TOKENIZATION CANVAS

How to Leverage Digital Technology into Strategic Ecosystems

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EXECUTIVE-SUMMARY

THE PLATFORM PROBLEM

The global platform economy has shown a powerful way to organize flexible matchmaking between supply and demand. For the consumer, it is less of a problem that the coordinating platform owner gets to unilaterally set the rules of engagement and on top of this also all the data from the transactions. For enterprises, however, such platform arrangements work less well as means of doing business since it immediately divides—first the platform owner, and then everyone else. Generally, the challenge for organizations to engage in effective, yet flexible, collaborative ecosystems almost always come at a high cost, which can take many forms: the intermediary organizing firm holds all the power, one firm over time gets the upper hand, and collaboration requires sharing too much critical data with potential competitors. Or the rules/terms changing over time.

THE TOKENIZATION OPPORTUNITY

This report presents a novel way of resolving this issue of strategic importance — tokenization. At its core, tokenization allows a group of organizations to collaborate flexibly in a digital consortium by agreeing on the transformation of particular digital data objects to become claims against the consortium. This can, for example, be a digitized asset or the reference to a particular form containing vital information. Distributed ledger technology (DLT) will ensure that these claims are recorded appropriately in a shared ledger to be inspected by the appropriate party or all consortium members. This distributed ledger represents a shared, consolidated, ground truth and can help resolve the double-spend problem where two or more entities make identical claims. In the physical world, the physical object itself resolves the double-spend problem – once you have handed over a banknote to someone, you can no longer claim it as yours.

For digital assets of all kinds, it is easy to resolve this problem through a centralized database, for example, a bank keeping the ledger on what funds are in your account. However, for digital data representing claims between firms, none of these two solutions are acceptable — digital data is easy to replicate, and keeping a centralized ledger brings us back to the essential problem with digital platforms coordinating the collaboration, namely the centralization of all the transactional data.

INITIATING THE JOURNEY

This report aims to support managers in taking the first steps in the tokenization journey. We do so firstly by explaining the strategic potential of tokenization in terms of a balanced approach to inter-organizational ecosystems, which through consensus establishes an equal playing field for all participants. A shared understanding from the ideation phase among organizations of the 'why' behind this setup is essential for creating strategically important collaboration across organizational boundaries and is critical to the success of the endeavor.. Tokenization enables removing inter-organizational friction while at the same time protecting critical informational assets. It can also support radical business model innovation.

FOUR FOUNDATION PILLARS

The report proposes the Tokenization Canvas made up of four fundamental pillars defining the primary areas of concern:

1) The **Business Object** that enables the creation and transfer of a claim, represented by a token, within the inter-organizational community;

2) The **Inter-Organizational Arrangement** defining the collaboration;

3) The **Governance** of the arrangement; and

4) The **Strategic Impact** of tokenization in terms of the overall value created.

The report exemplifies these four pillars through two real-world cases; Walmart's DL Freight case, and the tokenization of the Aberdeen Standard Liquidity Fund.

THREATS

The report also discusses tokenization risks, both the risks of hesitation, and the risks of going ahead. Considering similar developments as with the rapid growth of the digital platform economy, then the opportunities were initially wide open, yet dominant platforms rapidly emerged. After Apple and Google established the two smartphone app stores, there was no space for a third, despite Microsoft sinking billions of dollars into the competition annually. Failing to take tokenization seriously can not only result in missed opportunities for operation inefficiencies, missed innovation potential, and sub-optimal resource utilization. It can also result in missed opportunities for reshaping ecosystems of flexible collaboration and innovation.

When that is said, then there are also new risks of engaging in tokenization and experience shows that the primary one is governance, which the report discusses in detail in terms of the challenges of shared governance, sustaining good governance, and securing stakeholder engagement.

Some data on tokenisation platforms; how most of it is being centralised on AWS

MAPPING THE FUTURE

It is our hope that the main part of this report will wet your appetite for a hopefully exciting and prosperous tokenization journey by explaining and exemplifying why such processes will be standard for all organizations as the stable of engaging in complex business ecosystems. You will then, hopefully, be enticed to move beyond reading the report and into the Appendix where the real work awaits. Here, you will find a detailed unfolding of the four pillars into the Tokenization Canvas, which on the surface may feel familiar to those with experience in the original Business Model Canvas. You will here also find a document explaining the basic terminology of distributed ledger technology to help make the concepts easy to understand, as well as an atlas of 50 or so tokenization cases across sectors. As a final resource, we encourage reading further as part of the tokenization journey and have carefully selected a few books, reports and articles all listed in the order we find most appropriate and with a few words associated with each reading.

At the time it did not seem revolutionary when both Amazon and the Netscape Navigator web browser hit the world in 1994, and when Apple in 2008 launched the iOS app store. However, in hindsight these and many other business technology launches turned out to provide templates for dramatic changes to come. It is difficult to clearly mark where in such a trajectory tokenization is located, but what is evident to us is that few if any enterprises can turn their back to this technological innovation, when they rather should seek to embrace it, experiment with it, and in the process help create the future of flexible business ecosystems.

1 INTRODUCTION

To continuously improve and innovate, organizations must collaborate. The relevance and existence of inter-organizational relationships is nothing new. Over the last three decades, however, we have witnessed how inter-organizational relationships are being shaped through digital technologies. Our contention is that digitalization has, in fact, made inter-organizational relationships more challenging rather than more productive. On the brink of disparities and inefficiencies, we see an emerging digital technology with the potential to make inter-organizational relationships viable for the digital era: tokenization.

As a caveat, tokenization is neither bitcoin nor mundane, or complex, API integrations. Let us begin with a brief history of the web and inter-organizational relationships in three chapters, Web 1.0, Web 2.0, and Web 3.0, to illustrate what we mean (see Figure 1). The first era of the web (Web 1.0) was characterized by information access—a reading era. The internet protocol (IP) brought together multiple infrastructures, allowing for setting up a server that supports the distributed access to information. This first era of the web took shape with the creation of Sir Tim Berners-Lee's open HTML and HTTP technology and the GIF picture format. Thus, from 1993 it became possible to view web pages on the Mosaiq web browser.

The consequence for organizations was the creation of intranets and "extranets," which provided access to information that previously resided in the organization. This first era of the web allowed organizations to run their own web server while maintaining full control over the content provided. It became possible for enterprises to be present on the Web and information became available to their consumers and business partners. In a word, IP's standardization of digital communication across client-server networks made organizations open up. Inter-organizational relationships and their commercial activities were now supported by a new business channel that turned participants into readers.

What characterizes the second era of the web (Web 2.0) is the creation of content. This second era was not just about reading, but also writing. The receiver organization or customer became a participant. Different interactive services developed at the end of 1990s, e.g., blogging platforms, allowed for participation. For inter-organizational relationships, for instance, XML (Extensible Markup Language) in 1996 partook in helping document exchanges. However, as the creation of content became easier to conduct, we witnessed growth of information and the need for orchestration and standardization. A dominant, "winner-take-all," digital platform organizational arrangement appeared as technology-enabled coordinators of multi-sided markets.

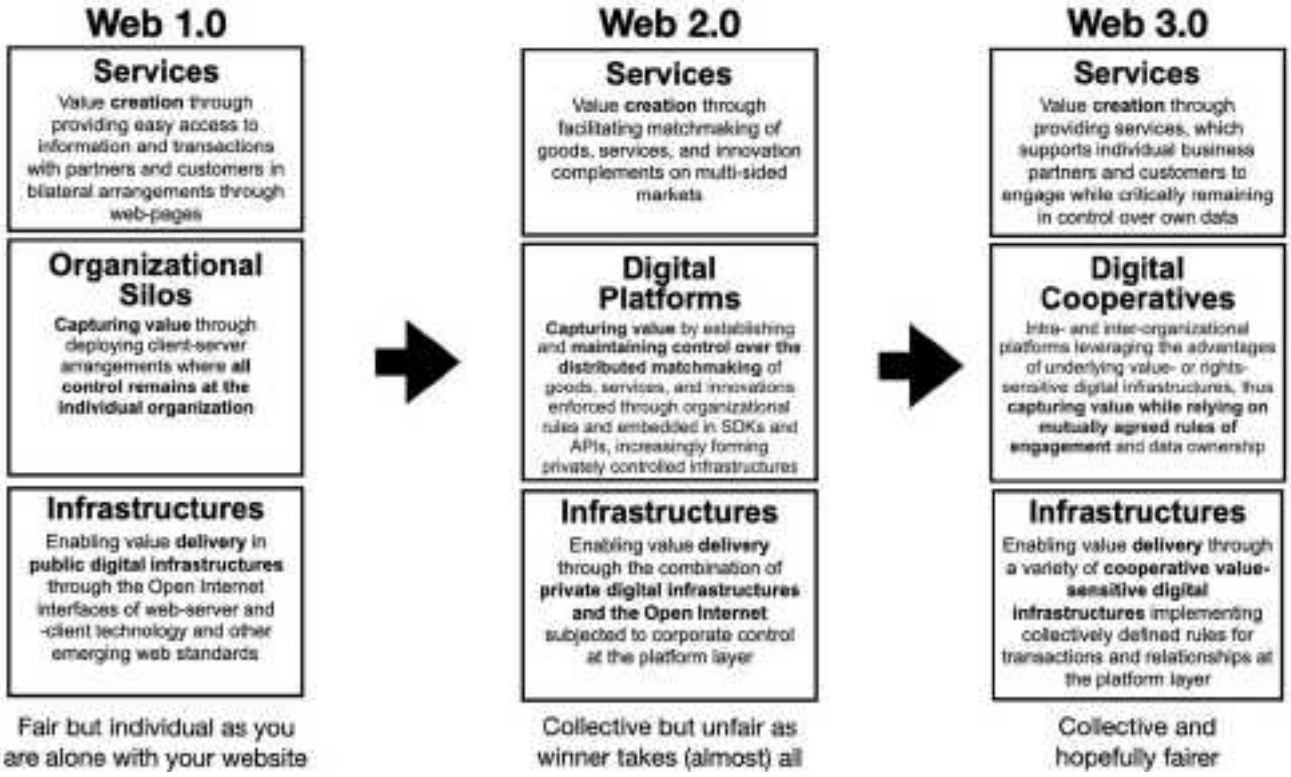

Figure 1 The evolution of the World Wide Web in three Eras

For inter-organizational relationships, this second era of the web culminates with disparities, inefficiencies, and lack of innovation. While there are innovative inter-organizational arrangements through digital technologies (e.g., Swift, VISA, GSM), these often take the form of an industry consortium giving rise to a standard and an accompanying central actor that is not alien to digital platforms. Thus, to engage in digital collaboration and cooperation, organizations have few options. Organizations can either remain operating in silos, use an existing platform, or build a platform that creates a coordinating and mediating standard among different organizations. The first choice conveys market inefficiencies and losing opportunities for growth. The second choice implies ceding control and access to a more powerful actor. The third choice is challenging and resource intensive. Thus, digital inter-organizational relationships do not easily take place. Yet, they remain important to enable organizations (1) to function, (2) to protect their interests and allow for their subsistence, and (3) to innovate, which creates value for collaborating participants.

Tokenization conveys an alternative approach that holds promise for the digitalization of inter-organizational relationships. This is the beginning of a third era of the web (Web 3.0) that will redefine the nature of inter-organizational relationships. Tokenization implies not only a shared claim of interest among multiple stakeholders, but also the possibility of moving from the ability to "read" and "write," as the first two eras of the web show, to "own."

> *"I think that over the next few years, we're going to start seeing Web 3 in our everyday lives. There's going to be real world objects interacting with Web 3 environments, rather than just your bank account or wallet address or some NFTs on your computer. So I think this is going to be the big transition."*
>
> ***James Dunthorne***
> ***CEO, Neuron Innovations***

This transition will require organizations to prepare and assess how they engage with each other to form digital collaborations that would otherwise not be possible.

DeFi Example based on comments from Google Doc???

In this report, we present the four pillars of tokenization for guiding organizations engaging in digital collaboration. Two illustrations of organizations engaging in tokenization give further insight. The report finishes with the risks of tokenization and closes with further steps to follow. Before then, the report continues with a further background on tokenization.

2 TOKENIZATION

> *"A key advantage is the algorithmic nature and the ease of record keeping and moving assets around. I think that's, to me, the key value proposition."*
>
> ***Sacha Ghebali***
> ***Senior Vice President of Strategy, The Tie***

Tokenization often relates to representations of value, such as coinage during the first Millennia BC, bills of exchange in the 13th century, and physical and digital payment cards during the 20th and 21st century.[1] However, in this report, tokenization refers to the possibility of digital ownership, a digital right, which formerly relied on a mediating party. This tokenization characterizes the Web 3.0 and involves three areas that hold promise for underpinning digitized inter-organizational relationships. Namely, the token itself, the computing network underlying such token, and the community running the network.

A token is a non-duplicable entity represented by a large unique alpha-numerical string.[1] Think of a single code, private key, proving ownership or the right to own. Such right to own is based on a public key infrastructure, facilitating traceability and a network of computers that record any changes of state across duplicated databases. An algorithm, often called a consensus protocol, defines the process by which the network of computers confirms changes state, and, thus, ownership. On top of this algorithm, coded scripts predefining the conditions for exchange—smart contracts—are also possible. Lastly, the community running the network of computers receives an incentive for offering their resources.

This community may also be involved in relevant updates to the network's protocol, assuming all agree to update their computers to the same version of the network protocol. Appendix 7.2 details the terminology and technicalities of this distributed ledger technology, and the tokenization it conveys.

What is relevant, however, is that the result of this arrangement prevents a token being used in the same way more than once — double spending. Thus, tokenization allows for digital scarcity, the exchange of value without one mediating party, and, more generally, the creation of digital ownership. While there are multiple applications for tokenization, these mostly center on empowering the end user. Bitcoin for instance shows the creation of digital currency, and peer-to-peer exchange. Other emerging developments center on the creation of digital rights for the ownership of digital art, music, and financial products. Yet, the true value of tokenization does not lie in these applications.

We posit the true potential of creating digital rights and ownership lies in the digitalization of salient aspects of inter-organizational relationships. In other words, tokenization is not just about cryptocurrencies or simple systems' integrations benefiting the end user. Tokenization digitizes inter-organizational relationships, creating digital cooperatives for organizations to enable activities, protect their interests, and innovate. With tokenization, we emphasize the emergence of digital collaboration and cooperation where organizations have the possibility of digitally interacting with each other.

2.1 TOKENIZATION TO ENABLE

One of the promises of tokenization is that it enables organizations to perform activities by creating their inter-organizational infrastructure. Currently, for example, organizations wishing to collaborate often need to join an established standard and consortium where the criterion for collaboration is already defined (e.g., SWIFT). Alternatively, organizations can create their own procedures for transacting, giving rise to complex negotiations that take place as they wish to collaborate. While creating their own standard is possible, as digital platforms today show (e.g., Apple), it is costly and difficult.

> *"There is a lack of connection between the real and digital worlds. The transfer between these two worlds is essential to build trust among investors, customers and participants. This major impediment to gaining confidence in tokenization must be addressed through a legal instrument."*
> ***Arnaud Brolly***
> ***Founder & CEO, Arkadia Global***

Through tokenization, organizations can define ownership through the token along with the business terms and conditions to transact, which smart contracts allow. This tokenization allows contractual arrangements and relationships without consolidation, e.g., a digital platform, or isolated organizations in silos. Tokenization reworks inter-organizational relationships removing friction or allowing for collaborations and exchanges. In a word, tokenization offers the possibility for organizations to create their infrastructure to transact, enabling exchanges that otherwise would be difficult and inefficient.

> *"How it's advantageous in general, I think, is obviously, you can remove a lot of inefficiencies. When you know how things are being processed, it's a lot easier for multiple parties to agree on the truth and verify things without having to involve very time-consuming verification processes."*
> ***Sacha Ghebali, Senior Vice President of Strategy, The Tie***

2.2 TOKENIZATION TO PROTECT

From a different angle, tokenization also holds promise to allow organizations to protect their interests and compete. When an organization joins an existing consortium or standard defining the parameters for collaboration, they cede control. Thus, we find disparities in the form of established industry consortiums, or emerging intermediaries that allow for exchange in the digital realm. Because not collaborating and remaining in silos is often not an option for organizations, they cede control. However, in ceding control and joining a consortium, they also end up losing their competitive position. Through tokenization, organizations can protect their interests in two ways. One is that it can become easier for multiple organizations to come together and compete against other consortiums or powerful entrants.

"But it does allow anyone that has created or issued their own security token to start their own liquidity pools. Traditional market makers do not yet exist for tokenized real world assets, but we can borrow some of the innovations coming out of Web3 and DeFi, concepts like automated market makers can be introduced for security tokens allowing anyone to start their own liquidity pools, a crowdsourced liquidity mechanism so that investors can start their own trading pools, breathing liquidity into their assets...So there is an avenue now that didn't exist before."

Alice Chen, COO, Co-Founder, InvestaX and IX Swap

The other approach is the possibility to control what is shared, and what remains in local databases. Thus, through tokenization, organizations can ensure they are kept as part of a market, instead of being removed by consolidating forces or powerful actors profiting from market inefficiencies.

2.2 TOKENIZATION TO INNOVATE

Lastly, through tokenization organizations can collaborate to transform and create value—to innovate. Because tokenization facilitates digitally mediated collaboration, as well as the creation of digital ownership and value, organizations can harness tokenization to innovate their business. For instance, new services can be built upon the infrastructure that tokenization implies. As businesses become digital and the ownership of value is made possible, organizations can benefit from compound innovation through further recombinations of previous innovations. Tokenization also implies the creation of data across organizational relationships, serving as new ground for the creation of value. Thus, as business becomes tokenized and a token-based economy becomes the new normal for digitized inter-organizational relationships, organizations have the possibility to reconfigure the way in which value is created and captured.

Disruption in business model opportunity- 2 sided marketplace.

"In terms of asset tokenization, that is in part about bringing our best offerings or capabilities to a wider audience. So new distribution channels. Many asset managers such as abrdn are large B2B businesses, where we serve institutional investors. And it is more challenging to access the individual investor or smaller investors because of the servicing that's required for that. So this gives us new access routes."

Duncan Moir, Senior Investment Manager, abrdn

2.4 SUMMARY

In brief, tokenization is a trifecta of token, network, and community. It is not just about integrating systems, or cryptocurrencies. Instead, tokenization implies the creation of digital ownership and rights. A digital token cannot be used in the same way more than once. While most applications have centered on end users, the true potential of this tokenization lies in allowing for digitized inter-organizational relationships. The promise is that tokenization allows organizations to collaborate: 1) to enable their activities and continue functioning, 2) to protect themselves and persist in the face of competition, and 3) to innovate, create and capture new value. However, engaging in tokenization can be challenging and uncertain. In the next section, we have developed four pillars for tokenization. These four pillars will help organizations in their tokenization journey as they engage in developing digital inter-organizational relationships.

3
THE FOUR PILLARS OF TOKENIZATION

In a reinterpretation of Osterwalder (2004) business model ontology dimensions, we have defined four fundamental pillars of tokenization. Tokenization represents a transformative approach in the realm of inter-organizational relationships, offering a new way to manage and transact digital assets, data, and rights. This approach is grounded in four key pillars that together create a comprehensive framework for leveraging tokenization to enhance business processes and collaborations. These pillars are designed to address the complexities and opportunities that arise when multiple organizations come together to use tokenization technology.

"What is the economic structure? How many tokens are needed, what are their utilities, and how will they be claimed? These are the questions we guide clients through, emphasizing the importance of having a clear economic concept. It's like building a business case; you can't start from nothing. You need a written framework outlining the principles, utility, token quantity, platform, and strategies to manage scarcity and attractiveness. Many underestimate the complexity and think, 'let's just issue more tokens,' without considering these foundational mechanisms."

Jakob Bosshard, Managing Director, JBWeb3

1

The first pillar, **Business Object**, focuses on the core processes that enable the creation and transfer of tokens within an inter-organizational community. It involves defining the specific assets or rights to be tokenized, such as delivery transactions, intellectual property, or financial instruments. Ensuring the secure and efficient transfer of these tokens, by leveraging blockchain technology to provide a transparent and tamper-proof ledger of transactions, is crucial. At its core, the business object tokenization results in it being encoded into a distributed ledger and through this represents a claim made against other participants in the arrangement. The cryptographic encoding likely forms only part of the business object, as other parts may be stored on local or shared servers.

2

The second pillar, **Inter-Organizational Arrangement**, outlines the collaborative framework that organizations use to implement tokenization. This pillar is divided into three elements: configuration, optimization, and transformation. Configuration refers to the collaborative process of setting up and structuring business processes to integrate tokenization, including defining roles, responsibilities, and interactions, and determining how tokens will be created, managed, and exchanged within the community. Optimization involves strategic decision-making where organizations assess whether to use tokenization to improve (exploit) existing processes, such as asset tracking, or to create (explore) new processes, like developing new

3

The third pillar, **Governance**, addresses the structures, policies, and processes necessary to manage and oversee the tokenized system effectively. It focuses on ensuring oversight, transparency, and security measures to maintain trust and integrity in the system. Effective governance is critical in a tokenized system because it defines how decisions are made, how conflicts are resolved, and how compliance is ensured. A robust governance framework ensures that all stakeholders are aligned and that the system operates smoothly and securely. This includes defining who has the authority to issue tokens, the criteria for validating transactions, and the mechanisms for addressing disputes that may arise between parties.

The governance structure of a tokenized system can vary significantly depending on the nature of the business object and the relationships between organizations involved. A centralized model allows for streamlined decision-making and consistent enforcement of rules. On the other hand, in more decentralized settings, where multiple organizations have equal stakes or the system is designed to be more democratic, governance may be distributed among all participants. This decentralized model can enhance transparency and trust, as it prevents any single entity from having disproportionate control over the system. Decisions in such models might be made through consensus mechanisms, where all participants have a say in the governance process.

The degree of centralization or decentralization in governance will also influence how agile the system can be in responding to changes and how resilient it is against potential risks. Centralized systems may respond faster to changes and enforce rules uniformly, but they can also be more vulnerable to single points of failure. Decentralized systems, while potentially slower in decision-making, benefit from greater resilience and trust among participants due to their distributed nature,

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4

The fourth pillar, **Strategic Impact**, evaluates the overall value created and captured by tokenization and the associated risks. This pillar considers the strategic benefits, potential challenges, and long-term viability of implementing tokenization in an inter-organizational context. It encompasses the evaluation of how tokenization enhances operational efficiency, fosters innovation, and improves collaboration while also identifying and mitigating risks. The value created by tokenization can be significant, transforming traditional business processes and enabling new business models. However, this value is intricately linked to the effective implementation of the other three pillars.

By understanding and leveraging these four pillars, organizations can unlock the full potential of tokenization, driving innovation, efficiency, and collaborative success in their business relationships. This comprehensive framework enables organizations to maximize the benefits of this transformative technology while effectively managing associated risks. We have encapsulated these four pillars in the Tokenization Canvas, a managerial tool designed to guide tokenization projects successfully (see 7.1).

In the next section, we delve into two real-world tokenization cases, using the four pillars as an analytical framework to assess each project's approach, challenges, and outcomes, highlighting key insights and best practices that can inform future tokenization initiatives.

"....."

ADDITIONAL QUOTE????

4
REAL-WORLD TOKENIZATION

Walmart's DL Freight and The Aberdeen Standard Liquidity Fund (abrdn) are two real-world instances of tokenization that show the potential of this technology and Web 3.0.

4.1 WALMART'S DL FREIGHT

THE PROBLEM

Founded in 1994, Walmart Canada operates more than 400 stores and employs over 90,000 people nationwide. To serve more than 1.2 million customers daily, Walmart relies on a network of over 70 carriers to support its supply chain logistics, ensuring nearly 120,000 products are available in its stores.

These carriers provide their services under challenging conditions, operating 24 hours a day, seven days a week. Unexpected events caused by weather conditions and road congestion negatively impact their operations, further complicated by fluctuating fuel prices. To address these challenges, carriers charge Walmart a combination of fixed and variable fees. The variable fees, known as 'accessorial charges,' often lead to discussions as they can represent the largest portion of the invoiced service.

The number of transactions, exceeding 500,000 shipments per annum, generates a massive volume of data that needs to be handled and reconciled between Walmart and the siloed information systems of its carriers. This mostly manual reconciliation process impacts administrative costs, which can account for up to 20% of transportation fees, and affects the financial stability of generally small to medium-sized carriers with capital-intensive business models.

In mid-2018, Walmart initiated a project to address this issue, as more than 70% of carriers' invoices were being disputed, leading to long approval processes and delayed payments for invoiced services. The situation was not only jeopardizing carriers' finances but also contributing to mistrust with service providers that Walmart intended to treat as partners.

"The pilot was tested for six months by Walmart Canada and Bison Transport, a key carrier of Walmart. After validation of the test, the solution went live in February 2020 and became the new national standard for Walmart Canada transportation management. Then, we started the process of onboarding the other sixty-nine carriers. It took some time to onboard each entity."
Sergei Beliaev, CIO, Walmart Canada

THE SOLUTION

DLT Labs, a Toronto-based technology company, proposed a system based on Hyperledger Fabric that addressed the root causes of the problem and restored trust among contracting parties. Instead of merely fixing the information system silos, DLT Labs created a unified architecture to automate and implement universal workflows across the network. This system benefited from DLT features such as data immutability, transaction transparency, and a cryptographically secured shared ledger.

DL Freight enables the standardized creation of invoices, collaboratively generated by the contracting parties. Deliveries are tracked, and any events that could cause accessorial charges are validated by both parties. The issuance of the invoice is then made automatically, triggering a payment without the need for reconciliation. This is possible because Walmart and its carriers work simultaneously on the same database and have already agreed on each element summarized in the final invoice during the transportation process.

The validation of accessorial charges during deliveries by both parties is facilitated through smart contracts that encapsulate agreed terms and conditions. As a result, DL Freight digitizes and standardizes an existing business process, simplifying its management. By achieving this, DL Freight becomes a tool that is accepted, understood, and effectively managed by all parties, fostering a high level of trust among contractors.

Hyperledger Fabric enables both data security and privacy at two distinct levels. First, the system is private and permissioned, ensuring that data is accessible only to authorized participants and allowing for permissioning of each member. Second, Hyperledger Fabric supports one-to-one transaction channels between Walmart and individual carriers. This ensures that transactions are private and contractual conditions remain confidential and can be customized for each carrier. As a result, information about a specific delivery service is inaccessible to other members, fostering private and independent relationships.

THE RESULT

DL Freight brought tremendous improvement, reducing the dispute rate from 70% of issued invoices to just 1.5%. The approval process for invoices, which previously took weeks and sometimes months, is now completed in less than a week. As a result, administrative costs have significantly decreased in a very short period, making the investment in the system highly profitable. Additionally, the Walmart-carrier ecosystem has become more efficient and is based on an enhanced level of trust.

"Collaboration is about sharing information and management of data. In this project, the main question was, 'How distributed data can be managed effectively with transparency, privacy, integrity and availability?'. Blockchain technology appeared to be able to solve these problems and develop interdepartmental and inter-organizational communication"
Ajay Singh, Co-Founder and CIO, DLT Labs

WHAT DID WE LEARN?

The Walmart-DL Freight case demonstrates how organizations can leverage tokenization to create a standard adopted horizontally across the supply chain. While the physical process of delivering services remains unchanged, the digital representation of deliveries allows contracting parties to share information and establish specific validation points. Given the volume of transactions involved, each based on individual contracts, automating this validation process based on pre-agreed terms and conditions encapsulated in smart contracts is essential. The system ensures privacy, security, and one-to-one transaction management through a process that is both effective and efficient.

In this case, the **business object** is the creation of delivery transaction tokens that are jointly claimed by transacting entities within a secure system maintained by blockchain technology. This ensures the authenticity and immutability of tokens through cryptography. The process meets participants' expectations for privacy, confidentiality, and security by restricting information access to only the specific organizations involved.

The **inter-organizational arrangement** is driven by a common interest to address an unsatisfactory situation that has both financial and trust impacts within the Walmart-carrier community. The system configuration was led by Walmart with the support of DLT Labs' experience in supply chain management. The creation, management and exchange of tokens occur in a closed-loop context, internal to the community. Consequently, the network is *private and permissioned*. Tokenization enhances the process of dealing with accessorial charges, speeds up validation by making reconciliation unnecessary, and expedites service payments. This arrangement optimizes transaction management and transforms the relationship between organizations.

"In the case of DL Freight, the social consensus was truly a business consensus."
Ajay Singh, Co-Founder and CIO, DLT Labs

"It was a business requirement to establish a one-to-one communication channel in between Walmart and each carrier. Data access governance comes down to permissions given to participants. One carrier will not see the transactions of another carrier. Each participant can access only its own data."
Sergei Beliaev, CIO, Walmart Canada

The **system governance** is decided by Walmart, which imposed DL Freight as a national standard for all transactions with carriers and defined the *decision-making framework* of the system.

However, the approval process is standardized and replicates the previously manual process of reconciliation. This process is based on terms mutually negotiated by each party, Walmart and a carrier, as in any traditional supplier-client relationship. These terms are then stored on the blockchain and will autonomously validate the different unexpected events that occur during the delivery, leading to explicit agreement of both parties on accessorial charges to be added to the regular transportation fee. The blockchain system enforces *accountabilities* of parties involved by keeping immutable records of validations on the shared ledger. Finally, all participants benefit from a faster and efficient process that enables expedited payments and instills trust. These *incentives* contribute to making the tokenization process both successful and effective.

The **value creation** of DL Freight is instrumental in aligning participants' behavior and expectations. All organizations gain from using the system and don't encounter any negative consequences. The trust-inducing environment reshapes business relationships and enables more efficient operation management. At the same time, the closed-loop context and meticulously crafted bipartisan smart contracts ensure companies are not exposed to any new potential **risks**. Thus, tokenization has a tangible **strategic impact** on the Walmart-carrier community and acts as an enabler of effective inter-organizational relationships.

The Four Pillars of Walmart – DL Freight Case

1. ***Business object****: Token of delivery transactions to trace and track unexpected events impacting transportation fees.*
2. ***Inter-Organizational Arrangement****:*
   - *Partnership between Walmart and its carriers to solve invoice dispute issues.*
   - *Operates within a private and permissioned network functioning in a closed loop.*
3. ***Governance****:*
   - *Centralized by Walmart, with one-to-one negotiations on smart contract content.*
   - *Client-supplier relationship, with Walmart holding a dominant client position.*
4. ***Strategic Impact****:*
   - ***Value Creation****: Streamlining processes and enhancing operational efficiency. Improved collaboration fosters a trustworthy relationship within a more efficient ecosystem.*
   - ***Risk Management****: The system operates in a closed loop, limiting risk and facilitating inter-organizational reconciliation without impacting operations or creating legal exposure.*

4.2 THE ABERDEEN STANDARD LIQUIDITY FUND

THE PROBLEM

Prominent global investment company, abrdn, made waves in 2023 when it tokenized the Aberdeen Standard Liquidity fund – one of its flagship funds boasting assets worth £15.7 billion. The tokenization of the money market fund marked the culmination of more than three years of research and development. It was also the first of the asset manager's investment products to issue tokens, following the company's acquisition of a stake in digital securities exchange, Archax, the year prior.

The initiative was meant to tackle the inefficiencies of the traditional finance sector. Among these were the exclusion of smaller and individual investors, due to high minimum investment sums, restrictive accreditation requirements, and limited access to alternative asset classes. In addition, traditional finance systems posed numerous operational and cost inefficiencies.

> *"In the old world (in finance) ... you have lots of different service providers, stakeholders who have got their own books and records, lots of different manual processes for reconciliation. Now, we move the asset on-chain. And those processes either don't need to exist at all, because a lot of them relate to trust, and we trust what's on-chain. Or if they do need to take place, they can take place within smart contracts."*
> ***Duncan Moir***
> ***Senior Investment Manager, abrdn***

> *"And so if we can create these innovative solutions that create better client outcomes, we're going to be rewarded by greater client inflows. And ultimately, that's good for the shareholders. So it's sort of a win-win. I mean, this all comes down to efficiencies, and when you can create really good efficiencies, everyone can win at the same time."*
> ***Duncan Moir***
> ***Senior Investment Manager, abrdn***

THE SOLUTION

Tokenization was seen as the answer to many of these issues. Firstly, it enabled fractional ownership of traditionally large-scale assets, opening the doors for smaller investors, for whom such investments were previously out of reach. This democratization of access not only broadened investor participation but also promoted greater liquidity through secondary markets – giving investors more flexibility in managing their holdings.

From an operational point of view, moving assets onto a distributed ledger consolidated data into a single source of truth. This improved the lengthy and often manual processes associated with reconciliation in traditional finance. In addition, tokenization facilitated instant settlement, benefiting parties in transactions by eliminating delays and optimizing capital utilization, giving them an edge over traditional setups

These operational efficiencies also translated to dollars and cents. By enhancing efficiency, tokenization could facilitate cost savings for abrdn — a significant advantage amid a challenging economic environment with squeezed margins. Moreover, cost reductions and consequently lower fees were seen as a potential benefit for the company and its clients.

"The asset management industry is constantly seeing squeezed margins, particularly in a high interest rate environment. It's challenging, and we're always looking for operational efficiency. Some of that benefits the asset manager, and a lot of that will also be passed on through to the client in terms of cost reduction."
Duncan Moir
Senior Investment Manager, abrdn

THE PROCESS

abrdn tapped on L1-protocol Hedera to enable tokenization, particularly the Hedera Token Service (HTS) and the Hedera Consensus Service (HCS). This choice was driven by reasons such as the network's high scalability and speed, and its low cost. It can process up to 10,000 transactions per second at an average cost of $0.001 per transaction, allowing parties to conduct transactions near-instantaneously, while keeping costs minimal.

Other aspects of the Hedera network that appealed to abrdn were its security and governance structure, comprising a governing council with reputable organizations such as IBM and Google.

But the tokenization process was not without its challenges. For one, finding manpower with expertise in both finance and distributed ledger technology proved to be a significant hurdle. In addition, the regulatory landscapes across jurisdictions are challenging to navigate, as laws governing asset tokenization vary widely, impacting product offerings. For instance, in some territories, it is not possible to take existing funds and make them on-chain offerings — and instead, entirely new funds must be launched, requiring setup costs and new assets.

Nevertheless, abrdn noted that its successful tokenisation efforts have hinged largely on the integration of the entire value chain. This includes working with regulated service providers who could support tokenization and offer different distribution channels, while also incentivising every group in the value chain to participate in the process.

Overall, abrdn's tokenization of the fund aimed to democratize access to investment opportunities, while enhancing operational and cost efficiencies. There was also a broader advantage to be gained: Offering better opportunities and outcomes for clients could facilitate even greater client inflows.

So the entire value chain is kind of thought out there … And then also, it goes without saying we're creating those incentives of value added for each group in that value chain. So we're not creating something then asking a favor from someone — every group is getting something out of that, including the investments."
Duncan Moir
Senior Investment Manager, abrdn

OUTLOOK

Looking to the future, abrdn expects further integration of distributed ledger technology into the business, such as by bringing backend processes on-chain, potentially revolutionizing middle and back-office functions across the industry. The firm also anticipates a proliferation of product offerings as more funds migrate onto blockchain platforms, thereby enhancing market depth and attracting broader investor interest.

4.3 THE MEANS AND ENDS OF TOKENIZATION

The two illustrations, Walmart and abrdn, show the four pillars of tokenization. These two companies engaged in the crafting of their *business object, inter-organizational arrangement, governance,* and *strategic impact*. Based on these four pillars, digitized inter-organizational relationships take hold. The pillars of tokenization are the means for achieving digitized inter-organizational relationships. In addition, there are ends.

By facilitating inter-organizational relationships through a digital right, tokenization leads organizations to enable, protect, and innovate. As the illustrations shows, through tokenization organizations can address market inefficiencies and pursue growth, protect existing market shares often swallowed by always growing digital platforms, and feasibly extend their products and interactions with other organizations. Table 1 offers a summary of possible benefits, further showing the relevance of considering tokenization as a way forward for digitized inter-organizational relationships.

The Four Pillars of Aberdeen – Tokenization of Assets Case

1. **Business object**: The ownership of assets and the value of assets is digitized into a token, which is easily divisible and transferable.
2. **Inter-Organizational Arrangement**: Building upon existing partnerships and clientbase while extending access to new clients with lower investment capital.
3. **Governance**: The issuance of tokens is centralized at Aberdeen. The validation of transfers and their settlement is supported by the distributed ledger protocol of Hedera.
4. **Strategic Impact**:
   a. **Value Creation**: facilitating client participation and interactions between buyers and sellers—liquidity—through fractional ownership of large assets. Integrating supply chain processes into the automated settlement of Hedera's distributed ledger protocol.
   b. **Risk Management:** Aberdeen is still working with regulated service providers to support tokenization. These partners receive incentives for supporting the issuance, purchase and sale of asset tokens.

Table 1 The Means and Ends of Tokenization

Tokenization Pillar (Means)	**Consequences for Inter-organizational Relationships (Ends)**		
	Enablement	*Protection*	*Innovation*
Business Object	Disclosing relationships criteria to ease interaction (Walmart)	Integrating transaction and validation processes of existing relationships (abrdn)	Modularizing products to allow for new interactions (abrdn)
Inter-Organizational Arrangement	Improving existing relationships through accountability (Walmart)	Developing existing relationships and interests for existing market shares (abrdn)	Making new relationships with different participants while accessing new markets (abrdn)
Governance	Reworking relationship dynamics to simplify exchange (Walmart)	Maintaining control of core business processes based on existing intermediating relationships (abrdn)	Allowing for the participation of others in new service categories (abrdn)
Strategic Impact	Removing frictions and allowing for exchange that would otherwise not be possible (Walmart & abrdn)	Consolidating efficiencies among a consortium of players to keep a market share (abrdn)	Creating new products, services, and markets that create value for more than one participant while mitigating risks (Walmart & abrdn)

5
TO TOKENIZE OR NOT?

5.1 RISKS OF NON-TOKENIZATION

Tokenization offers transformative potential for inter-organizational relationships by streamlining processes, enhancing transparency, and fostering innovation. However, the absence of tokenization can lead to significant operational inefficiencies, financial limitations, and regulatory compliance challenges. This section delves into three interconnected risks associated with the lack of tokenization in an inter-organizational context: Operational Inefficiencies and Sub-Optimal Development, Financial and Competitive Vulnerabilities, and Regulatory and Compliance Challenges. Understanding these risks highlights the critical need for organizations to embrace tokenization as a strategic imperative.

> *"The technology behind tokenization is not yet fully understood. Even a simple transfer from a bank account to a digital wallet is perceived as suspicious by potential users, driven by a fear of the unknown."*
> ***Ron Costa, Commercial Real-Estate Syndicator, Las Vegas VIP Network***

A. OPERATIONAL INEFFICIENCIES AND SUB-OPTIMAL DEVELOPMENT

Inter-Organizational Friction Inter-organizational friction arises when multiple organizations attempt to collaborate without a streamlined and standardized process. Each organization may rely on disparate systems and protocols, leading to miscommunications, delays, and errors. For example, coordinating transactions and validating data across different platforms can be cumbersome and time-consuming. Tokenization can mitigate these issues by providing a unified, transparent, and automated framework that ensures seamless interactions and reduces friction.

Innovation Bottlenecks Innovation is often stifled in environments where there is no streamlined mechanism for collaboration and data sharing. Traditional systems may not support the dynamic needs of modern business models, hindering the ability to explore new opportunities and develop innovative solutions. Tokenization facilitates a more agile and adaptable framework, allowing organizations to quickly experiment with and implement new business models. The absence of tokenization can therefore create significant bottlenecks, preventing organizations from keeping pace with industry advancements and competitive pressures.

> *"I would say (the advantages of) tokenization probably just breaks down into four things. The first one is transparency. The second is efficiency. The third is programmability. And the fourth accessibility."*
> ***Jim Hiltner, Co-founder Head of Business Development, Superstate***

Suboptimal Resource Utilization
Organizations may struggle with inefficient use of resources. Manual processes for asset tracking, contract management, and data verification consume valuable time and labor, which could be better spent on strategic initiatives. The lack of real-time data sharing and visibility into operations can lead to redundant efforts and wasted resources. Tokenization enables real-time tracking and automation of these processes, optimizing resource allocation and utilization. By leveraging tokens to represent and manage assets digitally, organizations can ensure more efficient and effective use of their resources.

> *"We can report on positions 24/7. So we can offer real time reporting – I have zero marginal distribution costs in servicing a high net worth (investor) who could be in Japan, versus one who might be in Brazil, versus one who might be in the US."*
> ***Sid Powell, CEO & Co-Founder, Maple Finance***

B. FINANCIAL AND COMPETITIVE VULNERABILITIES

Missed Synergies and Value Creation
Without tokenization, organizations face substantial financial and competitive risks. Suboptimal resource utilization and operational inefficiencies directly translate to increased costs and reduced profitability. Manual and redundant processes not only drain financial resources but also limit an organization's ability to invest in growth and innovation. In a competitive market, the inability to leverage tokenization for efficient operations can result in a significant disadvantage.

Erosion of Ecosystem Trust Moreover, organizations that fail to adopt tokenization may find it challenging to attract and retain partners and customers who demand transparency, security, and efficiency in transactions. The market increasingly favors organizations that can offer streamlined, tokenized solutions, making it imperative for businesses to adopt these technologies to remain competitive. Failure to do so can lead to erosion of market share and lost opportunities for revenue growth.

Vulnerability to Disruption Organizations that do not adopt tokenization may find themselves at a higher risk of being disrupted by more technologically advanced competitors. Tokenized systems offer enhanced operational efficiencies and innovative capabilities that non-tokenized systems cannot match. This technological lag can lead to lost business opportunities and a weakened competitive position in the market.

C. REGULATORY AND COMPLIANCE CHALLENGES

Regulatory and Compliance Risks
Navigating regulatory landscapes and ensuring compliance are critical aspects of modern business operations. Without tokenization, organizations may struggle with maintaining accurate and transparent records required for regulatory compliance. Traditional systems often lack the capability to provide immutable and verifiable audit trails, leading to potential legal and compliance risks. Tokenization offers a solution by providing a secure, transparent, and tamper-proof ledger of all transactions, ensuring that organizations can meet regulatory requirements with greater ease and confidence.

Data Security Vulnerabilities The absence of tokenization can expose organizations to vulnerabilities related to data breaches and cyber threats. Tokenized systems offer enhanced security features that protect sensitive information and reduce the risk of data breaches. Organizations that do not adopt tokenization may find themselves at a higher risk of security incidents, which can lead to regulatory penalties, loss of trust, and reputational damage.

CONCLUSION

The interconnected risks of operational inefficiencies and sub-optimal development, financial and competitive vulnerabilities, and regulatory and compliance challenges underscore the necessity for tokenization in inter-organizational relationships. By addressing these risks, tokenization serves as a critical enabler of enhanced collaboration, efficiency, security, and competitiveness. Organizations that fail to adopt tokenization risk falling behind in a rapidly evolving digital landscape,

5.2 RISKS OF TOKENIZATION: GOVERNANCE

While tokenization holds significant promise for revolutionizing inter-organizational relationships, its adoption also presents governance-related risks. These risks revolve around (a) shared and decentralized governance, (b) transparency and accountability, (c) evolving governance models, and (d) community engagement. This section explores each of these governance-related risks in the context of tokenization, emphasizing the potential obstacles organizations may encounter in their efforts to establish secure, trustworthy, and effective inter-organizational collaborations.

A. SHARED AND DECENTRALIZED GOVERNANCE

Balancing Control and Flexibility
Decentralized governance aims to distribute decision-making power across a network of participants, yet this balance can be difficult to achieve. Organizations adopting tokenization may face challenges in reconciling centralized control with the flexibility required for collaborative decision-making. If certain entities retain too much control, it can erode trust among stakeholders, whereas fully decentralized models may lead to inefficiencies or a lack of cohesion in strategic direction. Striking the right governance balance is essential to creating a stable and equitable collaborative environment.

Coordination Challenges. When multiple stakeholders are involved in a decentralized governance framework, coordinating decision-making and enforcing changes in rules becomes complex. Tokenized ecosystems often require consensus mechanisms to operate effectively, but achieving consensus can be time-consuming and prone to disagreements. Without a robust coordination process, the risk of delays and ineffective decision-making increases, potentially undermining the efficacy and stability of the tokenized network.

> *"I think the challenge is getting to a level of consensus around what those permissions should be, without simply replicating the way they are now. Because if they're replicated the way they are now, I think we give up on a lot of the promise of the technology. We really need an opportunity to engage and say, 'How can we achieve the goals of permissioned infrastructure and regulatory compliance, while unleashing the maximal benefit of this new technological layer?'"*
> ***Shaun Martinak***
> ***Portfolio Manager, Coinbase Asset Management***

B. LACK OF TRANSPARENCY AND ACCOUNTABILITY

Erosion of Trust Among Stakeholders
Transparency and accountability are foundational to the success of tokenized ecosystems. A lack of clear communication and accountability can erode trust among participants, leading to skepticism and hesitancy to engage fully. Without transparent governance mechanisms and accountability frameworks, stakeholders may fear that certain parties could manipulate the system to their advantage, compromising the integrity of the network. Ensuring that all actions and decisions are visible and accountable is crucial to maintaining a trustworthy environment.

Ambiguities in Role Definition and Responsibility Tokenized networks often blur traditional organizational boundaries, making it challenging to define roles and responsibilities clearly. Without explicit governance structures that assign accountability, organizations risk operational ambiguities that can lead to conflicts, misunderstandings, and inefficiencies. Clear role definitions and responsibilities are essential to ensuring that each participant understands their obligations and that accountability is consistently upheld.

"The US regulators have put up some, I would say, substantial roadblocks to adoption by financial institutions. [...] Our expectation was to be able to do much more than we're doing today. So on the one hand, I think that the expectations were quite ambitious. And particularly in the US, but we've been slowed down by legal and regulatory considerations."
Thomas Sullivan
Managing Director, Societe Generale - FORGE

C. EVOLVING GOVERNANCE MODELS

Adapting to Changing Governance Needs Tokenized ecosystems may require ongoing adjustments to governance structures as new stakeholders join, regulatory landscapes shift, or technology evolves. The need for flexible and adaptive governance models poses risks, as rigid systems may be unable to accommodate change, while overly flexible models can lead to instability and lack of coherence. Ensuring that governance structures remain relevant and effective is crucial to the long-term success of tokenized inter-organizational collaborations.

"The biggest obstacle is a massive kind of existing set of incumbents across the industry [...] And then it's not just one actor at a time that needs to move, we kind of need the whole industry to move together. So it's an enormously complex question. And I think actually, that's the biggest barrier."
John Whelan
Managing Director of Crypto & Digital Assets, Banco Santander's Corporate & Investment Banking

D. COMMUNITY ENGAGEMENT

Maintaining Active Participation
Community engagement is vital for the sustainability of tokenized networks, as active participants contribute to innovation, governance, and decision-making. However, achieving sustained community engagement can be challenging, especially as participants may have varying levels of commitment or conflicting priorities. Without proactive engagement strategies, there is a risk that key stakeholders may disengage, weakening the governance model and diminishing the potential for collective value creation.

Preventing Power Imbalances Tokenized communities can sometimes experience power imbalances, where certain participants or groups hold disproportionate influence over decisions. These imbalances can lead to governance issues, as less powerful stakeholders may feel disenfranchised or disregarded. Ensuring equal participation and preventing undue influence is critical to fostering a balanced and inclusive governance framework that supports diverse perspectives and fair decision-making.

CONCLUSION

Successfully adopting tokenization for inter-organizational collaboration hinges not just on addressing governance-related risks, but on establishing a shared understanding and commitment among all stakeholders from the outset. Addressing the challenges presented above requires organizations to align on the fundamental purpose behind tokenization: why they are undertaking it and what they collectively aim to achieve. Without this foundational agreement, any governance framework—no matter how carefully designed—may struggle to support a truly cohesive and sustainable ecosystem.

Early **consensus on the "why"** enables organizations to navigate evolving needs and governance complexities more effectively, as it grounds all decisions in a mutually defined purpose. This shared vision becomes the cornerstone of every interaction and decision, shaping the community's engagement, governance models, and the value generated from tokenization. By fostering this early alignment, organizations can lay a robust foundation for trust, transparency, and shared responsibility, making tokenization a transformative tool rather than an added risk.

"We found out that the second you tokenize something and that you want to have this increased liquidity pool from others, the interoperability of it. That was an oversight on our part, to where we didn't think, 'How do we create an environment that lets others contribute to the energy transition that we're trying to do?' And we tried to address this by creating a climate DAO (decentralised autonomous organisation) to manage all of those in there, and that started up in 2022, and didn't get off the ground."
Alex Smith
Technology Innovation Specialist, BP

6
THE NEXT STEPS IN YOUR JOURNEY

This report has presented tokenization as the way for digital inter-organizational relationships. While digitalization is not novel, we posit that current digital developments make inter-organizational relationships challenging. As a balancing act, tokenization allows for digital ownership. A transition that moves from reading and writing on the Web. In the Web 3.0 era, it becomes possible for organizations to interact without reliance on a powerful mediating actor, such as the digital platform that resulted from Web 2.0 era. Thus, tokenization serves as an option to remove market inefficiencies and pursue opportunities for growth, protect existing positions, and create value for collaborating participants. However, engaging with tokenization can be challenging. We have presented four pillars to get started in a digital collaboration through tokenization, as well as the associated existential threads tokenization brings. For the wondering mind, we have four next steps to follow in the journey towards tokenization and digital inter-organizational relationships.

1. Engage in the technical depths of tokenization through material in the appendix, such as the detail Tokenization Canvas and the Terminology document.
2. Review further examples of tokenization in our case atlas
3. How to tokenize? Dive into the Tokenization Canvas that addresses the four pillars of tokenization and their sub-categories in detail through thought experiments and workshops.

NOTES

1 Mundell, R. A. (2002). The Birth of Coinage. Columbia University.

2 De Roover, R. A. (1963). The rise and decline of the Medici Bank, 1397-1494.

3 See Encryption/Token in Terminology appendix.

7
APPENDIX

This Appendix contains material for further tokenization work in your organization. Some of the material is accessible online through download links. If you just want all of the available material for off-line work, just click here for a zip-file download:

Everything.TokenizationCanvas.com

7.1 DETAILED TOKENIZATION CANVAS

The following outlines the Tokenization Canvas, First we outline the four pillars of tokenization in more detail than in the main report text (7.1.1). Then the Tokenization Canvas is presented and elaborated in its totality through a detailed description of all the elements (7.1.2). Finally, we privacy an empty Tokenization Canvas for your own use (7.1.3).

7.1.1 DETAILED OUTLINE OF THE FOUR PILLARS OF THE TOKENIZATION CANVAS

A BUSINESS OBJECT

The business object pillar focuses on the core process that enables the creation and transfer of claims against the inter-organizational community. This involves identifying the specific assets, rights, or data that will be tokenized and ensuring that these tokens can be securely and efficiently transferred between parties.

Key Aspects:

- **Token Creation**: Define the assets or rights to be tokenized, such as financial assets, supply chain data, intellectual property, or service credits.
- **Claim Transfer**: Establish mechanisms for the seamless transfer of these claims or tokens between different entities within the network.
- **Security and Integrity**: Implement cryptographic techniques and blockchain technology to ensure the authenticity and immutability of tokens.
- **Compliance**: Ensure that the tokenization process adheres to relevant legal and regulatory requirements.

B INTER-ORGANIZATIONAL ARRANGEMENT

In the context of tokenization, an inter-organizational arrangement refers to the collaborative framework in which multiple organizations work together to implement and utilize tokenization technology to enhance their joint operations and interactions. This pillar involves three elements: configuration, optimization, and transformation.

Key Elements:

- **Configuration**: The collaborative process of setting up and structuring business processes to integrate tokenization. Configuration defines roles, responsibilities, and interactions, as well as how tokens will be created, managed, and exchanged, in a context of both closed-loop (internal to the community) and open (external impact beyond the community) systems.
- **Optimization**: The strategic decision-making process where the involved organizations assess whether to use tokenization to improve (exploit) existing processes, such as asset tracking and management, or to create (explore) new processes, such as developing new financial instruments or market opportunities.
- **Transformation**: The modification of business models and operations based on the optimized configuration, leading to significant changes that enhance efficiency, security, transparency, and innovation across all organizations involved.

C GOVERNANCE

Governance focuses on the structures, policies, and processes that ensure the effective and secure operation of the tokenized system. It addresses how to deliver tokenization value to inter-organizational systems through proper oversight and management.

Key Aspects:

- **Governance Structures**: Develop decentralized governance models that allow stakeholders to participate in decision-making processes.
- **Smart Contracts**: Utilize smart contracts to automate governance rules, reduce human error, and increase efficiency.
- **Dispute Resolution**: Establish clear mechanisms for resolving disputes that may arise within the tokenized network.
- **Transparency and Accountability**: Ensure all transactions and changes within the network are transparent and verifiable to maintain trust among participants.
- **Security Protocols**: Implement robust security measures to protect against fraud, cyber-attacks, and other vulnerabilities.

D STRATEGIC IMPACT

This pillar assesses the overall value created by tokenization and the associated risks. It considers both the strategic benefits and potential challenges that come with implementing tokenization in an inter-organizational context.

Key Aspects:

- **Value Creation**: Evaluate the tangible and intangible benefits of tokenization, such as increased efficiency, reduced costs, enhanced trust, and new revenue streams.
- **Risk Management**: Identify and mitigate risks associated with tokenization, including technological, legal, and operational risks.
- **Competitive Advantage**: Analyze how tokenization can provide a competitive edge by enabling innovative business models and improving inter-organizational collaboration.
- **Long-term Viability**: Consider the sustainability and scalability of the tokenized system to ensure it can adapt and grow with changing business needs and technological advancements.
- **Stakeholder Impact:** Assess the impact of tokenization on various stakeholders, including employees, customers, and partners, to ensure broad-based benefits and acceptance.

7.1.2 DETAILED CANVAS DESCRIPTION

The download below takes you directly to a detailed explanation of each of the Tokenization Canvas elements.

Elements.TokenizationCanvas.com

7.1.3 EMPTY TOKENIZATION CANVAS

You can download a pdf version of the template Tokenization Canvas document here:

Template.TokenizationCanvas.com

7.2 TERMINOLOGY DOCUMENT

We have provided a separate document containing explanations of the essential terms related to tokenization here:

Terminology.TokenizationCanvas.com

7.3 LIST OF READINGS

In this separate document you will find a ranked list of books, reports, and papers that can help you further in your tokenization journey:

Readings.TokenizationCanvas.com

7.4 ATLAS OF TOKENIZATION CASES

The link below takes you to a Google Sheet containing an Atlas of tokenization cases from across different verticals. You will also be able to add your own favourite cases for others to learn from as you learn about them in your journey.

Atlas.TokenizationCanvas.com

7.5 METHODOLOGICAL CONSIDERATIONS

This work is the result of a combined effort targeting both academics and practitioners. The interview data from more than 200 interviews formed the empirical foundation for the work. Of these, around 60 were original interviews conducted by the research team, and the remaining 140 interviews constituted secondary data transcribed from publicly available sources. All 200 interviews related directly to tokenization and distributed ledger technologies.

Immediately before and during the effort, the participants defended a PhD, a DBA, and an MSc, all closely related to the subject matter of this report. During the project, the participants produced the following output all accepted for publication: two book chapters in an esteemed collection of papers, a journal paper, and five conference abstracts. During the project, the participants also conducted over 20 keynotes, talks, and masterclasses with around 1000 C-suite executives, top managers, and academics presenting and discussing the opportunities and challenges of tokenization.

A big thank you to all of the interviewees for this project, most of whom requested anonymity. Thank you: Jim Hiltner, Shaun Martinak, Thomas Sullivan, Sacha Ghebali, Alex Smith, Richard MacNamara, Sid Powell, Duncan Moir, John Whelan, Arnaud Brolly, Ron Costa, Alice Chen, Jakob Bosshard, Daniel Liebau, Jack Nikogosian.

7.6 ADVISORY BOARD

During this research project, we liaised with an esteemed group of advisors, who provided invaluable comments on our ideas as they took shape. A big thank you to our Advisory Board for their invaluable input to this report.

- Dr Alice Chen, linkedin.com/in/salicechen
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7.7 AUTHOR BIOS

Carsten Sørensen (cbs.carstensorensen.com) is the DIRECT Professor of Digital Innovation at Copenhagen Business School. He has since 1989 been affiliated with several Danish, Swedish and British institutions and worked for 25 years at the London School of Economics and Political Science (LSE). He holds a BSc in Mathematics, an MSc and PhD in computer science from Aalborg University, Denmark. Carsten designed the first LSE course dedicated to distributed ledger technology — an online certificate course in cryptocurrency disruption and was instrumental in the LSE joining the Hedera consortium. He has published widely within the main Information Systems journals since 1989 and has extensive experience as a Principal Investigator on a number of national, EU, and industry research grants in the UK and Sweden. Carsten has since 1991 consulted and conducted executive teaching with a range of large international firms and public organizations, such as Microsoft, Google, PA Consulting Group, IMF, Orange, Intel, Vodafone to name just a few.

Thamim Ahmed (linkedin.com/in/thamimahmed/) serves as a Senior Research Associate at the London School of Economics, specializing in Distributed Ledger Technologies (DLTs). With over ten years of experience, he has contributed to the development of DLT protocols and collaborated with fintech companies to enhance their payment systems and network utilities. His work focuses on achieving market adoption and scalability for these technologies. Thamim is an expert in decentralized financial (DeFi) applications and infrastructures, helping to advance the field through innovation and practical application.

Christophe Viguerie (linkedin.com/in/christopheviguerie/) is a French national who has resided in Asia for two decades. He holds a master's degree in international business from Dauphine University in Paris and completed a Doctor of Business Administration (DBA) at City University of Hong Kong. Christophe is a member of the Institute of Directors (IoD) in Thailand and holds director certifications in both Thailand and Australia. In addition to his close to 30 years of experience in the luxury industry, Christophe launched Tech & Co in 2017, a collaborative platform dedicated to supporting innovative projects with a specific focus on blockchain applications. As of January 2024, Christophe has joined the Department of Management at City University Hong Kong as a Visiting Fellow.

Juan Camilo Giraldo-Mora (linkedin.com/in/giraldomora/) is a scholar of technology, currently appointed as a postdoctoral Fellow in the Information Systems and Innovation Group at the London School of Economics and Political Science (LSE). His research lies at the intersection between digital infrastructures, money and payment, and sustainability broadly understood. He is particularly interested in reconceptualising the instrumentality of technology. Juan Camilo's research, teaching, and service are present and recognised across institutions in Denmark, Colombia, and the United Kingdom, as well as global associations. He holds a PhD in Information Systems from the Department of Digitalization at Copenhagen Business School and an MSc in Management of Information Systems and Digital Innovation from LSE.

Cheryl Lin (linkedin.com/in/cheryl-linky/) is a product strategist, leveraging half a decade of experience as an ex-senior journalist. She holds an MSc in Business Administration and E-Business from Copenhagen Business School, where her master's thesis focused on the barriers to blockchain adoption in the Danish banking sector. Additionally, she holds a BA (Honours) in Communications and New Media from the National University of Singapore. As a digital and broadcast journalist in Singapore, Cheryl crafted high-impact stories on urban development, business, and technology, including blockchain.

WWW.TOKENIZATIONCANVAS.COM

APPENDIX 7.1
DESCRIPTION OF TOKENIZATION CANVAS

The Tokenization Canvas describes issues and process of tokenization in a multi-organizational context.

Pillar 1: Business Object (What = tokenization)

As a general description, the business object is a new tool, resource or technology that serves as the catalyst for change. It could be a piece of technology, a new methodology, or an innovative product that enables a new inter-organizational arrangement.
The business object of tokenization is specifically the process that enables the creation and transfer of a claim within the inter-organizational community (consortium). This process is concretized by the creation of a token, which represents the claim.

➔ Building block: **Token**

Pillar 2: Inter-Organizational Arrangement (Who = organizations involved in the inter-organizational arrangement)

In the context of business processes, an inter-organizational arrangement refers to the collaborative framework in which multiple organizations come together to leverage a new tool, resource, or technology (business object) to enhance their joint operations.
In the context of tokenization, an inter-organizational arrangement refers to the collaborative framework in which multiple organizations work together to implement and utilize tokenization technology to enhance their joint operations and interactions.

➔ Building blocks:

- **Configuration**: The collaborative process of setting up and structuring business processes to integrate tokenization. This involves defining roles, responsibilities, and interactions and how tokens will be created, managed, and exchanged, in a context of closed-loop (internal to the consortium) and open (external impact beyond the consortium).

- **Optimization**: The strategic decision-making process where the involved organizations assess whether to use tokenization to improve (exploit) existing processes, such as asset tracking and management, or to create (explore) new processes, such as developing new financial instruments or market opportunities.

- **Transformation**: The modification of business models and operations based on the optimized configuration, leading to significant changes that enhance efficiency, security, transparency, and innovation across all organizations involved

Pillar 3: Governance (How = framework for decisions rights, accountability, and incentives to encourage desirable behavior to deliver tokenization value to the consortium)

To deliver tokenization value to the consortium, governance must effectively address decision rights, accountability, and incentives.

➔ Building blocks:

- **Decision rights**: establishing a clear hierarchy and framework for decision-making processes. This includes identifying which roles or committees (role definition) have the authority to make strategic, operational, and technical decisions (decision-

making framework) related to tokenization and how these decisions are approved (approval processes).

- **Accountability**: Setting up systems to track actions, decisions, and outcomes, ensuring that all participants are responsible for their actions and decisions within the tokenized system.

- **Incentives** are designed to motivate participants to act in ways that support the success of the tokenization project. This includes financial rewards, recognition, and other benefits that align individual and organizational goals with the project's objectives. Tokens are used to incentivize certain behaviors and actions among participants, such as network security, user engagement, or development contributions. Tokenomics plays a fundamental role in aligning the interests of various stakeholders and maintaining the integrity and functionality of the ecosystem.

Pillar 4: Strategic Impact

The Strategic Impact pillar in the Tokenization Canvas serves as a comprehensive element that encapsulates both the value creation and risk management aspects of a tokenization project. This ensures a balanced approach, focusing on maximizing benefits while mitigating risks to ensure long-term sustainability and success.

➔ Building blocks:

- **Value creation**: Explores the overall benefits and value delivered to all stakeholders through the integration of tokenization technology. Includes enhanced efficiencies, new business opportunities, customer benefits, and overall impact on the ecosystem.
    - **Efficiency Gains**: Streamlining processes, reducing costs, and improving operational efficiency through tokenization.
    - **New Revenue Streams**: Generating additional revenue through new business models enabled by tokenization, such as transaction fees, service charges, or new market opportunities.
    - **Customer Experience**: Enhancing customer satisfaction and engagement by providing innovative solutions and seamless interactions.
    - **Interoperability and Collaboration**: Facilitating better collaboration and data sharing among organizations, improving overall ecosystem efficiency.

- **Risk management**: Covers the identification, assessment, and mitigation of risks to ensure the stability and security of the tokenization project. Includes internal and external risks, such as technological, operational, legal, and market risks.
    - **Risk Identification**: Systematically identifying potential risks that could impact the tokenization project. This includes technological risks (e.g., cybersecurity threats), operational risks (e.g., process failures), legal risks (e.g., regulatory compliance), and market risks (e.g., market acceptance and competition).
    - **Risk Assessment**: Evaluating the likelihood and potential impact of identified risks, prioritizing them based on their severity and probability.
    - **Risk Mitigation**: Developing and implementing strategies to mitigate identified risks. This includes implementing security measures, establishing compliance protocols, and creating contingency plans.
    - **Monitoring and Reporting**: Continuously monitoring risk factors and reporting on risk status and management efforts. This ensures ongoing vigilance and the ability to respond swiftly to emerging threats.
    - **Contingency Planning**: Preparing contingency plans for responding to significant risk events. This involves defining action steps and responsibilities in case of a risk materialization.

Authors / Content	Norton & Kaplan (1992)	Markides (1999)	Osterwalder (2004)	Sorensen et al. (2024)
Objective	Key business aspects of a company to be monitored.	Dynamic view of a company business strategy.	Business model issues of a company	Tokenization issues in a multi-organizational context
Pillar 1	**Internal perspective** What the company must excel at.	**What?** What products or services a company should offer.	**Product (What)** Offering / Value proposition.	**Business object (What)** Process that enables creation and transfer of a claim against the inter-organizational community (consortium).
Pillar 2	**Customer perspective** How the company is seen by its customers.	**Who?** Who a company should target as customers.	**Customer interface (Who/ How)** Customers – How to deliver offering & build customer relationship.	**Inter-organisational arrangement (Who)** Improving or enabling new inter-organizational business models.
Pillar 3	**Innovation and learning perspective.** How the company can continue to improve and create value.	**How?** How these services can be delivered best to customers.	**Infrastructure management (How)** How to perform infrastructural or logistical issue.	**Governance (How)** How to deliver tokenization value to inter-organizational systems.
Pillar 4	**Financial perspective** How the company looks to shareholders.	------	**Financial aspects** Revenue model & cost structure.	**Strategic impact** Value created and related risks.

The Tokenization Canvas

Decision Rights

Key words:
- Role definition
- Decision-making framework
- Approval processes

Accountability

Key words:
- Actions and decisions tracking (off-chain)
- Audit trail of transactions (on-chain)
- Sanctions framework

Incentives

Key words:
- Financial incentives
- Recognition programs
- Alignment of interests
- Tokenomics

Token

Key words:
- Business object
- Tokenization process
- Consortium

Process that enables creation and transfer of a claim against the consortium.

Configuration

Key words:
- Collaborative process
- Business process
- Closed loop / Open

Optimization

Key words:
- Strategic decision
- Exploitation / Exploration

Transformation

Key words:
- Optimized processes
- Transformative changes
- Improved or new business models

Risk management

Key words:
- Risk Identification
- Risk Assessment
- Risk Mitigation
- Monitoring and Reporting
- Contingency Planning

Value Creation

Key words:
- Efficiency Gains
- New Revenue Streams
- Customer Experience
- Interoperability and Collaboration

Inspired by Osterwalder, A. (2004). The Business Model Ontology: A Proposition in a Design Science Approach. University of Lausanne, Switzerland.

APPENDIX 7.2:
GLOSSARY OF TOKENIZATION INDUSTRY CONCEPTS

BLOCKCHAIN:

A blockchain is an example of a distributed ledger arrangement, which in addition to the ability of consistently replicate and synchronise data across distributed nodes, also includes a consensus protocol [1, Chapter 3.3.5, 2 p53ff]. The consensus protocol enables additional claims to be made by members of the consortium or social community operating the blockchain beyond the distributed ledger claim of consistency and accuracy of data across all nodes in the arrangements.

A blockchain enables claims on scarce digital rights by resolving the double-spending problem of two parties making identical claims on the same right. The consensus protocol is the underlying mechanism enabling these claims by encoding within the blockchain the transaction history of token (can also be characterised as a coin, a cryptoasset, or more generally, as a claim or right) exchanges in a manner highly difficult to compromise. This is ensured through cryptography, which secures the recording of transactions on the blockchain.

Before explaining in detail the consensus protocol, it is important to note that a blockchain arrangement consists of couplings between the three necessary and sufficient elements: Token, Network, and Community [2].

The **token** represents a scarce digital right that either has value for a closed community or something more widely recognised as having value. In general, it is a claim valid and enforceable against all other blockchain members.

The **network** is a distributed ledger arrangement governed by a consensus protocol allowing each node to directly access the same shared set of information about the titles claimed by all other nodes and to directly transact these titles with all the other nodes.

A blockchain represents shared ethical and political principles and a shared understanding of the rules governing transactions: The equality of all nodes vis-à-vis each other and bilateral freedom to transact unhampered by the potential surveillance and assent of any other third party endowed with special authority.

The **community**, therefore, represents the set of members sharing these principles and agreeing to abide by these rules of the transaction automatically enforced by the blockchain protocol. The members of the community may consist of a formal group of firms deciding to collaborate using blockchain technology (mainly in a business-to-business setting), of a loosely coupled social community of independent members (in a consumer-to-consumer setting) or a heterogeneous mixture of organisations and individuals. By sharing the same motivations and principles, the community members establish the rules of the cryptographic protocol and agree on the necessary decisions facilitating the exchange of tokens under the condition of equality and privacy without the need to trade in private data.

The token-network-community model explains the necessary and sufficient conditions for full-node blockchain arrangements (see Figure 1).

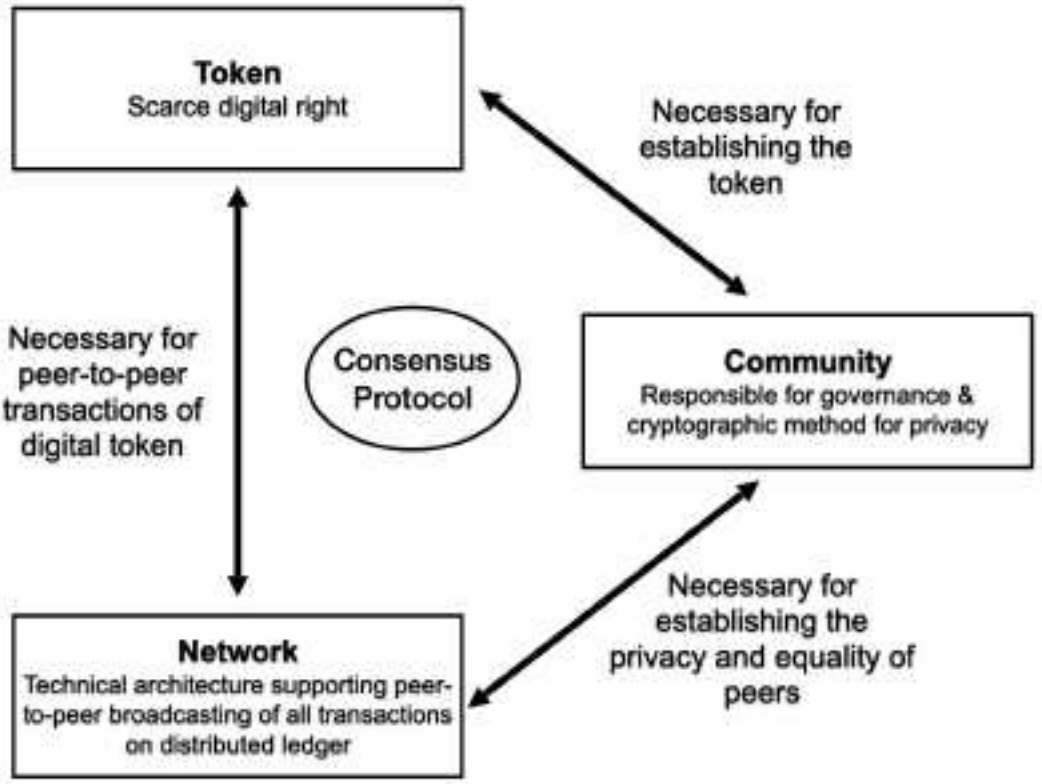

Figure 1: Token, Network, Community model for the necessary and sufficient blockchain elements. Adapted from [2, 3].

The consensus protocol is the underlying mechanism enabling these claims by encoding within the blockchain the transaction history of a token (can also be characterised as a coin, a cryptoasset, or more generally, as a claim or right) exchanges in a manner highly difficult to compromise. This is ensured through cryptography, which secures the recording of transactions on the blockchain. Every time a transaction occurs, it must be verified by the community of node operators. Transactions are bundled into blocks, which are added to the chain.

Without equality of community members, the operation of a centralised platform acts as a transaction gatekeeper, neither guaranteeing the equality and privacy of all members of the network nor their freedom to undertake unhampered bilateral exchanges. For example, the transactions among participants on the Amazon e-commerce platform are carried out under the auspices of the rules unilaterally stipulated by Amazon, who also get to be the custodian of all transaction data.

Without the token representing a scarce digital right, a traditional P2P system may allow direct private exchanges of encrypted data between two parties, but it will not support the exchange of anything scarce, where data is not merely copied but where the rights to a digital object is transferred from one party to the other. It is a P2P community without a token acting as an enforceable claim against the members of the digital community.

Without the P2P architecture of a distributed ledger, the arrangement becomes a classic client-server database, where all members of a community can access valuable data upon request but where private data on transactions are centralised.

There are a number of possible processes blockchains can apply to achieve consensus, i.e., help guarantee against incorrect transactions being recorded in a block and subsequently added at the end of the chain of blocks. The two most common are outlined below.

The Bitcoin blockchain deploys a **proof-of-work** process where the consensus protocol sets a cryptograhic puzzle that can only be solved through a very large number of trial-and-error guesses [4]. Some of the node operators engage in the proof-or-work process by competing to see who first can solve the puzzle. Once the puzzle is solved, a new block is created by the consensus protocol,

containing the bundled transactions. The node guessing the correct result will be rewarded by the consensus protocol by being paid a set number of tokens [1, Chapter 3, 5].

As the proof-or-work arrangement uses a significant amount of energy, blockchain arrangements increasingly deploy a **proof-of-stake** [6] process to reach consensus. Here, node operators are awarded the opportunity to validate transactions according to the number of tokens they possess. The more tokens they possess, the more likely they will be asked by the consensus protocol to validate the addition of transactions to the blockchain. The assumption is here that node operators with large token holdings will be less likely to compromise the validity of the network than those with small holdings. As the validation process here engages a fixed number of nodes where a subset will cast a vote, this is a less energy-consuming process than proof-of-work.

Distributed ledgers arrangements can be classified in terms of the anonymity of validator nodes and in terms of the a priori assumed trust in validator nodes [1, Chapter 3, Figure 3.2, 5].

This distinguishes between: 1) Who stores copies of a given blockchain and helps validate it; and 2) to what extent they are anonymous or need to be known entities. A private blockchain is a distributed ledger where only members of the consortium running the blockchain can retain a copy and help validate new blocks.

Public blockchains are stored and validated by anonymous members of the public. These come in two variants, permissionless and permissioned. Anyone can download and help validate new blocks on permissionless blockchains, such as bitcoin transactions. Permissioned public blockchains are open to anyone meeting certain pre-defined criteria, such as ownership of the particular tokens exchanged on the particular blockchain (See Figure 2 below).

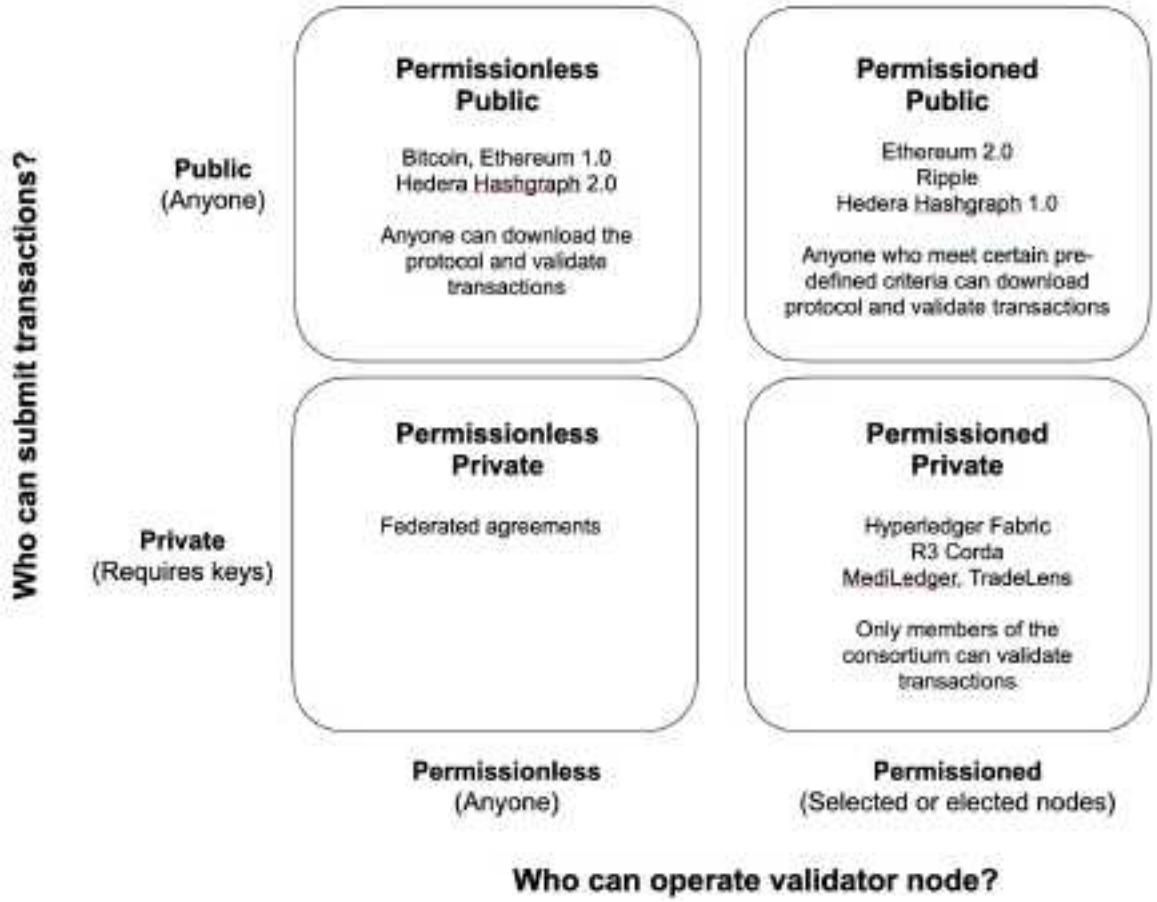

Figure 2: Types of blockchain projects in terms of transactions and validators. Revised version of [1, Figure 3.2].

COLD WALLET / -STORAGE:

A digital wallet that stores cryptocurrency offline, with keys stored in external hardware devices that are typically not connected to the Internet or an online server [7, Chapter 14]. However, simply recording the private keys denoting the cryptotokens on a piece of paper and storing it in a bank vault is, in effect, also a cold wallet.

CRYPTOCURRENCY/ CRYPTOTOKEN/CRYPTOASSET:

A "cryptocurrency" in traditional parlance, or more precisely a cryptotoken or cryptoasset is a native digital asset bound to a specific blockchain [1, Section 3.3.3]. Multiple cryptocurrencies have evolved over the last decade and have been used to denote several very different things. Cryptocurrencies are, in fact, best understood as financial instruments rather than as currencies, or as bearer bonds [8]. Cryptocurrencies can be defined by specifying the three elements required as necessary properties:

Pseudonymity or anonymity: This is achieved through the encryption of the addresses of all the actors transacting with the cryptocurrency, which makes transactions untraceable, and thus safeguards individual privacy.

Disintermediation: This is achieved through P2P communication between any two nodes of the network. It guarantees bilateral transactions, thus ensuring that the individual has the right to access and leave the economic system at will and transact with anyone they wish, with no prior authorisation or permission needed.

Trust: This is achieved through a distributed consensus protocol. It ensures the correctness, integrity, and legitimacy of any transaction independently from any trusted third party or central authority, which ensures non-trust-based coordination and cooperation among all nodes of the network.

Peer-to-peer cryptocurrency transactions are most often not anonymous but rather pseudonymous. For example, in Bitcoin, all transactions are public and traceable, but the real identity of the person is hidden – transactions are pseudonymous. The history of transactions for any wallet address is public, but the real private identity of the owner cannot be traced. Anonymity, which makes it impossible to track transactions, is attempted by a subset of cryptocurrencies. Furthermore, as the overwhelming proportion of cryptocurrency transactions are conducted through light nodes (wallet and exchange platforms), and as these are frequently requiring Know Your Customer (KYC) and Anti-Money Laundering (AML) identity checks, the platform will know the identity of the account holder and hand this over to the authorities when requested to do so.

Cryptotokens can be characterised in terms of their usage and the source of their value [9]. At the digital platform and service layer, we can distinguish between utility-, asset-, and payment tokens. **Utility tokens** are issued to investors in initial coin offerings (ICOs), and can be used for the service that the start-ups offer. These are services that the investor can use themselves, such as online distributed storage mechanisms, but do not need to. As the ICOs services can be offered to the public, they can also be acquired under the assumption that their value will increase as the services offered by the ICO firm becomes popular. **Asset tokens** represent shares in an underlying investment, such as companies, earnings streams (such as revenue), or an entitlement to dividends or interest payments. **Payment tokens** are used both as means of exchange to purchase or transact services or goods over the blockchain in which the token is embedded and belong to the application layer and usually belong to a specific application developer, platform owner, or company releasing them.

Cryptotokens can be used for a number of purposes, such as for mining reward as a means of incentivising and securing distributed consensus solving the double-spending problem. They can be used in exchange for other cryptotokens, they can be used for purchases, or as rights to access and use of services, or for staking in proof-of-stake blockchains. Distinguishing between cryptotokens at different layers, then we can classify tokens at the four architectural levels (See Figure 4).

Level 0 denotes the hardware, Internet protocols, tools and standards supporting Layer 1 blockchains to run smoothly, and to support some interoperability across blockchains.

Level 1 is the foundational cryptocurrency level. Early cryptocurrencies, such as for instance bitcoin, were originally devised as instruments of payment and as tools to create incentives and rewards for ensuring distributed consensus. The aim of the blockchain is here is to compute the amount of a cryptocurrency held by each node and to consolidate the various quantities by ensuring consistency and integrity. The computer networks supporting the transactions of cryptocurrencies are mere digital infrastructures.

Level 2, cryptocommodities: Here, the computer network cannot be seen as a mere representation of node account balance. Cryptocommodities reflect the multiple and flexible ways in which the computer network can be used. The network can process very different operations and transact different cryptotokens. This is the principle that inspired the birth of Ethereum. The Ethereum network must be flexible and open enough to support any type of transaction among two wallet- or smart contract addresses. Examples are transfers of ownership and rights, use of computing capacity or memory storage, and so on. The underlying computer network supporting cryptocommodities should be interpreted as a digital platform.

Level 3 consists of specific services, or distributed apps (DApps), based on a particular Layer 2 protocol representing operations involving cryptoassets.

Cryptocurrencies often do not have a central party issuing them (such as in the case of bitcoins), payment tokens belong to the application layer and they usually belong to a specific application developer or company releasing them.

The role of infrastructures is mainly to interconnect and ensure communication among nodes, while the role of platforms is mainly to facilitate the implementation and recombination of a variety of services and applications. Only payments and transfers of currencies are involved in the first case, while a vast array of heterogeneous use cases (mainly digital services) can be supported and processed in the second case.

As all cryptotokens are digital objects, the layers are inherently ambiguous [10, 11] in that a given type of cryptotoken can serve different purposes depending on time and context, as well as occur on several layers. The current regulatory debate on whether or not to classify cryptotokens as securities exemplify this. For example, an an investor purchasing tokens issued through an ICO will, in effect, own tokens that are much like Schrödinger's Cat — concurrently in different states, and only by opening the box will the true state be revealed. Whether a given token is an utility token or an asset token will only be clear at the exact time it is either spent on accessing the service, used to receive dividend from staking it to a validator node, or sold to another person.

DECENTRALISED AUTONOMOUS ORGANISATION (DAO):

A Decentralised Autonomous Organisation (DAO) denotes a specific kind of smart contract based on the foundational notion that an organisational entity can be entirely governed by the rules programmed into the smart contract and that this renders the entire company into a bunder of code [1, Section 3.3.6, 12, Chapter 9]. A DAO is an entirely digital entity without employees and managers, and where owners are those transferring cryptotokens into the DAOs account during the initial funding period. These investments will be governed by a set of contractual rules explicitly determining the operations. This implies that some traditional organisational functions will be carried out through pre-determined pre-codified arrangements.

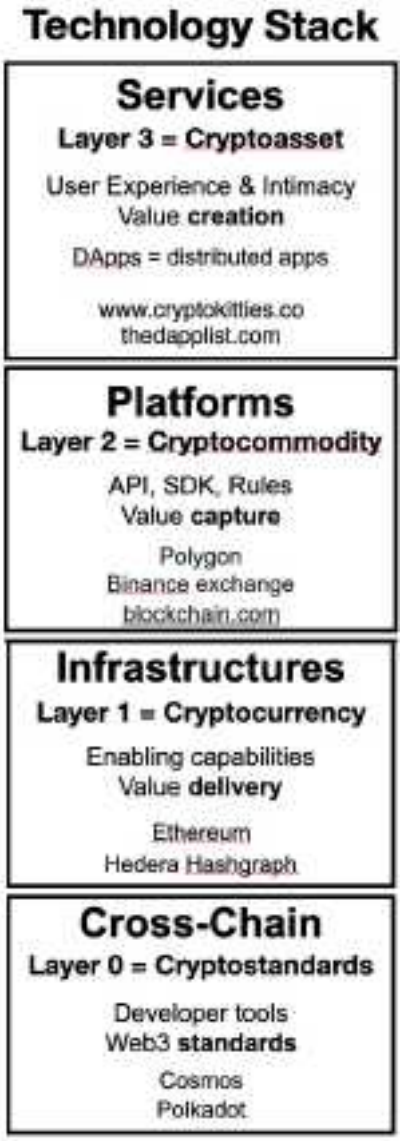

Figure 4: The blockchain technology stack. Figure synthesised from [13] and [14], but it also mirrors the distinction content, application, infrastructure in [15].

This particular kind of smart contract was launched by a project that named itself The ĐAO [16, 17]. It was a direct investment fund on the Ethereum blockchain established in June 2016 and founded by a team looking for investors and saw this as a funding opportunity. The project was an example of an ICO [16, 18]. Investors who funded The ĐAO by depositing Ethereum's native token ether during the fundraising could participate in votes on investment ideas pitched after the launch [1, Section 8.3.3]. Over a month, $150 million in ether was invested, representing 15% of the total supply at the time. The ĐAO became a famous project because a hacker exploited a vulnerability in the governing smart contract as one or more hackers in June 2016 exploited a vulnerability in the smart contract and removed $50 million in ether into an Ethereum digital wallet only they controlled. As The ĐAO smart contract was an automated irreversible bundle of computer code, the community was unable to intervene. The Etherum Founder, Vitalik Buterin, ended up, after some debate with the community, forcing a hard fork of Ethereum rolling back the blocks to before the hack. The Ethereum Proof-or-Work mining node operators who disagreed with this fork could then continue with the original blockchain Ethereum Classic, where the hackers could still cash out [1, Section 8.3.3].

While The ĐAO hack nearly broke Ethereum, and did break the illusion of pure decentralisation, it did establish the foundational idea for much of current DeFi activity as a number of institutions based on the application of DAO smart contracts for their financial innovations. Examples of these are the stablecoin MakerDAO and the Aave decentralised liquidity protocol for lending and borrowing. More than $20 billion are invested in DAO tokens as of 2023 [19].

DECENTRALISED FINANCE (DEFI):

The term Decentralised Finance (DeFi) covers not only a range of financial services conducted on public blockchains, but also services constantly subjected to innovation, change, and regulatory interest [20]. For this reason, any brief description will be partial and the aim here is to provide an overview of the main elements. It has been reported that the first use of the term DeFi was on an Ethereum developer Telegram channel in 2018 [21]. Ethereum was developed as the foundation for smart contracts as Bitcoin's blockchain was unable to directly support complex these, and Ethereum has, since its launch in 2015, developed into the main foundation for DeFi smart contracts both in terms of the underlyng blockchain, as well as the Ethereum Virtual Machine for smart contracts and the token standards [22, 23].

As the payment when transacting bitcoin between accounts belonging to different people technically can be seen as DeFi, the concept spans widely. The defining DeFi characteristic is public blockchain-based contractual relationships between the authorising parties for the purpose of allocating rights over financial capital subject to redemption instead of indefinite transfer of ownership titles [24, Chapter 4]. Since 2017, DeFi has mainly been associated with: **borrowing**, **lending**, **trading**, and **derivatives** [24, 25].

The core elements in this ecosystem are [24, 26, 27]: 1) lending protocol platforms, such as Aave; 2) distributed cryptocurrency exchanges (DEX) offering peer-to-peer cryptotoken exchange through the execution of smart contracts, e.g., Uniswap; 3) derivatives gaining exposure to an asset's value through a smart contract without assuming ownership, such as, dYdX; 4) cryptocurrency portfolio management and yield aggregators; 5) staking of assets to validator nodes to receive a yield, supported by all main Proof-of-Stake blockchains; 6) bridges allowing for the financial contracting between different blockchains; and 7) services providing decentralised oracle services and prediction markets, such as Chainlink and Augur.

Common claims are that DeFi allows the individual more control and is more open since the funds are held by the individual and not a financial institution, the processes are automated and not based on slow manual work, DeFi is open to all, and built on transparency [25]. While these claims have merit, it is also evident from recent activities that the emerging DeFi institutions are not all stable and transparent. Indeed, as in the non-blockchain financial system, there are value and valuation uncertainties, even of the so-called stable coins aimed at providing stability [24]. While early rudimentary blockchain-based financial services were considered uncorrelated with traditional financial markets, recent years have seen both more integration between the two systems and also an increased correlation between the price of tech stock and that of the main cryptocurrencies [28].

DIGITAL WALLET:

A digital wallet denotes a digital facility enabling the storage of a token represented by an alphanumerical string. Digital wallets can generally be categorised as either: hot wallet, which is located on a device connected to the internet, or cold wallets (also called cold storage), which are offline [7, Chapter 14]. Wallets can, furthermore, be characterised in terms of control over the private key to access the wallet and manage the tokens stored there as either direct control, where the wallet owner has control over the keys, or third-party control where control is delegated [29]. The distinction between hot and cold storage is relevant for security reasons as cold storage is more secure than hot storage since the former does not offer direct access. Hardware wallets, such as those manufactured by Ledger.com, function as cold wallets in their normal state when not connected to a computer, but temporarily as hot wallets when connected to a computer, thus allowing tokens to be transmitted to or from the wallet.

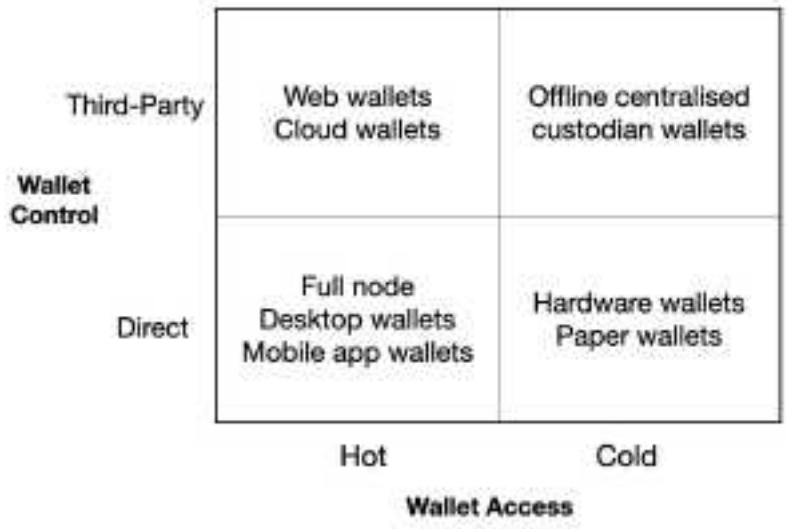

Figure 5: Illustration of the types of cryptotoken wallets.

DISTRIBUTED LEDGER:

Distributed databases denote an architectural configuration that connects the geographically distributed storage, updating, retrieval, and deletion of data. Distributed Ledger Technology (DLT) is a specific type of distributed database supporting common agreements among the participating databases. This is achieved through the locking and time stamping of records to ensure the agreed synchronisation of content between the distributed databases [1, Section 3.4]. A given distributed ledger arrangement is comprised of a network of distributed databases (nodes) and the governing logic (code), ensuring the agreement on data replication and validation across all nodes.

This can, for example, ensure that a consortium of firms each has a local node with data identical to that stored on all the other nodes in the network. Time stamps and locking of records ensure that consistency is maintained while the node can be continuously updated to reflect the relevant changes to the data stored [30]. When one of the participating firms changes data on their local node, this change will be propagated to all the other nodes in the network.

Critically, the participating organisations will either have participated in shaping the design of the database and the associated rules for ensuring consistency across nodes, or they will have accepted the rules stipulated by others. This ensures that all claims enjoyed by any member of the community or consortium can be accessed and known to all other members [31]. In the case of a basic distributed ledger arrangement, the primary claims made will be timely access to local data, which are consistent with data stored across all other nodes in the network.

The participants in a distributed ledger arrangement need not be public or private organisations, but can also be individuals, each operating a full node within the distributed ledger network, or indeed a heterogeneous collection of individuals and organisations.

ENCRYPTION/TOKEN:

The consensus protocol employs information encryption and decryption as a means of enabling only the intended user to access parts that should be kept secret from others. This process of encryption and decryption is achieved through the use of sets of private and public keys. These enable one party to encrypt information using the intended recipient's public key in such a way that only this intended recipient can decrypt the information using their private key. This process secures the information becoming accessible in a readable form to others than these two parties.

At the core of this process is the cryptographic hash function that takes an input of any length and predictably creates an output of a fixed-length string of characters. Each hash function with produce exactly the same string of characters of a set length when given as input the same input. See examples below of how texts are transformed into strings of fixed-length text.

SHA1 hash of "*Distributed ledger*" =
8A65A4B666060F93A319C44085B246459870B24E
SHA1 hash of "*distributed ledger*" =
8BC25837347DA3B2FE4E6B21CEA5547029C17972
SHA1 hash of "*At the core of this process is the cryptographic hash function that takes an input of any length and predictably creates an output of a fixed-length string of characters. Each hash function with produce exactly the same string of characters of a set length when given as input the same input.*" =
D74E4509C4F1E87D20B2B3CC8A5F2D66BA402AD3

Example from **http://www.convertstring.com/Hash/**

When transactions or information need to be added to the blocks in the blockchain, it first goes through the process of hashing. Hashing is a one-way mapping of data into a string with no immediate way of going back from the hashed data-string to the data from which it originated. Using a specialised type of hash function called a cryptographic hash function allows transactions to be recorded permanently. Any attempts to tamper with these transactions will be visible to the entire community.

Cryptographic hashing constitutes core of blockchains as each new block contains the hash of all the previous blocks. This implies that any subsequent changes made anywhere to information previously stored in the chain will make the hash of that particular block different, and thereby also all the subsequent block hashes. Once consensus has been reached about the information stored in a given block, then this automatically locks all the previous blocks, and so on, all the way back to the genesis block. In this way, a blockchain serves as an effective audit trail of transactions. If a hacker, for example, tampers with the data in a given block, then these changes would alter the overall hash-string for that given block, which in turn would change the previous block header, and so on all the way back to the first block, also called the genesis block.

Hash functions are also deployed in asymmetric encryption arrangements to ensure secure peer-to-peer transactions. Here, each person's public key is derived directly from their private key, in a way that ensures that anything encrypted with the public key can only be decrypted with the private key. As each person's public key is publicly available, anyone can use it to encrypt the information they only wish the person holding the private key should see. The system is, therefore, critically premised on the owner of the private key keeping this part a secret. In a public blockchain, such as Bitcoin, every user has a public key, which, when hashed, becomes the address that others will use when they wish to transfer bitcoins to that person. The public key is recorded in the block documenting the transaction of bitcoins and is the unique address and identifier of the recipient's wallet.

The private key enables users to spend their bitcoins by transferring them to another person within the network. A private key is linked to the wallet address where the cryptocurrency is stored and is itself stored either in the wallet or with the person who holds the coin. If a person does not hold the private key of their bitcoin, they do not own the bitcoin and cannot spend it.

FULL AND LIGHT NODES:

A blockchain full node is a computer server running the distributed ledger software enabling data to be maintained consistently across all participating full nodes in the distributed network according to the rules encoded in the consensus protocol. The network of full nodes constitutes a digital infrastructure solving the double-spending problem across all members of the community operating the network of nodes [2]. However, as it is often highly impractical for everyone to dedicate skills, time, computer power, and network traffic to being a full member of the blockchain community, organisations can offer to operate a full node and provide access to it. These organisations then become obligatory passage points for connecting blockchain users to a given blockchain and, therefore, examples of digital platforms operating a business on top of the underlying digital infrastructure of one or more blockchains [13] (See Figure 3).

Wallet providers are one such example of trusted intermediary digital platforms [32] that allow anyone with an account to obtain a wallet and, therefore, to join the blockchain without being directly involved in the blockchain as a full node. Exchanges are another type of platform, which by operating several cryptoasset blockchains are able to facilitate that users holding accounts on the platform can exchange

fiat currency for cryptotokens, or exchange cryptotokens from one blockchain with cryptotokens from a different blockchain. The main platforms operating blockchains are both wallet providers and exchanges, with some also offering their own bespoke cryptotoken.

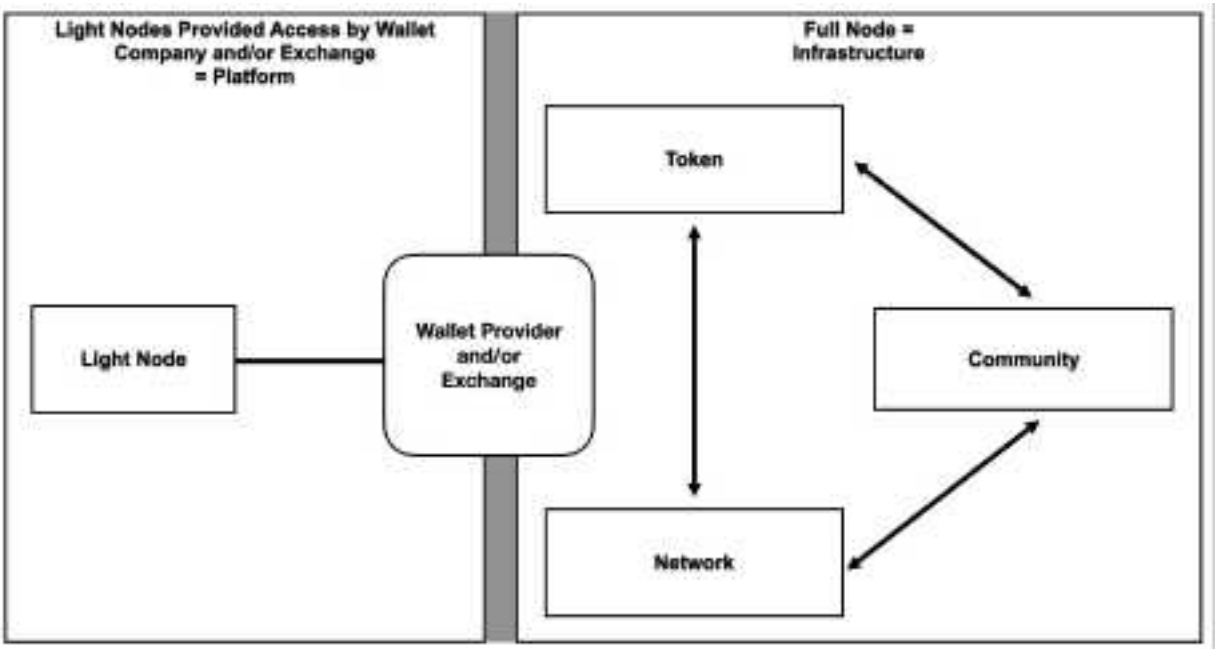

Figure 3: Model outlining the architectural relationship between the infrastructure of full nodes, the associated light nodes, and the digital platforms facilitating the latter.

GENESIS WALLETS:

The genesis block of a blockchain is the block that starts the entire blockchain [1]. The first wallet interacting with the blockchain is the genesis wallet. The initiator of Bitcoin, Satoshi Nakamoto, holds the private keys to a bitcoin genesis wallet containing an estimated 1.1 million bitcoin as of early 2009, which have been stored safely since, and which in March 2023 represent a value of $29 billion [33].

HOT WALLET:

A digital wallet that is accessible online, with keys stored on a programme through a digital device connected to the Internet such as computer, or mobile phone, on on an exchange or wallet company [7, Chapter 14].

INITIAL COIN OFFERING (ICO) OR INITIAL MEMBERSHIP OFFERING:

An initial coin offering (ICO), also referred to as an initial cryptoasset offering, is the process whereby blockchain start-ups can seek capital from investors in return for their tokens or coins [7, Chapter 16]. There are both some similarities but also differences between crowdfunding projects on Kickstarter or Indiegogo and ICOs or peer-lending platforms, such as, Lending Club and FundingCircle [12, Chapter 5, 34, Part 7]. Contributors to a Kickstarter campaign will collectively invest in order to reap the benefits when the project is completed. Similar to the crowdfunding platforms, the ICO allows average retail investors to contribute to new and innovative projects with the risks and rewards that follows. An ICO is also a form of crowdfunding, but all contributors or investors will upfront receive an allocation of cryptotokens reflecting the size of their investment. Some ICO projects offer the tokens on the open market, others conduct private sales to selected investors at a preferential rate before sales on the open market [1].

ICOs have traditionally been announced and marketed at conferences and on social media and documented in or more whitepapers [7, Chapter 16]. This allows potential investors to investigate the proposition, and research has found that whitepaper quality affects the level of ICO funding — whitepapers should emphasise robust technological content over singel issue focus [35]. Inspecting activity on the ICO Github or other codebase platform can also support the assessment of the ICO. The funding is typically paid into a cryptotoken account provided by the founders. Investors will typically assess the provided roadmap of activities and financing, inspect code if the project has open source software elements. The fairness of the token pricing, the token sale, and the proportion allocated to the funding team also form an important part of an ICO assessment. The treasury function of token release schedule will also be assessed along with an appreciation of how to protect against centralised control over tokens [7, Chapter 16, 36].

The first ICO ended July 2013 and raised 4740 BTC (then around $500.000) for the “MasterCoin” project aimed at leveraging the Bitcoin blockchain by adding additional features [37]. Ethereum was in 2014 famously funded by an ICO when Vitalik Buterin raised 3700 BTC in the first 12 hours. The infamous DAO project ICO raised in 2016 $130 million in ETH. The fallout of the hack of the DAO, led to some cooling, but during 2017 a large number of ICOs raised just short of $500 million that year alone. This growth led to many poorly designed, and also some fraudulent projects, resulting in some websites specialising in tracking abandoned projects [38].

MINTING:

The process of a blockchain consensus protocol generating cryptotoken for the particular blockchain is a process of minting [7, Chapter 2, 39, Chapter 4]. For Bitcoin this is an elaborate and lengthy process by which the protocol continuously adjusts the difficulty of the cryptographic puzzle according to the number of validator nodes seeking to solve the puzzle, and at regular interval, halve the number of bitcoin released to the winning validator node for each block added until around 2140 when all 21million bitcoin has been minted [7, Chapter 4, 40].

For some blockchain projects, the supply of cryptotokens is pre-mined or pre-minted, which means that the total supply of tokens are created at a specific point in time and subsequently held in treasury accounts and with some supply allocated to investors and founders according to ICO and SAFT agreements. The process of creating new coins through verification of data, creation of new blocks, and documentation of the verified information on a blockchain network.

MULTI-SIGNATURE WALLET (MULTISIG):

Multi-signature (MultiSig) wallets support cryptographic signatures to be made by multiple private keys and come in a number of variants. A MultiSig wallet is a form of escrow account where the arbitrator remains dormant as the participating parties use their individual private keys to execute transactions. Depending on the specific arrangements, an arbitrator may be involved in cases of disputes [41]. MultiSig wallets either 1) allow any of multiple parties to sign transactions similar to several members of a household, each having a physical key to the house, or 2) require that all or a subset of the authorised signatories must jointly sign transactions, similar to bank vaults where two physical keys must be turned at the same time to unlock the vault [42]. MultiSig wallets can support mitigating risks from the single point of failure of one person having sole-access to cryptotokens, and are designed, so signatories do not reveal their individual private keys when signing [41, 43]. Multi-signature wallets can have two or more different private keys associated. They can generally be characterised as either n-of-n where all keys are needed to authorise transactions, e.g. both if two keys are defined, or all three if three keys are issued, or n-of-m MultiSig wallets, where transactions require signatures from a predefined subset of keys, e.g., 1-of-2, 2-of-3, or 3-of-5. Three example use-cases of this type of wallet are:

1-of-2 MultiSig wallets allow two people to independently share access to the same store of cryptotokens.

2-of-2 MultiSig wallets are, in effect, providing two-factor authentication, for example, by keeping a private key on both a laptop and a mobile phone. Signing can then only be done by authorisation from both devices.

2-of-3 MultiSig wallets are frequently used by exchanges to protect hot wallets with one private key held in a hot wallet online, one kept secure in a cold wallet on an isolated device, and a third key kept with a separate security firm. This protects the wallet both if the exchange is hacked as only the online

keys will be compromised, and if the exchange goes out of business, as the key stored on a cold wallet combined with the key kept at the security firm jointly will unlock the stored cryptotokens.

Many blockchains support the creation of multi-signature addresses, and the ability for clients to recover cryptotokens from online wallets and exchanges relies on some version of a multi-signature wallet [42].

SIMPLE AGREEMENT FOR FUTURE TOKENS (SAFT):

Blockchain projects can raise funds through an investment contract promising to pay the investor who fund in fiat currency back discounted native digital tokens from the treasury wallets at a future date when the blockchain has been deployed and the crypto tokens are minted. This is a simple agreement for future tokens (SAFT) arrangement [1, Section 2.4.5, 34, Section 7]. The SAFT Project saft initiated by Marco Santori, President and Chief Legal Officer of Blockchain.com aims at supporting blockchain projects through regulatory challenges by establishing a standard protecting both investors, blockchain creators, and users [1, Section 2.24, 44]. The project provide contract forms stipulating SAFT arrangements in terms of: Main SAFT related events, e.g., network launch and dissolution, and contract termination; the various definitions of, for example, price, rate, events and launch; company and purchaser representations; and the procedure for purchase and for valuation of purchase amount.

SMART CONTRACT:

Nick Szabo formulated in the early 1990s the notion of a smart contract that “combine protocols with user interfaces to formalize and secure relationships over computer networks” [45]. A smart contract is the unambiguous formalisation of a contractual agreement between parties. Once launched on a blockchain, a smart contract will be self-executing once the predetermined conditions for its operation are successfully met and is generally not revocable [1, Section 3.3.6]. Smart contracts are generally either deterministic or non-deterministic. The former will, once deployed on a blockchain, execute without further need for outside information. The latter category can only execute properly when outside information is added [1, Section 3.3.6].

The Ethereum blockchain was founded as an alternative to the Bitcoin blockchain as the latter is not Turing complete, i.e., able to support the execution of code containing programming statements containing combinations of sequential listing of computer statements, selections branching according to specific criteria, and the specification of iterations [46]. The aim of Ethereum was precisely to provide a digital infrastructure (Layer-1 blockchain) supporting smart contracts [47]. Ethereum’s programming language for smart contracts, Solidity, and the associated Ethereum Virtual Machine (EVM), and the ERC Ethereum token standards supporting the development of cryptocurrency tokens and smart contracts operating on these across different blockchain protocols [22, 23].

Ricardian Contracts, invented by Ian Griggs and Gary Howland in 1996, are legally binding contracts with the core dual properties that they are readable by humans and can be translated into a computer-readable form through deploying a markup language [48]. This encasing of legally binding documents into blockchains through asymmetric encryption. Ricardian contracts have some advantages over smart contracts in terms of establishing legally bi-party contractual agreements [49]: 1) Cases of dispute can be directly taken to court; 2) the contracts are written in legal prose while also machine executable through the markup language; 3) they can flexibly integrate smart contracts into standard legal agreements; and 4) they are signed by all parties involved using private keys. In some use cases, it can be difficult and even impossible to integrate plain smart contracts into the legal system, such as when a Non-Fungible Token (NFT) sale evokes a smart contract stipulating that a resale of the NFT will result in a certain percentage of the sale going to the originator of the NFT [50]. However, smart contracts will not be replaced as there are many use cases where they serve the purpose well.

The blockchain community has forwarded the notion that organising a whole range of societal and business arrangements through smart contracts introduces fairness, accountability, and transparency. The notions of “code as law” and “law as code” are at the core of the blockchain organising vision [51, 52]. While it is reasonable to link computer code to the law in the sense that what goes on in the computer-controlled worlds of the Internet is also carried out within broader legal contexts [53]. However, it is a flawed notion that law as code is feasible, or even practically possible, as disambiguating economic and social processes to an extent allowing laws to be expressed and executed in an automated manner separated from a legal system of assessment and disambiguation [54, 55]. The early days of the open

Internet and the World Wide Web share many of the normative visions with Web3, namely a system separate from the existing arrangements and entirely self-governing. However, over time, it becomes clear that political-legal systems are more powerful than technology-driven efforts [54, 56]. Indeed, it is a core strength that he systems increasingly integrate [57].

STAKING:

The consensus protocol adopting Proof-of-Work can rely on the alignment of interests between the blockchain and validator nodes as spending significant electricity to guess the correct answer to the cryptographic puzzle will likely be in vain if attempting to validate incorrect transactions. When the consensus protocol implements a Proof-of-Work method of resolving the double-spending problem, the interests of the validator nodes and the blockchain are aligned by the validators staking holdings of cryptotokens to validator nodes and receiving rewards by validating new blocks by voting according to the size of their stake. The main assumption is here that those with the largest stake will most frequently be asked to vote on the addition of blocks but also have most to loose of fraudulent transactions are recorded onto the blockchain. Some blockchain consensus protocols implement various degrees of slashing, which means the entire or fractional loss of cryptotokens in case of fraudulent transactions being validated onto the blockchain.

TOKEN:

A cryptographic alpha-numerical string (see cryptography) embedded and accounted for by a concensus algorithm within a distributed ledger/blockchain. The token represents a claim against the members of the social community/consortium who collectively interacts with and validates the validity of the transactions.

TREASURY WALLETS:

Whereas the Bitcoin blockchain consensus protocol releases new bitcoin as the cryptographic puzzles are solved and new blocks are added, other blockchain projects operate with pre-mined cryptotokens. This means that all available tokens are generated a priori and therefore need to be accounted for to the community engaging with the project. The treasury wallets will contain these tokens as the reserve for the particular blockchain project. They can here be used for a number of purposes, such as converted into fiat currency in order to pay for the operations, they can be invested, or staked to nodes operated by the treasury, assuming that a Proof-of-Stake consensus protocol is adopted [58].

WHITE PAPER:

Since the eponymous Satoshi Nakamoto launched the Bitcoin project on October 31st 2008 with the now famous white paper [4], blockchain projects have followed the tradition of also providing information about their project in one or more white papers. The technical white paper is at the core of blockchain projects as it provides authoritative, informal, and non-binding technical description of the project along with a website hosting the white paper and presenting the founders and other team members [12, Page 102]. A blockchain white paper will typically cover: the project goals; the current problem and how the project aims at solving this; development milestones; project team background and experience; the expected amount to be raised; how the funds will be managed and spent; the purpose of the tokens and how they will be used; the initial minting of tokens and how they will be distributed by the team [34, Part 7] [1, Chapter 2]. The quality of white papers in terms of thorough coverage of these topics have been found leading to higher levels of funding that white papers only focused on one issue, such as presenting the problem and solution without covering other critical issues in depth [35].

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APPENDIX 7.3
RANKED LIST OF BOOKS, ARTICLES & REPORTS

BOOKS

Dixon, C. 2024. Read, Write, Own: Building the Next Era of the Internet. London, UK: Random House.
Our best bet if you wish to read a sober book on tokenization essentials. Highly recommended.
Amazon Link

Lacity, M. C. (2020): Blockchain Foundations for the Internet of Value. Arkansas: epic books.
Excellent book full of explanation and examples drawn from a rich background of cases.
Amazon Link

DuPont, Q. (2019): Cryptocurrencies and Blockchains. John Wiley & Sons.
Both a thorough and brief book explaining the subject matter very well. Also an early book.
Amazon Link

Tapscott, D. & A. Tapscott (2016): Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business, and the World. Penguin.
A very early book on the subject of blockchain by one of the most prolific commentators of technology and business, and his son.
Amazon Link

REPORTS

Brodie, A., Brennan, D. E., & Sørensen, C. (2019). Tides of Disruption: How to Navigate Business Transformation.
Gowling WLG & LSE Consulting Whitepaper discussing the future business impact of five disruptive technologies
http://stuff.carstensorensen.com/TidesOfDisruption2019.pdf

Borbon Galvez, Y., Nausedaite, R., Howard, A., van Gend, L., Coatanroch, G., Malite, G., Romeo, S., Collini, L., & Beck, R. (2024). Study on the potential of blockchain technology and other digital tools in facilitating EU climate policy implementation.
https://op.europa.eu/en/publication-detail/-/publication/4ebd7dc9-d646-11ee-b9d9-01aa75ed71a1/language-en/format-PDF/source-307948034

Hedera. (2024). Exploring the Emerging Token Economy: Unlocking the potential of tokenized real-world assets.
An overview of the Layer-1 protocol Hedera's support for tokenization with several case studies.
https://hedera.com/use-cases/real-world-asset-tokenization

Enterprise Ethereum Alliance. (2023). Ethereum Business Readiness Report 2023. Similarly, overview and cases related to Ethereum's ability to support asset tokenization.
https://entethalliance.org/eea-ethereum-business-readiness-report-2023/

ARTICLES

Lacity, M. C. (2018). Addressing Key Challenges to Making Enterprise Blockchain Applications a Reality. MIS Quarterly Executive, 17(3).
This is an excellent introduction to the organizational application of tokenization, with three insightful cases described in detail.
https://aisel.aisnet.org/misqe/vol17/iss3/3/

Sørensen, C., & Rossi, E. (2019). When is a Blockchain Actually a Blockchain? Harvard Deusto Business Review special report on "Blockchain and its impact". https://www.harvard-deusto.com/sumando-ideas-blockchain-revolucion-disruptiva (in Spanish)
http://stuff.carstensorensen.com/TC/SorensenRossi2019.pdf (in English)

Goldsby, C., & Hanisch, M. (2022). The Boon and Bane of Blockchain: Getting the Governance Right. California Management Review, 64(3), 141-168.
Excellent paper discussing the challenges of blockchain governance based on an extensive set of cases from projects IBM has supported.
https://journals.sagepub.com/doi/pdf/10.1177/00081256221080747

Lacity, M., Sabherwal, R., & Sørensen, C. (2019). Special Issue Editorial: Delivering Business Value through Enterprise Blockchain Applications. MIS Quarterly Executive, 18(4), ix-xix.
Brief introduction to the challenges and opportunities of blockchain for enterprises. Introduces a special issue with a number of papers (listed below)
https://aisel.aisnet.org/misqe/vol18/iss4/3/

Jensen, T., Hedman, J., & Henningsson, S. (2019). How TradeLens Delivers Business Value With Blockchain Technology. MIS Quarterly Executive, 18(4), 221-243.
Detailed case study of the now failed TradeLens
https://aisel.aisnet.org/misqe/vol18/iss4/5/

Mattke, J., Hund, A., Maier, C., & Weitzel, T. (2019). How an enterprise blockchain application in the US pharmaceuticals supply chain is saving lives. MIS Quarterly Executive, 18(4).
Discussion of the MediLedger case.
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Zavolokina, L., Ziolkowski, R., Bauer, I., & Schwabe, G. (2020). Management, governance and value creation in a blockchain consortium. MIS Quarterly Executive, 19(1), 1-17.
A vertical consortium for the second-hand car industry.
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Rieger, A., Guggenmos, F., Lockl, J., Fridgen, G., & Urbach, N. (2019). Building a Blockchain Application that Complies with the EU General Data Protection Regulation. MIS Quarterly Executive, 18(4), 263-279.
Design challenges for organizational blockchain use under EU's GDPR legalisation.
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Blockchain for regulatory compliance.
https://aisel.aisnet.org/misqe/vol19/iss1/4/

Pedersen, A. B., Risius, M., & Beck, R. (2019). A ten-step decision path to determine when to use blockchain technologies. MIS Quarterly Executive, 18(2), 99-115.
Outline of the 10 decision steps towards blockchain using the example of a ship register.
https://aisel.aisnet.org/misqe/vol18/iss2/3/

Iansiti, M., & Lakhani, K. R. (2017). The truth about blockchain. Harvard Business Review, 95(1), 118-127.
Early HBR article outlining blockchain challenges and their disruptive potential.
https://hbr.org/2017/01/the-truth-about-blockchain

Sunyaev, A., Kannengießer, N., Beck, R., Treiblmaier, H., Lacity, M., Kranz, J., Fridgen, G., Spankowski, U., & Luckow, A. (2021). Token economy. Business & Information Systems Engineering, 63(4), 457-478.
Collection of academic essays discussing tokenization and decentralized asset transfers.
https://link.springer.com/article/10.1007/S12599-021-00684-1

Karhu, K., Gustafsson, R., Eaton, B., Henfridsson, O., & Sørensen, C. (2020). Four Tactics for Implementing a Balanced Digital Platform Strategy. MIS Quarterly Executive, 19(2), 105-120.
Overview of four possible tactics when opening up the firm to collaboration with outsiders.
https://aisel.aisnet.org/misqe/vol19/iss2/4/

Sørensen, C., Viguerie, C., Giraldo Mora, J. C., & Ahmed, T. (2024). Tokenization: A Foundation for Digitized Inter-organizational Relationships. In A. Baiyere, M.-K. Stein, & R. D. Galliers (Eds.), The Routledge Companion to Management Information Systems.
An academic chapter making the argument for tokenization for those with this interest.
http://stuff.carstensorensen.com/TC/SorensenEtAl2024.pdf

Name	Purpose?	What is Tokenized?	Sector	L1 Protocol	URL
GoMint	Full-service tokenization platform/ NFT marketplace	Digital content	Arts & Entertainment	Hedera	https://www.gomint.co
Fairchain	Infrastructure for fine art to support digial contracts and certificates for collectors	Art works	Arts & Entertainment	Ethereum	https://fairchain.art
Arttrade	Tokenised art marketplace	Art works	Arts & Entertainment	Solana	https://artrade.app
Arcual	Creates digital infrastructure for the art industry (digial contracts, certificates, community)	Art works	Arts & Entertainment	Unclear	https://www.arcual.art https://artreview.com/discover-arcuals-pioneering-blockchain-technology/
Fresh Supply Co (FSCO)	Agricultural supply chain management and payment automation	Assets and events across the agrifood supply chain	Agrifood	Hedera	https://fsco.io
Foodchain	Tracks food product from farm to fork	Food products	Agrifood	Unclear	https://food-chain.it
Open Food Chain	Tracks food product from farm to fork for greater transparency and ESG reporting	Food products	Agrifood	Unclear	https://www.openfoodchain.com/About-us
Tejouri	Digital vault to secure sensitive documents and information	Documents and information	Civic	Hedera	https://www.tejouri.com
Diamond Standard	Natural diamond commodity tokens	Diamonds	Commodities	Hedera	https://www.diamondstandard.co
Paxgold	Tokenized gold	Gold	Commodities	Ethereum	https://paxos.com/paxgold/
WisdomTree	Tokenized gold	Gold	Commodities	Stellar	https://stellar.org/case-studies/wisdomtree
Aurus	Provides software, network and crypto infrastructure for global precious metals businesses to tokenise their assets, while allowing others to buy them	Precious metals	Commodities	Unclear	https://aurus.io/faq#basics
Sentr3	Enables businesses to create and manage token-gated experiences for their customers/ members, which involves offering exclusive content, access, or other experiences to holders of certain tokens or NFTs	Access & membership	Customer engagement	Chain-agnostic	https://sentr3.com
Versal	Infrastructure For Moving Digital Assets	Digital assets (Stablecoins, Central Bank Digital Currencies (CBDCs), cryptocurrencies, and tokenized assets like NFTs)	Digital assets	Hedera	http://versal.money
Energy Tokens	Trading platform to acquire, hold and transfer direct interests in energy producing assets, including oil/gas and solar/wind	Energy-producing assets	Energy	Unclear	https://www.energytokens.io/why-et/
Tolam Earth	Marketplace for carbon offsets	Carbon offsets	Environment	Hedera	https://tolam.io/armm/
Moss	Offers tokenised carbon offsets	Carbon offsets	Environment	Unclear	https://moss.earth/en https://mco2token.moss.earth
Nori	Supports regenerative agriculture, soil restoration, and carbon sequestration	Carbon credits (Certificate representing one tonne of CO2-equivalent heat-trapping gas that has been removed from the atmosphere and stored)	Environment	Unclear	https://nori.com/carbon-removal/regenerative-tonne
Hydrokken	Aims to democratize investment, improve liquidity, and enhance transactional transparency, to ultimately make the natural hydrogen market more accessible and efficient.	Hydrogen	Environment	Unclear	https://hydrokken.com/about/
Archax / ABRDN	Investment tokenisation	Investment instruments e.g. money market funds	Finance	Hedera	https://archax.com https://www.abrdn.com/en-sg/
Ondo Finance	Institutional-grade, blockchain-enabled investment products and services	Investment products e. g. First to tokenise exposure to US Treasuries.	Finance	Ethereum	https://ondo.finance
BackedFi	Composable tokenized securities that track the value of RWAs such as Bonds, Stocks, or ETFs	Financial instruments	Finance	Ethereum	https://backed.fi/?ref=alphagrowth
NAOS Finance	Decentralized lending protocol for SMEs accessing DeFi liquidity	Various types of real world collateral	Finance	Ethereum	https://naos.finance/?ref=alphagrowth
Circle	Stablecoin to facilitate digital transactions known as USDC	USD	Finance	Ethereum	
DigiFT	Tokenisation of real-world assets. DigiFT is an on-chain real-world asset (RWA) exchange.	US T-Bills	Finance	Ethereum	https://www.theblock.co/post/284382/singapore-digift-tbill-rwa https://www.digift.sg

Name	Purpose?	What is Tokenized?	Sector	L1 Protocol	URL
Maker	Other cryptocurrencies, currencies, and "real world assets"	Stablecoin (and a DAOI) to facilitate transactions in blockchain systems and handle volatility	Finance	Ethereum	https://makerdao.com/en/ https://en.wikipedia.org/wiki/Dai_(cryptocurrency)
MatrixDock	Enables yields from U.S. Treasury securities	U.S. Treasury Bills	Finance	Ethereum	https://www.matrixdock.com/wstbt
OpenEden	Tokenized RWA vault offering access to US T-bills	U.S. Treasury Bills	Finance	Ethereum	https://openeden.com/#how-tbill-works
Credix	Credit marketplace. Investors invest stablecoins (USDC) in liquidity pools, and FinTech borrowers in emerging markets borrow this and convert them into their local currencies.	Private/ institutional credit	Finance	Solana	https://credix.finance / https://solana.com/news/case-study-credix
Bridgesplit	Capital markets infrastructure. Infrastructure for fixed-rate borrowing and lending to facilitate exchange of capital	Alternative assets/ collateral	Finance	Solana	https://www.bridgesplit.com/businesses https://docs.bridgesplit.com/bridgesplit-markets/why-bridgesplit
Etherfuse	Tokenised bonds backed by real-world bonds	US, EU, Mexican bonds	Finance	Solana	https://etherfuse.com
Moreliquid	Provides liquid exposure to EU Money Markets	EU Money Market Funds	Finance	Polygon	https://www.moreliquid.io
Franklin Templeton	Processing transactions and recording share ownership of U.S.-registered mutual fund on-chain	Money Market Fund	Finance	Polygon	https://www.franklintempleton.com/press-releases/news-room/2023/franklin-templeton-money-market-fund-launches-on-polygon-blockchain
Ripple	Settlement between banks in global payments	Currency	Finance	XRP Ledger Consensus Protocol	https://ripple.com
Polymath	A platform for digitizing and trading "real world assets"	"real world" assets creating liquidity	Finance	Private, it seems. It's unclear	https://polymath.network
Plural	Decentralised insurance (building a risk transfer ecosystem)	Insurance	Finance	Unclear	https://plural.fi/#about https://plural.fi/whitepaper.pdf
Infineo	Blockchain-based company tokenising insurance to improve transparency and efficiency for policyholders, carriers, and investors	Life insurance policies	Insurance	Provenance	https://provlabs.io/newsroom/posts/infineo-first-tokenized-life-insurance-policy/
Staex	Project Rise - Monetizing drone ground stations through IoT and blockchain	Payments	Logistics	Lisq	https://staex.io / https://staex.io/projects/rise
Baxus	Peer-to-peer Marketplace for buying, selling, trading, and storing rare spirits & wine	Alcohol	Luxury	Solana	https://www.baxus.co/?sortBy=listedDate%3Adesc
Aura Consortium	Blockchain solutions provider dedicated to the Luxury Industry (founded by Luxury companies) - focusing on authenticity, supply chain transparency, loyalty)	Product information	Luxury	Chain-agnostic	https://auraconsortium.com
Parcl	Perpetuals decentralised exchange that offers real estate index markets for speculating or hedging	Real estate price indices	Real estate	Solana	https://app.parcl.co/portfolio
Homebase	Fractionalised real estate investments	Real estate	Real estate	Solana	https://www.homebasedao.io
Outsyde	Enables partners and third party service providers to monetize opportunities from land - such as by offering carbon credits or tokenisation of investments	Property rights	Real estate	Polygon	https://www.getoutsyde.com/
Lofty	Fractional real estate marketplace	Property	Real estate	Algorand	https://www.lofty.ai
Atma.io / Avery Dennison	Connected product cloud - a platform that enables authentication of devices or products, management of inventory, and tracing them throughout their lifecycle.	Product information	Supply chain	Hedera	https://www.atma.io
Textile Genesis	Traceability platform custom built for the fashion & textile ecosystem	Textile product information	Supply chain	Unclear	https://textilegenesis.com
Aware	Enables traceability and validation of impact of textiles	Textile product information	Supply chain	Unclear	https://wearaware.co
Blockride	Allows users to buy a fraction of revenue-generating bus fleets and receive a percentage share of daily revenue directly in their wallet.	Fleet/ vehicle ownership	Transport	Solana	https://www.blockride.xyz

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JPM Coin	Inter-bank payment network	Payment transactions between JPM's clients	Finance	Ethereum Enterprise	https://www.jpmorgan.com/kinexys/digital-payments
Microsoft	Blockhchain-as-a-Service	By use case	Cloud	Ethereum	https://aka.ms/ABService
Samsung	Wallet for Digital Assets	Keystore	Crypto	Multichain	https://www.samsung.com/ca/apps/samsung-blockchain/
FedEx	Shared digital ledger for more efficient and secure supply chains for customers	Supply Chain Data	Supply chain	Ethereum	https://www.fedex.com/en-us/about/policy/technology-innovation.html
Visa NFT Creator Program	Immersion program geared towards digital creators working in art, music, fashion and film looking to accelerate their small business through NFTs	IP	Creative	Ethereum	https://usa.visa.com/partner-with-us/info-for-partners/visa-creator-program.html
The British Museum	Created a range of NFT digital collectibles to provide immersive experience	Art pieces	Arts	Ethereum	https://decrypt.co/150405/british-museum-enter-metaverse-via-sandbox
Budweiser	Launched NFTs for greater fan engagement and community building	Fan Club	Entertainment	Ethereum	https://nft.budweiser.com
Sotheby's	Art Metaverse	Art - collectibles	Arts	Ethereum	https://metaverse.sothebys.com/marketplace/artist
Nike	Collectibles	Collectibles	Clothing / Art	Ethereum	https://rtfkt.com
Shell	Open-source climate solutions	Climate Data	Sustainability	Ethereum	https://gov.gitcoin.co/t/passed-climate-coordination-network-funding-proposal/18522
European Investment Bank	Digital Bonds	£50m Bond	Finance	Ethereum	https://www.eib.org/en/press/all/2023-030-eib-issues-its-first-ever-digital-bond-in-british-pounds
Fidelity	Crypto to Clients	Crypto	Finance	Etherum	https://www.fidelity.com/crypto/trading
National Bank of Australia	Cross-border Stablecoin	Fiat - transactions	Finance	Ethereum	https://news.nab.com.au/news/nab-completes-world-first-with-cross-border-stablecoin-transaction/
Google	Blochain Data Indexing	On-chain data analytics	Data	Multichain	https://cloud.google.com/blog/products/data-analytics/data-for-11-more-blockchains-in-bigquery-public-datasets
Franklin Templeton	Government Money Fund (US)	Money Markets	Finance	Polygon	https://www.franklintempleton.com/investments/options/money-market-funds/products/29386/SINGLCLASS/franklin-on-chain-u-s-government-money-fund/FOBXX
Monetary Authority of Singapore	DeFi- wholesale money market	Live Currency Transaction	Finance	Ethereum	https://www.mas.gov.sg/news/media-releases/2022/first-industry-pilot-for-digital-asset-and-decentralised-finance-goes-live
Standard Chartered, Deutche Bank	completed the first Universal Digital Payments Network (UDPN) proof-of-concept (PoC), executing real-time on-chain transfer and swap test transactions between USDC and EURS stablecoins	Currency Swap	Finance	Ethreum	https://www.gft.com/be/en/about-us/news/press-releases/press-and-news/2023/news/udpn-poc-no-10-successful
EQTY Lab	Ensuring traceability and validation of the data used to train generative AI models	Data sources for AI training	AI	Hedera	https://hedera.com/users/eqty-lab

Name	Purpose?	What is Tokenized?	Sector	L1 Protocol	URL
Dovu	Provides the technical infrastructure for the audit trail of standards and methodologies relating to carbon credits	Carbon credits	Sustainability	Hedera	https://hedera.com/users/dovu
AdsDax	Media advertising platform that tracks and verifies advertising events and engagement	Data about advertisement engagements	Advertising	Hedera	https://hedera.com/users/adsdax
Earth ID	Decentralized identity management platform	Identity data	Identity Management	Hedera	https://hedera.com/users/earth-id
docStribute	Immutable file sharing allowing institutions to send documents to their customers	Documents and information	RegTech	Hedera	https://hedera.com/users/docstribute
Karate Kombat	Incentivises fan engagement and fighter payouts with crypto	Consumer engagement	Media & entertainment	Hedera	https://hedera.com/users/karate-combat
Everyware	Provides connected sensors to track and monitor critical assets in healthcare	Information e.g. temperature recordings	Internet of Things / Healthcare	Hedera	https://hedera.com/users/everyware
Maalexi	B2B ecosystem that enables wholesale cross-border trade of food and agriculture products	Transactions, transactional documents, and buyers/seller ratings	Supply Chain	Hedera	https://hedera.com/users/maalexi
Red Swan	Allows investors to purchase fractional ownership in premium commercial properties	High-value real estate assets	Real Estate	Hedera	https://hedera.com/users/redswan
SAFE	Platform for patient information that allows data authenticity while protecting end-user privacy	Patient data	Healthcare	Hedera	https://hedera.com/users/safe-health-systems-inc
Things Protocol	IoT device management software that prevents spoofing by allowing devices to authenticate themselves in a trusted way	Device identity	Internet of Things / Healthcare	Hedera	https://hedera.com/users/things-protocol
Unthink	Provides tools that help brands and creators construct highly tailored e-commerce pop-up stores, to foster better community engagement	Information such as sales attribution, user preferences, and influencer profile ratings	E-commerce	Hedera	https://hedera.com/users/unthink
Diamond Standard	To provide greater liquidity and accessibility to the diamond market, while ensuring transparency and traceability	Diamonds	Finance	Hedera	https://hedera.com/users/diamond-standard
Doctor Who - Worlds Apart	Card trading game where each card is an NFT, based on the Doctor Who series	Trading cards, as well as the business relationship between BBC and Reality+	Media & entertainment	Hedera	https://doctorwho-worldsapart.com
The Stigverse	Virtual online gaming experience	Characters, in-game items etc.	Media & entertainment	Hedera	https://realityplus.com/case-study/top-gear-sandbox
Avelia by Shell	Digital book-and-claim solution for scaling sustainable aviation fuel (SAF) usage	Environmental attributes associated with SAF delivered into aviation fueling network	Aviation / Energy	Ethereum	https://aviation.shell.com/avelia-panel-interactive
Blocksquare	Provides tools and protocols for real estate tokenisation (focused on SMEs)	Real estate	Real Estate	Ethereum	https://blocksquare.io
BRØK	Blockchain-based cap table management platform that uses tokenisation for share ownership and transfer, and to track unlisted stock ownership	Receipts of shares for unlisted companies	Finance	Ethereum	
Circularise	End-to-end traceability solution for raw materi	Product information	Supply Chain	Ethereum	https://www.circularise.com
Fnality	Multi-jurisdctional wholesale payment system backed by consortium of central banks	Wholesale cash	Finance	Ethereum	https://fnality.com
Roxpay	B2B software platform specializing in blockchain-based pay-per-use asset management and financing solutions.	Pay-per-use assets, usage data	Supply Chain	Ethereum	https://www.roxpay.eu/en/
Sage Management	Enterprise-grade telecom cost management: Aims to optimise operations functions	Service level agreements, orders and billing data	Telecommunications	Ethereum	https://www.sagemi.com
Tokenchampions	To manage the image rights of professional football players	Image rights	Media & entertainment	Ethereum	https://tokenchampions.com
Covantis	Platform that digitizes and streamlines post-trade operations in global agricultural trading	Documents, transaction data	Agriculture	Ethereum	https://covantis.io/about/
Nyala	Tokenisation platform helping companies issue compliant tokenized securities such as bonds and shares	Securities	Finance	Ethereum	https://www.nyala.de/en/
Palm	NFT Ecosystem and Studio for Creators to build communities	Art work	Arts & Entertainment	Ethereum	https://palmnftstudio.com
Aconomy	Global real-world asset marketplace for asset discovery, tokenization & liquidity	Real-word assets	Finance	Unknown	https://www.aconomy.foundation
Fusang	Digital securities exchange connecting brokers and banks to private markets & alternative investments	Alternative assets	Finance	Ethereum	
Opera MiniPay Wallet	To make mobile payments more accessible and secure for people in Africa	Mobile payments	Finance	Ethereum	https://www.opera.com/products/minipay

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Rubey	Art tokenisation platform to create greater financial accessibility to art investments	Artwork	Art	Ethereum	https://www.rubey.be/en
Tokeny	Enterprise-grade tokenisation platform for digital assets	Real-word assets	Finance	Ethereum	https://tokeny.com
XEROF	To optimise international payments and settlements in global supply chains	Payments	Finance	Ethereum	https://www.xerof.com
Mattereum	Protocol that makes it possible to securely buy and sell almost any asset worldwide on digital marketplaces with full legal protection and binding effect	Various assets	Legal	Ethereum	https://mattereum.com/services/
Nayms	Marketplace for on-chain insurance and reinsurance contracts	Insurance policies, capital pools	Insurance	Ethereum	https://www.nayms.com
Bitwave	Enterprise crypto tax and accounting data platform	Crypto assets, transactions, reports	Finance	Ethereum	https://www.bitwave.io