-platform-to-oversee-fifa-2020-construction-project

[44] CoinShares Group (2020) "CoinShares' DGLD Consortium Allows Investors to Redeem Gold Tokens for Physical Bullion." Cision PR Newswire. https://www.prnewswire.com/news-releases/coinshares-dgld-consortium-allows-investors-to-redeem-gold-tokens-for-physical-bullion-301152528.html

## OUTLOOK

Whilst these token offerings show the potential of the underlying technology in creating a more efficient way of raising capital and trading secondary securities, the widespread adoption of security token offerings has still been limited to date.

Looking into the future, a stable and regulated market infrastructure layer will further need to develop to drive the adoption of security token offerings in the financial market industry. This trend will further be accelerated by increased corporate involvement, including involvement from financial services institutions who are at risk of seeing parts of their business being disintermediated through the automation of various middle- and back-office processes.

These financial services institutions have to understand the potential benefits and risks that security token offerings provide to their institution and identify the best way of participating in the market. At the same time, they need to continue to provide financial services to their clients. Incumbent financial services institutions have been quite active in the industry through strategic investments, joint ventures, in-house development, and industry consortia participation.

A number of incumbent financial services institutions have also been actively testing and issuing financial securities on a distributed ledger protocol, including:
· Bank of China bond tokenisation $2.8bn[45]
· Santander $20m tokenisation[46]
· Nomura tokenisation of bond[47]
· JP Morgan tokenisation of gold bars[48]

Regulatory frameworks around tokenised assets are developing. However, while some regulatory bodies recognised that tokenisation offers an opportunity to develop a new market and respective regulatory guidelines that promote international alignment and consistency, this is harder to conceive in practice.

The European Commission, for example, is pursuing to develop international standards with the executive vice president saying that "Lack of legal certainty is often cited as the main barrier to developing a sound crypto-asset market in the EU. This is a good chance for Europe to strengthen its international standing and become a global standard-setter with European companies leading new technologies for digital finance."[49]

Nevertheless, some jurisdictions are progressing on their own, including Switzerland and Liechtenstein, which acted as first movers and implemented legal frameworks accommodating the issuance of digital securities in a regulatory compliant way. The UK is also progressing with the establishment of a new crypto-asset framework and the approval of a new crypto-asset licensing regime, with the first market participants (including security token exchange Archax) already being granted licences to operate. The US has also been moving forward with new broker-dealers being licensed to service security tokens and alternative trading systems (ATS) being created to list and exchange security tokens.

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[45] https://currency.com/bank-of-china-blockchain-bonds-issued

[46] https://www.internationalinvestment.net/news/4004771/banco-santander-issues-usd20m-blockchain-bond

[47] https://www.nomuraconnects.com/focused-thinking-posts/japans-first-bond-offering-using-blockchain-technology/

[48] https://tokenist.com/jpmorgan-to-tokenize-gold-bars/#:~:text=It%20has%20just%20come%20out,premium%20on%20the%20global%20market.

[49] https://ec.europa.eu/commission/commissioners/2019-2024/dombrovskis/announcements/speech-executive-vice-president-valdis-dombrovskis-digital-finance-outreach-2020-closing-conference_en

The increased involvement of institutional investors and regulated financial services institutions over the coming year will further support the development of clear and consistent regulatory frameworks for the issuance of security tokens.

# Navigating Digital Assets with a Token Taxonomy

Whenever discussions about any digital asset come up, especially in the enterprise context, one vital component is regulation. Below, we present a taxonomy to help guide an innovation manager's understanding of the legal and regulatory treatment of particular digital asset uses.

*Figure 16* shows two axes, one on the scope of a digital asset and the other on its representations;

- Scope here refers to whether the use case is more akin to a traditional financial asset and used for fundraising on one side, or more applicable to be utilised within a platform ecosystem.
- Representations here refer to the type of claims and obligations or rights and issues present with a use case.

It should be noted that the position of a token use case does not imply a greater degree of scope or representation, except for those highlighted in red that have a greater regulatory burden. Furthermore, certain emerging digital assets sit across several of these lines – making context especially important.
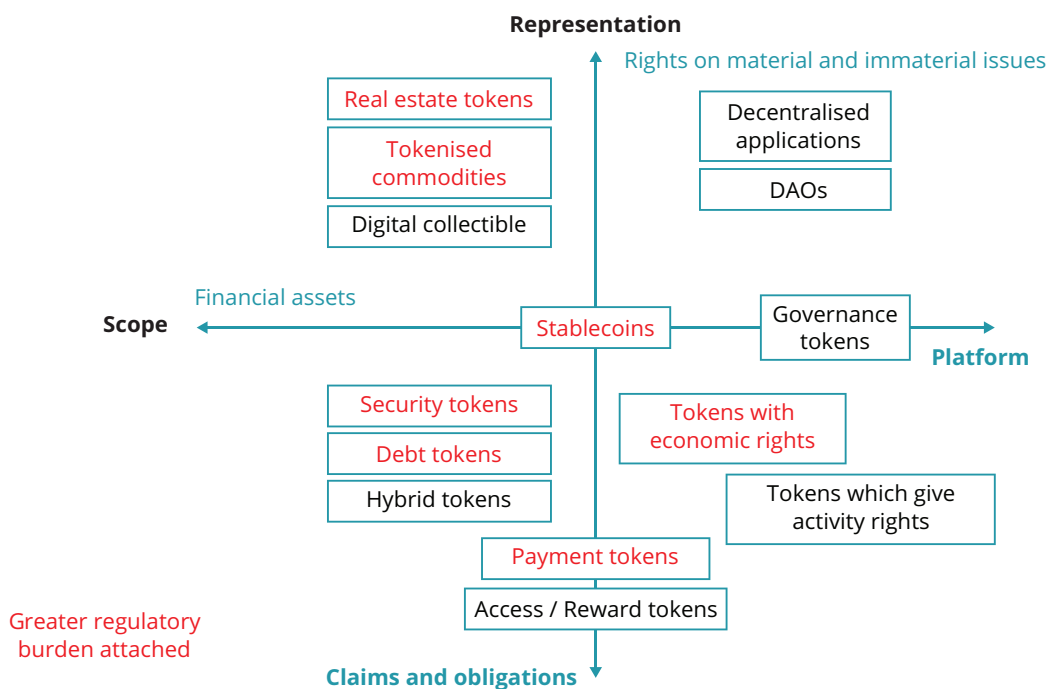


*Figure 16: Where digital assets may stand with respect to representation, scope and regulatory burden.*

Whilst nearly every use case presented in *Figure 16* and throughout this report will require an innovation manager to consult on legal and regulatory issues, those coloured in red may have a greater degree and sensitivity of regulatory burden attached to them.

# Opinion pieces

## Status quo and future of digital asset use cases for enterprises - Andranik Tumasjan

The notion of enterprise digital assets has recently become increasingly popular in the business world and parts of society. The basic idea is to create a (blockchain-based, cryptographic) unique digital representation of a physical good (e.g., a piece of paper document, land, product) or even immaterial entities (e.g., time) for enterprise use. Creating digital assets is no more and no less than the apparently next logical step in the digital transformation – from physical entities (e.g., paper documents) toward digital documents (reproducible, non-unique) replacing paperwork with unique digital assets (non-reproducible, unique) representing physical and immaterial entities in the digital space. Potential gains for companies are mainly process efficiency gains – managing, transacting and collaborating on assets may become faster and more transparent. In addition, completely novel forms of digital assets, such as tokenised working time, are imaginable to be created and traded.

Thus, in theory, both the idea and the prospects are compelling. In the current and short-term future practice, we are of course not there yet. However, the notion of enterprise digital assets – or in other words, tokenisation of entities – can as of now certainly serve as a futuristic beacon guiding us toward the days when enterprise digital assets may become widespread reality. Until then, several barriers have to be overcome, the complexity and resulting transformation needs of which cannot be underestimated.[50]

Naturally, a major point will be legislation and regulation. Many rules and regulations need to be changed and complex questions, such as data protection and property rights, need to be addressed. As many companies are involved in international business, these questions have to be tackled to be compliant with different legislations. Compatibility with existing legacy IT and other management systems is a further point that will require huge transformation efforts. Interoperability between different DLT/blockchain systems within and between companies and according interfaces need to be designed. Employee upskilling and training and/or recruiting new talent having the required knowledge and skills will be needed. In short, this rather incomplete and illustrative list demonstrates that we are facing no less than a huge and comprehensive paradigm shift[51] if enterprise digital assets are to become widely adopted by businesses.

At the end of the day, to make enterprise digital assets a priority for companies now, there has to be a clear relative advantage in comparison to the existing solutions that would justify investing in the above-mentioned transformation efforts. Achieving the above-mentioned transformations requires a huge collaborative effort of many firms within and across industries, such as is the case in existing blockchain industry alliances. Alternatively, a compelling novel solution could come from existing large tech players or emerging start-ups which would then be widely adopted due to its relative advantage to existing solutions (e.g., as in the case of big innovations, such as the world wide web or personal computers). Regardless of the way in which such a transformation may happen, it is clear that introducing and using enterprise digital assets is not a short-term one-shot project run but rather a collaborative marathon.

[50] Tumasjan, A.; Beutel, T. (2018) "Blockchain-based Decentralized Business Models in the Sharing Economy: A Technology Adoption Perspective." In Treiblmaier, H.; Beck, R., Business Transformation Through Blockchain. Volume 2, Cham, Switzerland: Palgrave Macmillan.

[51] Schneck, P.; Tumasjan, A.; Welpe, I. M. (2020) "Next generation home sharing: Disrupting platform organizations with blockchain technology and the Internet of Things?" In Treiblmaier, H.; Clohessy, T,: Blockchain and Distributed Ledger Technology Use Cases: Applications and Lessons Learned. Basel, Switzerland: Springer Nature.

# Blockchain and Collaboration Efficacy - Seongbae Lim

Bitcoin has made a very substantial contribution towards raising awareness about the value of blockchain technology. Nevertheless, the identification of blockchain to Bitcoin (and, more generally, cryptocurrencies) has also obscured the possibility of other uses of technology.

Fortunately, numerous services using blockchain have recently appeared in various fields beyond cryptocurrency, including supply chain management, medical care, education, games, food, publishing, and more. Blockchain technology provides various advantages in these fields, such as security, transparency, data integrity and reliability, cost reduction, identity verification, and transparency.

Blockchain provides these advantages by strengthening collaboration efficacy, as described in *Figure 17*. Collaboration efficacy is one of the key factors towards overcoming global crisis such as the Covid-19 pandemic, as it enables organic cooperation between members of a community.



*Figure 17. Blockchain technology increases collaboration efficacy through four mechanisms.*

First, there is the reinforcement of autonomous cooperation. Due to the nature of a P2P distributed network, in which all members are connected on a one-to-one basis without a central power, democratic participatory governance is possible and may even be enhanced in a blockchain network. This was also the ideal behind Decentralised Autonomous Organisations. Since the blockchain network itself is designed to be operated under autonomous governance, the governance system will further advance and improve the value of the entire network through autonomous cooperation.

Second, there is the reduction in the cost of cooperation. Blockchain technology relies on consensus mechanisms based on decentralisation and autonomy. This, together with an increased ability to incentivise counterparties using tokens and cryptocurrency, enhanced prediction and decision-making abilities, and the automatic implementation of agreements through smart contracts can minimise conflicts between members and reduce collaboration costs, including time.

Third, there is the restoration of trust in the community through the reduction of freeriding. Freeriding is the most important problem for cooperation. When members who have not made any effort for the community enjoy the benefits given as a result of the voluntary cooperation of all other members, the collaborative capacity of the community is diminished. Blockchain can solve the freeriding problem by transparently showing each member's (track record of) contributions to the community.

Fourth, there is the effective use of tokens. Tokens from each blockchain service can be used as an incentive for collaboration. To solve the freeriding problem, tokens may be used to pay for participation. Furthermore, as tokens accumulate for each member over time, the number of tokens acquired can serve as a reputation for each party's contribution to the community, further motivating cooperation.

An example of trying to take advantage of these advantages is D-CENT (Decentralised Citizens Engagement Technologies). D-CENT aims to support democratic governance through a distributed architecture. The system helps citizens receive real-time notifications of important issues and collaborate to make related policy and make decisions, using blockchain technology to manage the trust and reputation of the community and provide verifiable and transparent rewards.

Zhiyuan, a non-profit organisation in China, created a Volunteer Tracking Platform in cooperation with EveriToken to track the activities of more than 1 million volunteers a day and reward them with a token called Yi Coin. Volunteer records are stored in a blockchain ledger, and Yi Coins received by volunteers can be used to purchase food, electrical products, and hygiene products.[52]

Human history is about conflict and cooperation. In pressing times, blockchain technology can make a very valuable contribution toward demonstrating the power of cooperation, now more necessary than ever.



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[52] EveriToken (2019) "Zhiyuan Hui, the World's Largest Volunteer Platform, Announces Blockchain Dapp Based on EveriToken." EveriToken Medium. Available at https://medium.com/@everitoken/zhiyuan-hui-the-worlds-largest-volunteer-platform-announces-blockchain-dapp-based-on-everitoken-362f93f8720

# About UCL CBT

The UCL CBT is the first centre globally to actively focus on blockchain-related research on the adoption and integration of Blockchain and Distributed Ledger Technologies into our socio-economic system.

The unique characteristics of the CBT at UCL provides a cross-sectoral platform connecting expertise and drawing knowledge from eight UCL departments centrally in one place. The CBT is a centre of excellence fostering open dialogue between industry players and sharing expertise and resources. It is a neutral think tank providing consultancy services to industry members, dedicated knowledge-transfer activities and cutting-edge in-house solutions.

For engagement outside of the academic world, the CBT's activities have been tailored to industry and policymakers' needs. The UCL CBT draws on its world-leading academic expertise to produce blockchain solutions for industry, start-ups and regulators. With a community of over 250 Research & Industry Associates and Industry Partners, it is the largest Academic Blockchain Centre in the world.

Notable Work

- The CBT released a report on the current adoption of DLT in global physical supply chains. The report featured an analysis of over 100 different projects taking place all over the world in the Grocery, Pharmaceutical and Fashion industries. Access the report here.

- The CBT organised seven consecutive editions of the P2P Financial Systems Workshop, a world- leading conference bringing together policymakers, regulators and academics interested in emerging technologies and P2P financial systems. Read about the conference here.

- The CBT hosts monthly Online Open Seminars where top academics and industry practitioners explicate cutting-edge developments in the field of blockchain. Read more about the seminars here.

- The CBT successfully funded fourteen research proposals that investigated topics including stable coin policy, smart contract innovation, blockchain economics, blockchain governance models and blockchain applications to aid in the fight against the Covid-19 pandemic. This was done through two research proposals, and a third one is under way in 2022. Research teams who were funded were made up of individuals from a variety of academic and industry organisations. Learn more about the projects here and here.

- The CBT launched the Block-Sprint hackathon to promote DLT innovation in the financial services sector. Around 300 individuals took part in the 2019 and 2020 editions, forming teams made up of industry practitioners, academics, and students. Learn about the winners and innovate ideas that were generated in the hackathon here and here.

# About Ripple

Ripple is a crypto solutions company that transforms how the world moves, manages and tokenizes value.

Ripple's financial solutions are faster, more transparent, and more cost-effective - solving inefficiencies that have long defined the status quo. We identify use cases where crypto technology will inspire new business models and create opportunities for more people.

Ripple's payments solution enables instant cross-border and cross-currency payments with 24/7/365 uptime, no blackout dates, and near-instant settlement. By working directly with strategic receiver partners, customers and their end users receive access to global payment rails for a seamless cross-border payment service regardless of local currency or destination market. Flexible post-funding models allow for "buy now, pay later" options with no pre-funding requirements. By joining Ripple's growing, global network, businesses and financial institutions can process customer payments anywhere in the world instantly, reliably and cost-effectively.

For businesses and financial institutions that are looking to offer crypto-forward solutions to their customers, Ripple Liquidity Hub will be an all-in-one enterprise platform to meet customer demand. This plug-and-play solution will make it easy for companies of any size to buy, sell or hold crypto internally or on behalf of their customers absent the time, resource or capital commitments normally required to do so. Through one simple implementation, Liquidity Hub offers access to deep liquidity pools and leverages smart order routing and advanced algorithms to source optimized prices for a range of digital assets, including BTC, ETH, and others.

Lastly, Ripple is committed to evangelizing projects on the XRP Ledger: a decentralized, public blockchain led by the global developer community. The XRPL is a sustainable, open-source ledger providing developers and businesses a fast, efficient and reliable chain to build and test their use cases: From tokenization and NFTs, to stablecoins, CBDCs and a Decentralized Exchange, the opportunities are endless.

With every solution, we're realizing a more sustainable global economy and planet - increasing access to inclusive and scalable financial systems while leveraging carbon neutral technology and a green digital asset, XRP. This is how we deliver on our mission to build crypto solutions for a world without economic borders.