Aaro Capital

A Primer on the Economic Aspects of DLT and Cryptoassets

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Executive Summary

In this paper, we provide a primer on the economic aspects of DLT and cryptoassets. We first explain what the DLT data architecture is, how it differs from standard, centralised structures and what constitutes good DLT governance. We then provide an overview of various cryptoassets, such as cryptocurrencies and tokens. Finally, we examine the economic benefits of DLT and cryptoassets, which stem from the unique characteristics of DLT, such as decentralisation, shared ownership and control of one's information.

The success of Bitcoin has demonstrated that it is possible to create, store and transfer digital value, without relying on a central authority, or trusted intermediary, by building a network that is open to everyone with a computer and an internet connection. This success has prompted a discussion of how some of the advantages of this technology can be applied in various industries, such as insurance, international remittances, finance and supply chains. This technology is broadly known as Distributed Ledger Technology (DLT).

DLT is a new and distinct family of digital data architectures. In the dimension of control, it is decentralised, so that no central entity controls it. In the dimension of execution architecture, it is distributed, so that information is shared in a peer-to-peer network with no centre(s). These two characteristics create both advantages and disadvantages for distributed ledgers. The decentralisation of DLT forces developers to adopt a clearer and more standardised structure for the different layers of the data infrastructure stack. Software standardisation has many advantages, including inducing the development and usage of more robust and interoperable solutions.

However, the key innovation of DLT is that it implements an immutable and append-only ledger, using the tools of cryptography and game theory. Although immutability is technically possible also in centralised databases, there is no guarantee that the entity who owns it will not tamper with the database and get away with it. In contrast, a distributed ledger is immutable by design. Participants do not need to trust each other for the distributed ledger to be maintained and updated. Moreover, DLT provides a transparent, secure and accountable way of managing and transferring data and value, which is achieved by creating digital scarcity. One unit of bitcoin, for example, cannot be duplicated, even though it is digital and not backed or maintained by a trusted central authority. It can be transferred between two individuals without the involvement of any trusted intermediary. This creates a plethora of opportunities that, up to now, were not considered possible in a purely digital world.

One of the issues that has received relatively little attention up to now is DLT governance. Historically, governance could only be effectively undertaken via a centralised structure, due to the limitations of coordinating many individuals and aligning their incentives. DLT governance is more challenging, because decision-making is distributed among many participants. These challenges can be evaluated by analyzing four characteristics of good governance: transparency, security, decentralisation and accountability.

Achieving these four characteristics of good governance is enabled via cryptoassets, which are digital representations of assets, recorded on a distrusted ledger and secured by cryptography. Cryptoassets are issued and traded within a distributed ledger network. The asset which these tokens represents can be a real-world asset, such as commodities and real estate, or purely digital. Different types of tokens include security, utility, work, reward, and payment and access tokens.

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The other major category of cryptoassets is cryptocurrencies, which are designed to be a general means of payment for goods and services. In addition, they act as an incentive and coordination mechanism that prevents attacks aiming to corrupt data stored in their ledgers. This is achieved through protocols, such as Proof-of-Work and Proof-of-Stake, that generate digital scarcity and incentivise random participants to maintain, update and protect the ledger. This is a major innovation of permissionless DLT, which is enabled via the tools of game theory and cryptography. Without cryptocurrencies, good decentralised governance of distributed ledgers and the economic benefits they bring, is not possible.

Several key economic benefits arise due to the differentiating characteristics of DLT and cryptoassets, such as decentralisation and shared ownership, immutability, trustlessness and digital scarcity. First, DLT can disintermediate the control of networks and the flow of information by promoting trust among participants, enabling the removal of rent seeking intermediaries. Second, by sharing the ownership of the ledger among participants, they can alleviate the hold-up problem, where one party in a business relationship leverages its negotiating power at the expense of others. Finally, by issuing tokens to those who contribute to the network, they can solve the “chicken and egg” problem of network growth, without creating a central entity that monopolises the network. The largest benefits of DLT, over and above those stemming from traditional digitalisation and automation, are in solving these three economic problems. There are also beneficial use cases for DLT in more centralised settings, although the value added over traditional digital infrastructures is more limited.

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Contents

Executive Summary i
Contents iii
1 DLT Software Architecture 1
1.1 Database Design 1
1.2 Data Infrastructure Stack 2
1.3 Software Standardisation 3
2 DLT Governance 4
2.1 Transparency 4
2.2 Security 4
2.3 Decentralisation 5
2.4 Accountability 6
3 Cryptoassets 7
3.1 Cryptocurrencies 7
3.2 Tokens 9
3.2.1 Utility tokens 9
3.2.2 Payment and Access Tokens 10
3.2.3 Work Tokens 10
3.2.4 Reward Tokens 10
3.2.5 Security Tokens 10
4 Economic Benefits of DLT and Cryptoassets 12
4.1 Disintermediation of Trusted Intermediaries 12
4.2 Disintermediation of the Hold-Up Problem 13
4.3 Disintermediation of Network Monopolies 14
5 Conclusion 16

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1 DLT Software Architecture

1.1 Database Design

A database is a structured set of digital information, with a unique identification number for each row, and defined rules for the data stored in each column. Historically, the term “ledger” was only used for databases which contained financial transactions. The most important properties of a database are the control system and the execution architecture. There are sliding scales for each of these properties, thus databases come in many forms.

In the dimension of control, the sliding scale varies between completely centralised, where only one entity has read and write permissions, and decentralised, where multiple entities must come to agreement on governance of the database.

In the dimension of execution architecture, databases fall into three general buckets: centralised databases, decentralised databases and distributed databases, as illustrated Figure 1 below. In centralised databases, a single master copy of the entire database is stored in a single location. In decentralised databases, data is split between multiple centres. In distributed databases, information is consensually shared among different nodes, dispensing with any centres completely, such that each node in the peer-to-peer network is created equal.

Figure 1: Database execution structures



Source: Aaro Capital Research

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Table 1: A comparison of database execution structures

	Centralised	Decentralised	Distributed
Pros	Highest transaction speed and volume	More resilient to attacks, as there are multiple local centres Data can be stored where it originated, reducing data copying	Most resilient to outside attacks, as there is no single point of failure
Cons	Less robust to attacks as there is a single point of failure May involve copying data from multiple sources into one location Reliant on a trusted third party	Reliant on a trusted third party There are still bottlenecks	Least scalable for transaction speed and volume Least efficient as data is duplicated many times

Source: Aaro Capital Research, Cointelegraph, Multichain, Ben Morris

A distributed ledger is a specific type of a distributed database, based on and verified by the mathematical properties of cryptography. Introducing a cryptography-based data structure makes the ledger immutable and append only. However, immutable, read-only databases are nothing new and can easily be created by changing the write permissions of a database. The key innovation is cryptography-based data structure, which for the first time enables digital scarcity.

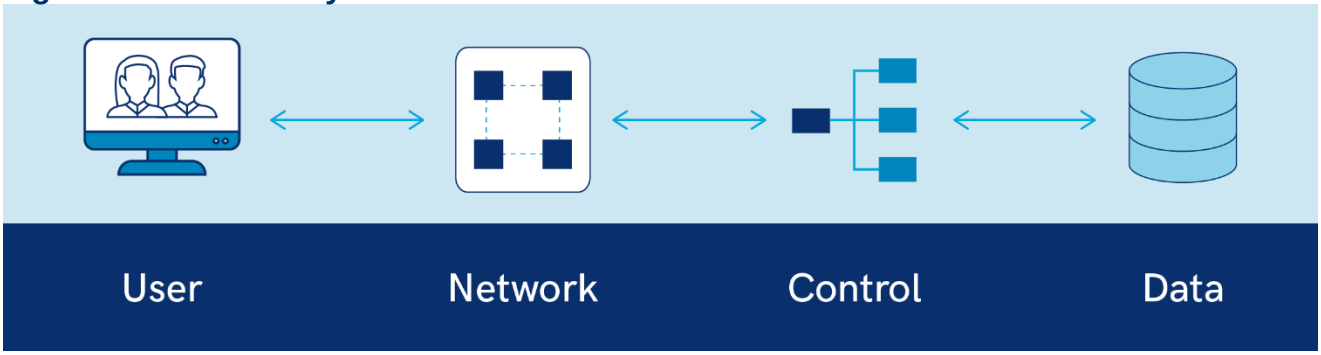
Cryptography makes distributed ledgers far more suited for instances where trust between participants is lacking, and a database is to be governed in a decentralised manner. There is no need to trust other participants on the ledger, and this is its key advantage over a traditional distributed database.

1.2 Data Infrastructure Stack

Data infrastructure itself provides three separate functions, which are provided by three separate layers of software:

- Data layer: This layer represents data and stores it.
- Control layer: This layer gives access to the data, running queries and controlling and enforcing access rights.
- Network layer: This layer gives network participants access to the control layer.

Figure 2: Different Layers of Data Infrastructure



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1.3 Software Standardisation

It is the poor or bespoke design of the non-database components, and how these components interact, which cause most data infrastructure issues.

Table 2: The different layers of a platform

	Traditional	Permissionless Ledger
Data Layer	Standardised data formats	Standardised data formats
Network Layer	Typically bespoke and poorly designed software architecture	Standardised and robust software architecture
Protocol Layer	Typically bespoke and poorly designed software architecture	Standardised and robust software architecture

Source: Aaro Capital Research

DLT forces developers to adopt a clearer and more standardised representation of data, the logic around data, access controls, data storage and validation as well as other layers of the software stack. Standardisation allows for better solutions to emerge, increases the ease of system interoperability and system upgrades. DLT not only reduces the need for customisation, but also removes the option for quick fixes and poor software design choices which end up costing clients more in the long run. However, as with other standardised hardware and software, it is more complicated than what is currently used in many instances. For small use cases where trust or robustness is not a major concern (i.e. one is not building a large software stack on top), traditional databases are far easier, quicker and cheaper to use. While this increases the difficulty of implementing bespoke DLT systems relative to simpler databases, standardised DLT platforms increase the ease of system interoperability and system upgrades.

Standardisation of data architecture via DLT has many advantages:

- More robust structure means that one can build large infrastructure stacks without overwhelming base protocol layers (common issue in traditional software development)
- Ability to switch between vendors for best price or service
- Ability to use standardised software with limited customisation
- Ease of doing upgrades due to known data structures and no quick fixes
- Standardisation reducing scope for major software bugs

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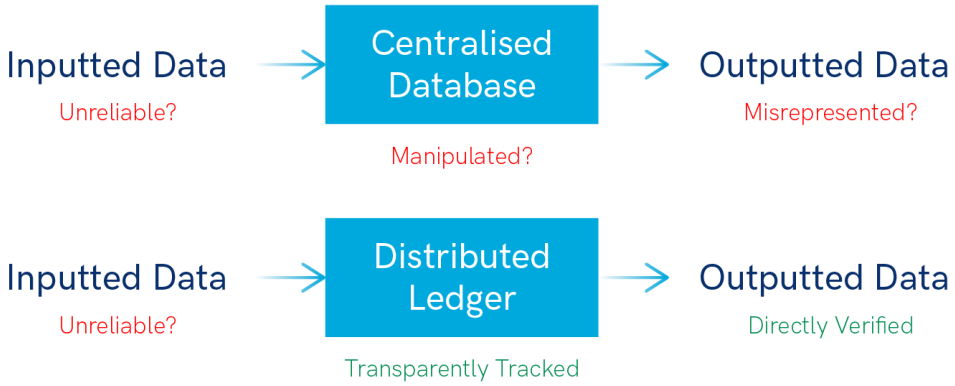
2 DLT Governance

Historically, governance could only be effectively undertaken via a centralised structure, due to the limitations of coordinating many individuals and aligning their incentives. Using a native cryptoasset, a cryptocurrency, DLT can effectively coordinate large decentralised ecosystems using game theory and free market forces. Below, we elaborate on four characteristics of good governance: transparency, security, decentralisation and accountability.

2.1 Transparency

Unlike in traditional databases, in a DLT-based network, the governance role of an admin and the ownership of data is distributed across the whole network equally in a flat, non-hierarchical structure. This kind of design significantly increases transparency, integrity, as well as the resilience of the entire system. At the same time, the need to trust one particular organisation is significantly reduced. The trust-minimising effect of DLT is often misinterpreted and misunderstood, however. Even though a distributed system provides a much higher level of certainty about data integrity, it still does not solve the authenticity of data inputs, as they may be as unreliable as in any other system.

Figure 3: Trust issues with centralised databases



Furthermore, formal on-chain governance enabled by DLT is designed to provide a more transparent and efficient decision-making process. It is implemented by embedding specific rules in the system, which can only be changed through formal procedures, such as voting.

2.2 Security

How secure is a decentralised, consensus-driven and sybil-proof mechanism, as compared to the security of a centralised, permissioned database, for example that of a bank? Theoretically, a system can be breached in one of three ways. First, there is a human error or the system is undermined by one or more insiders/employees. Second, there is a software vulnerability or insufficient security protocols that outsiders discover and exploit. Third, there is a brute force method of hacking the system.

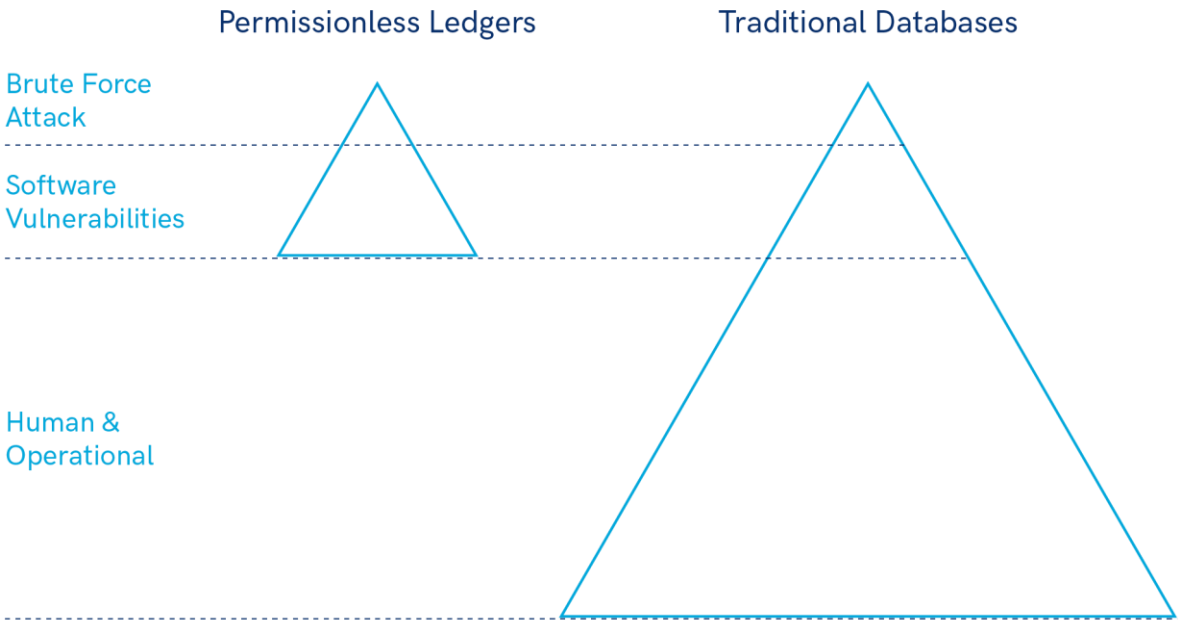
In practice, databases are compromised very often. The overwhelming majority of these breaches are due to either a human error, or software vulnerabilities and weak security protocols. Both issues arise due to human error.

The innovation of the permissionless ledger is that it removes the human factor as much as possible. There is no insider that alone maintains the system; hence their actions are irrelevant to security. Software vulnerabilities could compromise the system but, since the code is usually open source, mistakes can be checked by anyone and identified quickly. Moreover, there is a strong incentive for network participants to resolve any security issue

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in a responsible way, to protect the value of the cryptocurrency they own. The only other method of hacking the ledger is by using the brute force of a 51% attack. Sybil-proof mechanisms, however, make the cost of such an attack proportional to the value stored in the blockchain.

Figure 4: Potential points of failure for permissionless ledgers and traditional databases



Source: Aaro Capital Research

The second aspect of security is platform continuity. This has two important aspects. First, it is important that the technical distribution of a system ensures high uptimes of the service. Second, a system should be resistant to change but only if the majority are willing to uphold the status-quo – which they are economically incentivised to do.

On the technical side, traditional server-based web services tend to have numerous central points of failure, such as server or data centre power supply, internet connection or management company. These typically are above 99%, but never at 100%. A major advantage of decentralised platforms is that users are not dependent on a fixed group to run the platforms, nor any single server or location. As each participant runs at least a subset of the service's functions in parallel with the others, there is an effective 100% uptime, through wide scale distribution.

2.3 Decentralisation

Most of the security benefits of DLT is achieved through decentralisation. If the ledger is stored, maintained and updated by a large number of independent nodes, it is very difficult for an attacker to destroy or corrupt all copies simultaneously. The key to decentralization is ensuring that anyone has the means and incentives to participate in the network. This means that a standard computer must be able to run a node on the network. Second, anyone must be incentivised to participate in the ecosystem.

In the dimension of control, the sliding scale varies between completely centralised, where only one entity has read and write permissions, and decentralised, where multiple entities must come to agreement on the governance of the database.

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Table 3: Centralised vs decentralised governance

	Centralised	Decentralised
Pros	Fewer decision makers in the governance process – quicker and more efficient Most customisable for ease of use	Less reliant on third parties More resilient than a single database administrator
Cons	Only as reliable and resilient as the governing body Heavy dependence on third-party intermediaries Incentives of owner and users may collide	Increasing number of decision makers complicates and slows the governance process, making the system less versatile

Source: Aaro Capital Research

2.4 Accountability

There is a direct connection between accountability and performance. If people are accountable, they feel that they have ownership of the tasks that they execute, giving them an incentive to perform well. Centralised governance structures rely on company processes and rules to hold decision makers accountable. Formal DLT governance does this via the DLT protocol layer and voting of DLT stakeholders. A native token enables voting power that is proportional to the value they "invest" in to become an influential voter. Incentives are in theory aligned as the most influential voters stand to gain the most from good decisions which benefit the platform and other users, but also stand to lose the most if the decision causes harm.

Table 4: Centralised vs decentralised accountability

	Centralised	Decentralised
Pros	Centralised decision makers are typically quicker and more efficient Most customisable for ease of use	De facto transparent Less reliant on third parties More resilient than a single governing body Accountable to users
Cons	Only as reliable and resilient as the governing body and its accountability rules Often heavy dependence on third party intermediary oversight Owners may not be accountable to users	Increasing number of decision makers complicates and slows the governance process, making the system less versatile Venerable to free market failures

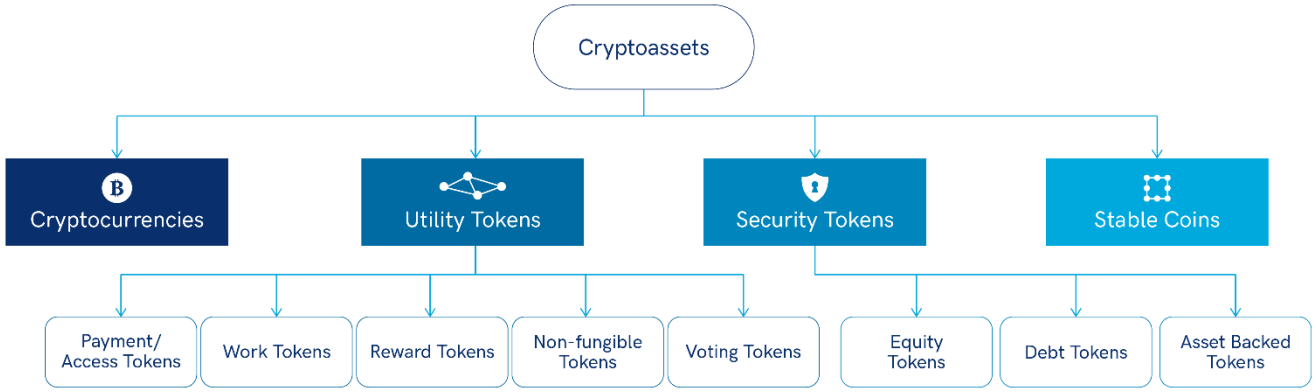
Source: Aaro Capital Research

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3 Cryptoassets

Cryptoassets can be divided into several distinct groups, each with their own defining characteristics. There are two broad top-down approaches which are used to do this: the regulatory and technical approaches. In the regulatory approach, we can distinguish between three broad categories of cryptoassets: cryptocurrencies, security tokens and utility tokens. All require a distributed ledger to exist. At the time of writing, stablecoins do not fit clearly in any one of these categories. From a more technical point of view, we can distinguish between two types of cryptoassets: cryptocurrencies and tokens. Figure 5 below provides an overview of some key types of cryptoassets.

Figure 5: Types of cryptoassets



Source: Aaro Capital Research

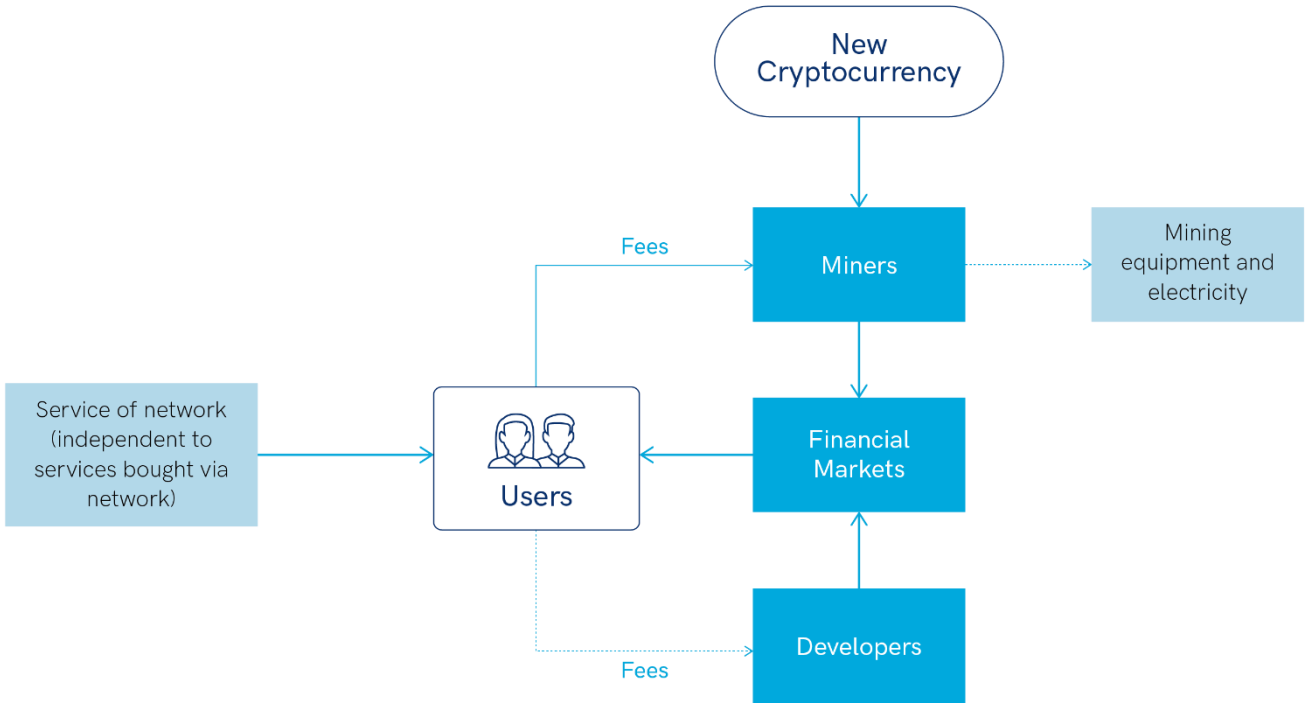
3.1 Cryptocurrencies

Cryptocurrencies are designed to be a general means of payment for goods and services. In addition, they act as an incentive and coordination mechanism that prevents attacks aiming to corrupt data stored in their ledgers. Without a well-designed cryptocurrency, a distributed ledger is of little use as it cannot be trusted, particularly as there is no central governing body maintaining the integrity of the platform. The Proof-of-Work and Proof-of-Stake protocols are designed to incentivise any random participant to maintain, update and protect the ledger. This is a major innovation of permissionless DLT, which is enabled via game theory and cryptography.

In a Proof-of-Work protocol, the blockchain's transaction validators (i.e. "miners") solve a difficult mathematical problem, for the chance to propose the next block and receive compensation. As this problem can only be solved by repeated guessing, miners face large upfront computer hardware and electricity costs in fiat currency, whereas they receive compensation in the cryptocurrency they are mining. Mining equipment is limited in that it can only be used for mining cryptocurrency (and more often than not, for a specific cryptocurrency only). If the cryptocurrency fails, this investment cannot be recovered. On the other hand, network users must pay transaction fees in cryptocurrency when using the network and may undertake transactions in the cryptocurrency. Finally, on some ledgers (e.g. Dash), a proportion of the fees go to the developers. In the absence of fees, developers can monetise their work via the appreciation of the cryptocurrency they hold.

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Figure 6: Stakeholder incentives in a Proof-of-Work protocol

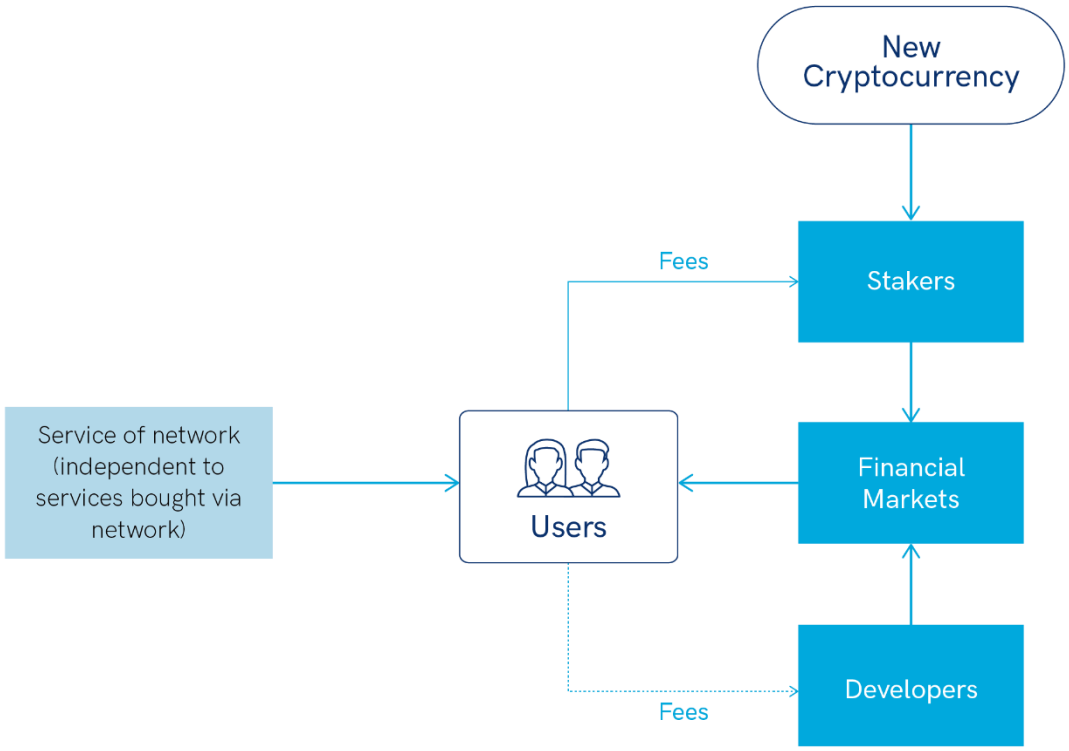


Source: Aaro Capital Research

In a Proof-of-Stake protocol, the blockchain's transaction validators (i.e. "stakers") lock their cryptocurrency away for the chance to propose the next block. This means that they face large upfront costs to purchase the cryptocurrency and receive the compensation in the cryptocurrency they are staking. The cryptocurrency is an income-generating asset for stakers, incentivising them to hold it and act in a manner which allows the cryptocurrency to retain its value. The same incentive structure from Proof-of-Work holds for users and developers.

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Figure 7: Stakeholder incentives in a Proof-of-Stake protocol



Source: Aaro Capital Research

As the usage of a platform increases, so does the demand for its cryptocurrency, thus increasing its market price. In Proof-of-Stake systems, the increased price makes staking rewards more valuable, which tends to increase the proportion of cryptocurrency locked up for staking, thereby exacerbating the demand. Miners and stakers are therefore incentivised to support the platform to encourage usage and consequently increase their income.

3.2 Tokens

A token is a digital representation of an asset. It is issued within a distributed ledger network, where it can also be traded. The asset that the token represents can be real (off-chain) or digital (on-chain). Examples of off-chain assets are commodities, fiat currencies, real estate, or even future earnings from an NBA contract. On-chain assets live exclusively on the distributed ledger. An example of an on-chain asset is a reward for participating in or contributing to a network. Although the value of these native tokens can be influenced by the real world, there is no direct link with the real world. Below, we provide a non-exhaustive list of the various types of tokens, explore how they are used and why they are economically useful.

3.2.1 Utility tokens

Utility tokens are used to digitally access (or reward for providing) an application or service within a distributed ledger. Coupons, gift vouchers and loyalty points are straightforward use cases for utility tokens. They are also used to influence the development of a decentralised App (dApp) or a network, because in many cases they grant voting rights to their holders. More importantly, utility coins provide an alternative revenue model for the development of a dApp. For a dApp to succeed, it requires users, developers and investors to contribute their time and resources. By issuing utility tokens, each participant is rewarded according to their contribution and can pay for services within the ecosystem, using these tokens. If the dApp succeeds, then the value of the utility token increases and participants are rewarded depending on their relative contributions. Investors can bet on the

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dApp's success by buying utility tokens and, at the same time, support early adopters and developers as the price increases.

3.2.2 Payment and Access Tokens

Payment (or access) tokens are the most common type of utility tokens. They are issued by a dApp or a company and they are used to access a defined service, which is similar to traditional paper tickets. The key differences are that they are often limited in number and trade on a wider secondary market. Fairgrounds and gaming arcades have adopted payment token models to reduce the risk of currency theft, however outside of such environments there is little economic benefit of adding a representative token into the system. Payment tokens therefore tend to be used as fundraising tools and are made available only in limited supply. This fosters a volatile secondary market and gives the token an independent valuation – an opportunity for investors to make a profit.

When more user-friendly applications are developed, users will likely be able to seamlessly buy and redeem the payment tokens they require without needing to be aware of their existence. This decreases the price risk of tokens to users but increases token velocity. In other words, even if application usage increases, there may be a limited relationship between application demand and token price. The issuer may be able to support thousands of purchases per day with the same fixed quantity of tokens being redeemed and re-issued again and again. Introducing an additional token of any sort may add another layer of friction to transactions, via conversion or liquidity costs, execution risks, tax implications, counterparty risks, or time delays. Thus, in the absence of any additional function of a payment token, they may be of little benefit to end users.

3.2.3 Work Tokens

Work tokens are used to provide a service (supply-side), unlike payment tokens which are used to acquire a service (demand-side). An individual who wishes to contribute towards a service must acquire the relevant tokens and submit them to the smart contract or protocol in the form of security bonds, which can be forfeited if the work is substandard. In return, the worker is awarded with some positive cash flow – hopefully greater than the cost at which the work tokens were initially acquired at.

Work tokens are designed to be bonded and locked out of circulation for an extended period of time, decreasing velocity and increasing price. As demand for the service increases, so will revenues, leading to an influx of additional demand for the work token from new competitors on the supply side. This leads to a better standard of service which should attract even more new users. Developers and early adopters can monetise positive externalities as the network grows, compensating them for the high risk they initially took. The incentives of service providers with consumers are therefore aligned.

3.2.4 Reward Tokens

Customer loyalty points, air miles, gift cards and coffee stamps are tokens that stand to benefit from digitisation in the form of utility tokens. Users can trade their collections on secondary markets at a premium or discount, and issuers can have more granular interactions with their customers. The key difference between Reward tokens of DLT and centralised databases is the increased control users are likely to have on a decentralised platform.

3.2.5 Security Tokens

Security tokens are connected to assets that exist outside the blockchain and comply with existing legal frameworks. Examples of connected assets include equity stakes in companies, debt, and units in a fund.

In the UK, security tokens are cryptoassets that have the characteristics of a Specified Investment. In Switzerland, FINMA defines asset tokens as cryptoassets that represent a claim on the issuer. In the U.S., the Howey test is used to determine whether a financial instrument qualifies as a security.

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The advantage of security tokens is that they can automate and streamline certain aspects of the process by removing third parties, thus reducing costs and time delays, especially in settlement and payments. Registrars, as the ultimate keeper of the record of ownership, can be decentralised using Decentralised Ledger Technology (DLT), custody can be mutualised using cryptography, rules can be enforced with smart contracts and voting, and payments can be processed within the blockchain natively.

Since tokens are by default a bearer asset, security tokens need to implement some form of inherent linkage with real-world identity for ownership verification and prevention of accidental loss of assets. Bearer security tokens can also be secured by a custodian who then issues non-bearer, tradable replications of these assets.

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4 Economic Benefits of DLT and Cryptoassets

There are three fundamental economic problems which DLT help mitigate. First, they disintermediate the control of networks and the flow of information by promoting trust among participants, enabling the removal of rent seeking intermediaries. Second, by sharing the ownership of the ledger among participants, they can alleviate the hold-up problem, where one party in a business relationship leverages its negotiating power at the expense of others. Finally, by issuing tokens to those who contribute to the network, they can solve the “chicken and egg” problem of network growth, without creating a network monopoly.

4.1 Disintermediation of Trusted Intermediaries

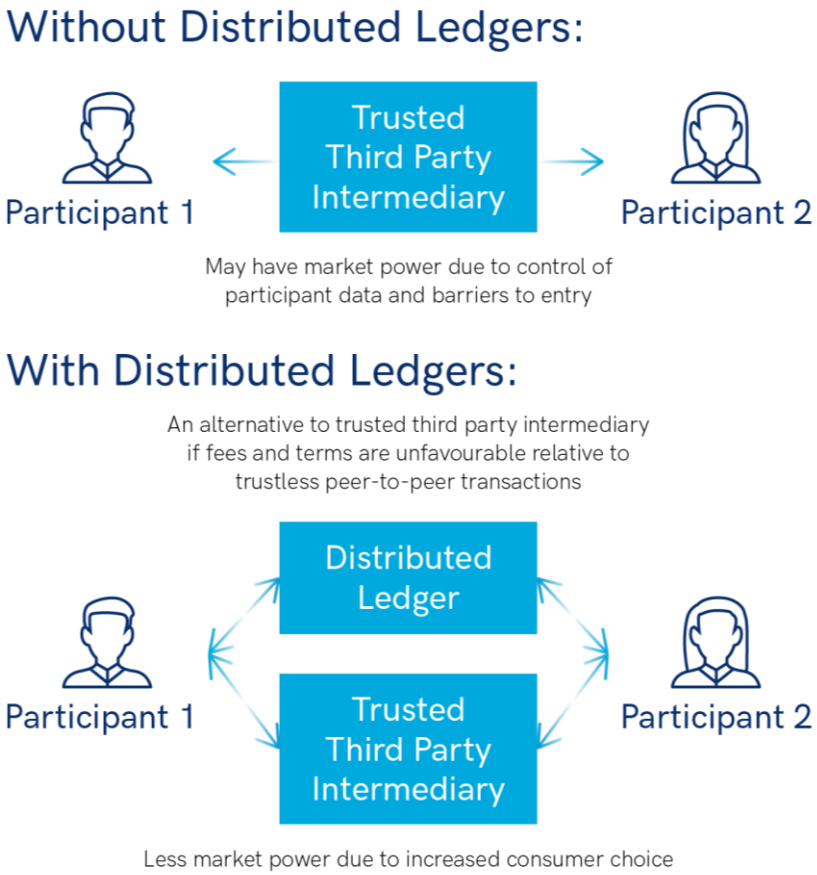
Markets that operate efficiently have systems of maintaining records on transactions that have taken place. Importantly, buyers and sellers are required to trust that this information is kept safe and updated correctly, so that they have a path of recourse should a dispute arise. For example, a buyer on eBay has to trust that the network will register their transfer of money and ultimately send the goods they purchased, despite never physically meeting the seller.

Until recently, updating and maintaining records of transactions could only be performed by trusted intermediaries, such as banks, firms or governments, operating in an environment with strong institutions. The unintended consequence is that these intermediaries may obtain market power, which they may abuse. Market power can arise when a firm undertakes a large investment to become a trusted intermediary, via an extended period of building reputation and, in some cases, becoming regulated.

DLT can alleviate this issue because the users of the distributed ledger can also be the owners. More importantly, breaking the monopoly over the ownership of the ledger has the potential to create more efficient and trusted systems of disseminating information. DLT promotes trust among market participants because all elements of a transaction that are recorded on a ledger can be reliably and directly verified at low cost, by any participant.

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Figure 8: Moderating market power via decentralised ledgers



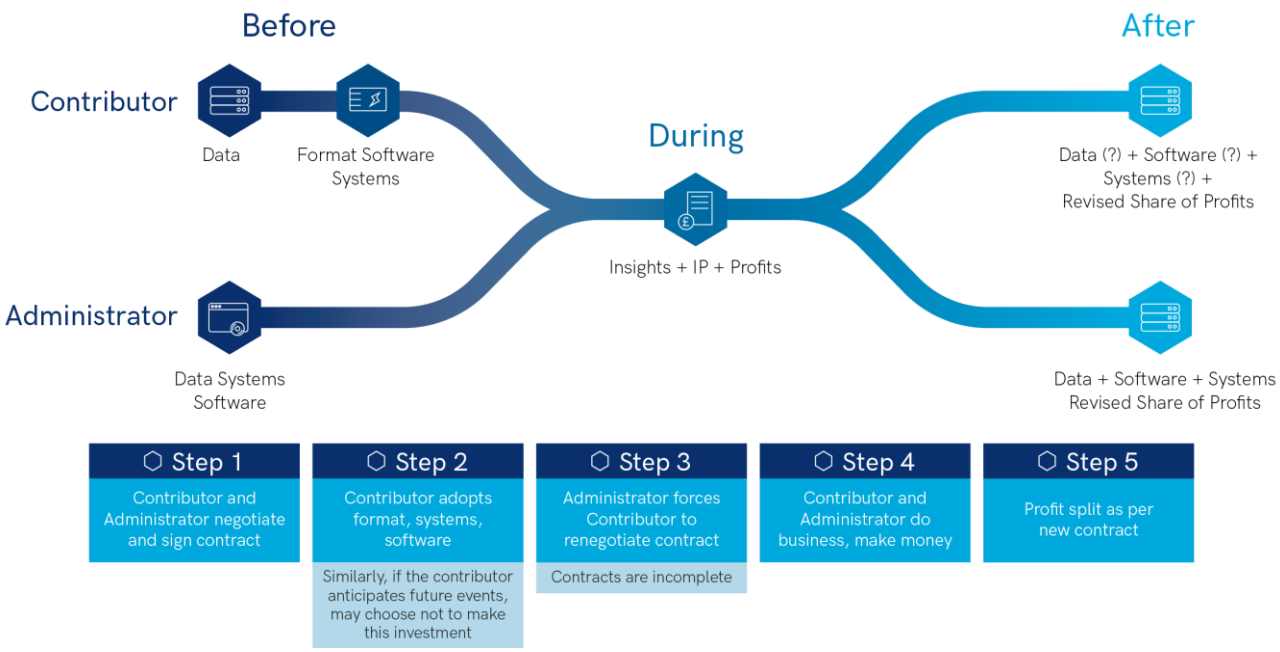
Source: Aaro Capital Research

4.2 Disintermediation of the Hold-Up Problem

DLT has the potential to solve issues of trust that arise from the "hold-up" problem. The hold-up problem arises in situations where different entities must commit to working with each other via an irreversible investment, but the two entities do not trust each other. An example of a hold-up problem is outlined in Figure 9 below. When a contributor (firm A) deposits its data on a database controlled (fully or partially) by an administrator (firm B), it makes a substantial investment that has little value outside of the relationship between these two firms. However, contracts are almost always incomplete, meaning that unforeseen contingencies might arise in the future, so that the two parties need to renegotiate their relationship. At this point, firm A is held up by firm B and may therefore be forced to accept worse terms during the renegotiation. DLT alleviates the hold-up problem, mainly because ownership of the ledger is shared, so there is no single owner who could abuse their market power at a future date. Moreover, each party owns their data and can easily disable or enable access to other users or transfer them to a different ledger.

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Figure 9: Hold up problem for Consortia

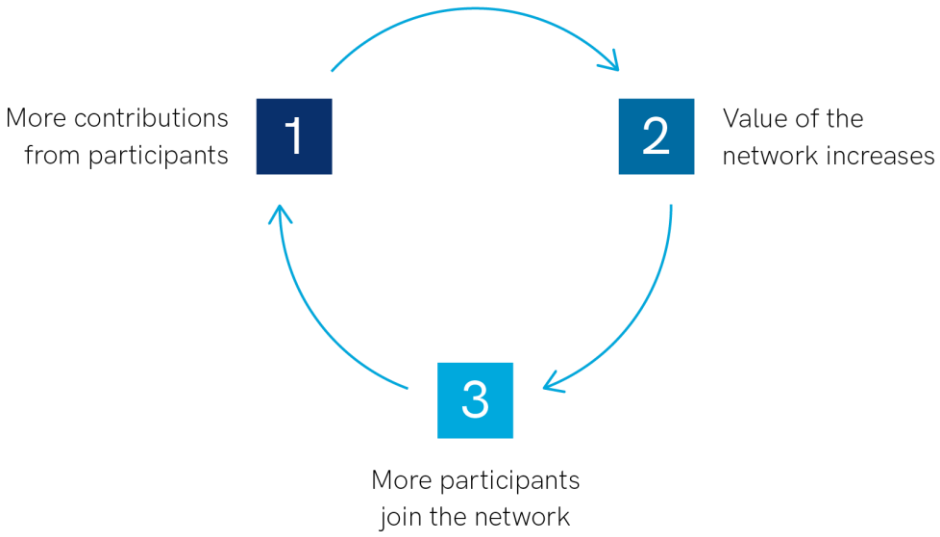


Source: Prysm Group

4.3 Disintermediation of Network Monopolies

Another manifestation of the interplay between trust and market power is the familiar “chicken and egg” problem that any new network faces. A network’s value increases as more participants (users, developers, investors) join, but their participation depends on the network already being valuable.

Figure 10: The “chicken and egg” issue faced by new networks



Source: Aaro Capital Research

Traditional revenue models solve this problem of trust by granting early participants (usually investors) property rights over the network, so that if it becomes valuable, they get rewarded. However, in many cases the unintended

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consequence is that these participants also gain excessive market power, which they may abuse. DLT has the potential of solving this issue of trust, while limiting the market power gained by platform contributors and early adopters. This is achieved by issuing a token on the network, which is earned by participants (users, developers and investors) through various forms of contributions to the network. The token may generate economic value for its holders through mechanisms such as network voting rights, or as a means of payment between network participants. With the correct token design, the incentives of network participants can be aligned.

Table 5: The different layers of a network

	Traditional	Permissionless Ledger
Data Layer	Platform owners typically own and control user data	Users own and control their data
Network Layer	Network effects usually lead to market consolidation	Network effects do not lead to market consolidation
Protocol Layer	Platform owners typically own and control platform protocols	Users typically own and control platform protocols

Source: Aaro Capital Research

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5 Conclusion

The key message of this report is that DLT implements a different type of a data architecture, that focuses on decentralisation and leverages economic incentives. On the one hand, as with any Proof-of-Concept, further development is required for it to become more competitive against entrenched database technology in terms of scalability and speed, which is rapidly progressing. On the other hand, it provides a unique mix of characteristics, that cannot be achieved by traditional data architectures and has the potential to enable a paradigm shift on how data and value are created, stored and transferred.

This paradigm shift is clearly visible when we analyse the key economic benefits of DLT and how they directly link to specific characteristics of its data architecture and its governance. The focus of DLT on decentralisation implies that market power stemming from the ownership of a ledger and the data it contains is inevitably broken. The economic benefit is two-fold.

First, it pushes markets to become more competitive, as it enables movement away from an oligopoly model with a few very big players. Software standardisation allows participants to switch between networks and platforms more easily, so that they are not locked in. This enables a more flexible market, which can adapt quickly in changing conditions.

Second, the incentives of the ledger's owners are more aligned with the contributors and users of the network via its shared ownership. This alignment of incentives can solve several economic problems. Using tokens, participants can vote on how the DLT project is governed. By giving full control to each participant on the data they deposit, DLT can solve the hold-up problem and promote trust between parties, which encourages new collaborative partnerships. By issuing native tokens that are tradable and whose value is directly linked with the success of the network, DLT can solve the chicken and egg problem faced by new networks and help them bootstrap, without requiring a big initial investment by a concentrated few, who then control the network.

Finally, this report emphasises that cryptocurrencies are neither a by-product of DLT, nor the only reason why DLTs are of value. Their key value-add are closely interlinked. On the one hand, cryptocurrencies, and more generally cryptoassets, are central to the realisation of many of the economic benefits of DLTs. On the other hand, DLT is what distinguishes a cryptocurrency from a digital currency and makes it unique, not being backed or maintained by a central authority. DLT protocols involved in ensuring consensus on the ledger rely on the ledgers' core participants being compensated in the native cryptocurrency. Through the protocol's design, there is a feedback loop between the cryptocurrency's value and the value that the ledger generates to its users, linking the integrity and hence value of the service provided to compensation. Moreover, there are also beneficial use cases for DLT in more centralised settings, though the value added over traditional digital infrastructure is more limited.

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