DSF Blog

DLT Science Foundation

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CONTENTS

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CHAPTER

ONE

GOVERNANCE IN DEFI

Key Insights!

- The voting power in DeFi protocols becomes increasingly concentrated among a percentage of token holders over time in decentralised exchanges, lending protocols and yield aggregators.
- The paramount wallet addresses ranking within the top 5, 100, and 1000, exercise predominant influence over the voting power in the Balancer, Compound, Uniswap, and Yearn Finance protocols, with Compound displaying the least evidence of decentrality
- The most significant governance challenges identified by DeFi users are voter collusion, low participation rates, and voter apathy.
- To address vulnerabilities in DeFi governance, a novel voting mechanism resistant to sybil attacks called bond voting has been proposed.
- To enhance the manual parameter section, an AI-enabled adjustment solution has been demonstrated to automate governance mechanisms.

1.1 Introduction

Decentralized finance (DeFi) has emerged as a potential substitute for traditional financial institutions, offering peer-to-peer transactions and a diverse range of services that democratize finance by enabling users to participate in protocol governance. However, several studies have suggested that the current governance mechanisms require improvements. This article provides an overview of findings associated with DeFi governance.

1.2 Centralisation of Governance in DeFi Protocols

Lending protocols are DeFi applications built on top of blockchain technology that allow users to lend and borrow cryptocurrency assets without the need for intermediaries such as banks or traditional financial institutions.

Decentralized exchanges (DeXs) are peer-to-peer trading platforms built on top of a blockchain that enable the direct exchange of cryptocurrency assets without the need for a central authority or intermediary.

Yield aggregator are DeFi applications that automate the process of seeking out the best yield opportunities for cryptocurrency assets, and provide users with a way to optimize their returns on investment.

Centralisation in DeFi has become a growing concern among researchers with several studies identifying a significant level of centrality in the governance mechanisms of DeFi protocol. Barbereau et al., [BSP+22a] found that the decentrality of voting is significantly low with a majority of the voting power concentrated among a percentage of governance token holders. As evidenced by their findings, there was a significant degree of centrality, in lending protocols, decentralisd exchanges and yield aggregators. This research work employed case studies to comprehend the governance mechanisms of these protocols.

Similarly, result by Jensen et al. [JvWR21] demonstrate centrality in voting power with the protcols top 5, top 100, and top 1000 wallet addresses controlling majority of the voting power in Balancer, Compound, Uniswap and Yearn Finance protocols. In this study, the token holdings and users' wallets of protocols were analysed; Compound displayed the most evidence of centrality and Uniswap the least with the top 5 wallet addresses accounting for 42.1% and 12.05%, respectively.

Barbereau et al. [BSP+22b] ascertained that DeFi protocols become more centralized over time. In this longitudinal study, voting patterns demonstrated changes in the power dynamics as time progressed. The tendency for this centralisation of DeFi protocols is shown in [Fig. 1.1]. Furthermore, in analysing the governance structures of DeFi protocols, Stroponiati et al. [S+] ascribed reward-based economic incentives as the significant cause behind the development of centralized structures.

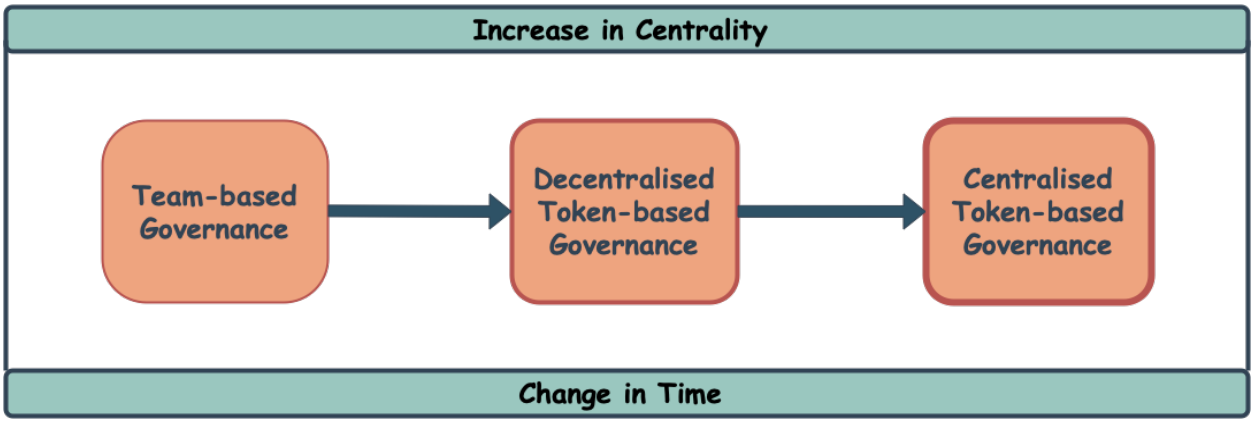


Fig. 1.1: The Tendency for Centralisation in DeFi Governance.

1.3 Challenges & Vulnerability In DeFi Governance

Voter Collusion refers to a situation where a group of voters collude together to manipulate the outcome of a voting process in their favor, typically by coordinating their votes to create a supermajority.

Voter Apathy refers to a situation where token holders or members of the organization do not actively participate in the voting process due to a lack of interest

In investigating governance challenges, Ekal et al., [EAw22] identified voter collusion, low participation rates, and voter apathy as the most significant challenges. This empirical investigation utilised an interview survey approach to collect data from protocol users. Furthermore, to address vulnerabilities, Mohan et al. [MKB22] proposed a novel voting mechanism resistant to sybil attacks called bond voting. This solution factors in time commitment to be resistant to plutocracy.

1.4 AI-enabled On-chain Governance

To enhance and automate governance mechanisms, Xu et al., [XPFL23] demonstrated an AI-enabled parameter adjustment solution which is more efficent than current current implementations. Specifically, the study employed Deep Q-network (DQN) reinforcement learning to investigate for automated parameter selection in a DeFi environment. Although a lending protocol was employed in the study, the model's application can extend to other categories of DeFi protocols as well. In investigating DAOs, Nabben [Nab23] observes that GitcoinDAO also employs algorithmic governance in various organizational components such as monitoring the compliance with organizsational rules.

1.5 Conclusion

The vision of DeFi is to forster a democratic process of governance and sustain high levels of decentrality. However, recent studies have highlighted significant centrality in DeFi governance mechanisms, indicating the need for improvements in the existing governance models. The studies analysed in this article have revealed that the majority of the voting power in several protocols is concentrated among the top token holders, with evidence of increasing centralization over time. Moreover, DeFi has been found to face challenges in the voting and governance process. In view of some of these challenges, researchers have proposed novel solutions such as a bond voting and a AI-enabled parameter-selection solution to improve the current mechanisms. Given the importance of decentralization in the underlying philosophy of DeFi, proposing more solutions to governance challenges is crucial for creating a more inclusive and democratic financial ecosystem. Therefore, continued research and development will ensure be required.

CHAPTER

TWO

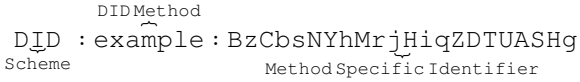
SELF-SOVEREIGN IDENTITY: TECHNICAL FOUNDATIONS AND APPLICATIONS

Key Insights

- SSI systems use DIDs as unique, resolvable identifiers for each entity, allowing the secure management of digital identities without relying on a centralised authority.
- VCs provide cryptographically verifiable proof of an individual's attributes or personal information, enabling secure and trustworthy data sharing between issuers, holders, and verifiers.
- SSI incorporates privacy-preserving mechanisms such as zero-knowledge proofs and selective disclosure, allowing users to prove their credentials without revealing their actual identity or unnecessary information.
- While not mandatory, using Blockchain as a decentralised data registry in SSI systems enables secure, tamper-evident, and verifiable storage of credentials, enhancing the trustworthiness and reliability of the identity management process.

2.1 Introduction

According to World Bank estimates, nearly 850 million people lack an official identity [JC23], and the proliferation of digital devices has made it increasingly essential to possess a verifiable digital identity. This has led to a rise in digital transactions and the need for a secure and reliable identity management system. SSI is emerging as a decentralised alternative to traditional centralised identity management systems, in which identities are cryptographically verifiable. It allows individuals to control their digital identities and share them with trusted parties. Each entity in the SSI system is identified by a unique DID (Decentralised Identifier) as shown below, which can be resolved to reveal information such as the entity's public key and other metadata.



See also:

Find out more about some of the most commonly used DID methods:

- DID:INDY
- DID:UPORT
- DID:SOV

While centralised identities and federated identities offer convenience, control remains with the identity provider [LB15]. User-centric identities such as OpenID [RR06] and OAuth [FKustersS16] improve portability but do not give complete control to the users. SSI is designed to give users full control over their digital identities, and involves guiding principles around security, controllability, and portability. In addition to providing total control, Bernabe et al. [BCHR+19] presented a classification of techniques for maintaining privacy in SSI, which included Secure Multiparty Computation and Zero-Knowledge Proofs, among others.

The three main parties involved in SSI systems are the issuer, holder and verifier, as shown in [Fig. 2.1]. The issuer issues a cryptographically signed credential to the holder, and the verifier is the entity that confirms the credential's authenticity using a decentralised data registry such as Blockchain. Holders store their credentials in secure digital wallets and can share them with other parties as needed. The holder can also create a presentation request and share it with the verifier.

SSI

Self-Sovereign Identity (SSI) is a decentralised digital identity management system which leverages blockchain technology as a data registry, allowing individuals to create, control, and share their identities securely.

Verifiable Credential

A verifiable credential is a digital artefact that provides tamper-evident, cryptographically verifiable proof of an individual's personal information or attributes.

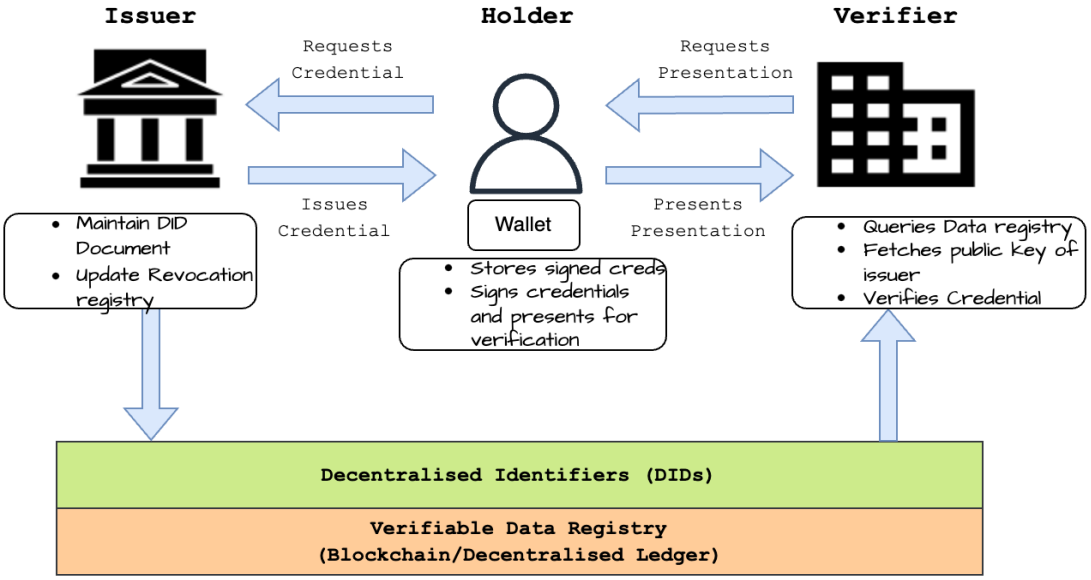


Fig. 2.1: SSI entities and their relations

Click here to see how a verifiable credential actually looks like

This is a credential issued using the javascript library didkit-wasm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         {
            "alias":"https://schema.org/name",
            "logo":"https://schema.org/logo",
            "website":"https://schema.org/url",
            "description":"https://schema.org/description",
            "BasicProfile":"https://tzprofiles.com/BasicProfile"
         }
      ],
      "id":"urn:uuid:7041d211-72c9-49fe-b6d1-d8b6b94abfe3",
      "type":[
         "VerifiableCredential",
         "BasicProfile"
      ],
      "credentialSubject":{
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         "alias":"TU Munich",
         "website":"Germany",
         "description":"My name",
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            "TezosSignature2021":{
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                  "@protected":true,
                  "@version":1.1,
                  "challenge":"https://w3id.org/security#challenge",
                  "created":{
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                     "@type":"http://www.w3.org/2001/XMLSchema#dateTime"
                  },
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                           "@type":"@id"
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      }
   }
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Nitty Gritties of SSI

- SSI solutions are designed to be blockchain-agnostic and adhere to W3C's specifications.
- The identity wallets (e.g., uPort, Trinsic, Connect.Me) are different from the digital wallets (e.g., Coinbase, Ledger, Trezor) that store cryptocurrencies in the sense that they store and manage DIDs and VCs instead of cryptocurrencies.
- To protect privacy, SSI solutions (e.g. - Hyperledger Indy and Aries) are increasingly using Zero-Knowledge Proofs (ZKPs) to prove the authenticity of credentials without revealing the actual data.
- To facilitate secure communication between different SSI components (issuer-holder-verifier), DIDComm and CHAPI protocols have been developed and heavily used.

2.2 Applications for SSI

Recent studies have demonstrated the feasibility of using zero-knowledge proofs to disclose information selectively, such as proof of vaccination status, without revealing users' identities. These studies have employed interoperable open-source tools to implement these systems globally at a minimal cost. Schlatt et al. [SSFU22] illustrates how a customer can leverage a Zero-knowledge Proof concept called 'blinded link secret' to disclose information selectively. Similarly, Barros et al. [dVBSFCustodio22] implemented a prototype of an application for presenting proof of vaccination without revealing users' identities. Furthermore, it uses interoperable open-source tools across countries to implement this system globally at a minimal cost for each country's government. The NHS Digital Staff Passport solution [LC22] employs the Sovrin Network as a public key infrastructure (PKI) to manage verifiable credentials for staff onboarding. Hospitals register on the network and use their private keys to sign credentials, while staff members utilise Evernym's Connect.Me SSI digital wallet app to store and share credentials.

Shuaib et al. [SHU+22] suggest that a blockchain-based land registry system can be combined with a self-sovereign identity (SSI) solution to provide a secure and efficient identity management system for landowners. Three existing SSI solutions: Everest, Evernym, and uPort [Ame22], were evaluated based on SSI principles [All16] to determine their compliance and effectiveness in addressing identity problems in land registry systems. The Everest platform was found to be the most compliant with the SSI principles, whereas Evernym and uPort had some limitations in terms of interoperability and user control.

Estonia is one of the few countries in the world that have managed to make e-voting a reality [SS22]. Sertkaya et al. [SRR22] proposed an EIV-AC scheme that integrates the Estonian Internet voting (EIV) scheme with anonymous credentials (AC) based on self-sovereign identity (SSI). The use of SSI-based anonymous credentials enables voters to prove their eligibility to vote without revealing their identity. The zero-knowledge proof of knowledge is used to prove that the voter has the right to vote without revealing any additional information. The EIV-AC scheme enhances the security and privacy of the EIV scheme, making it more compliant with privacy-enhancing and data minimisation regulations.

2.3 Can SSI work without Blockchain?

Blockchain is one of many options when implementing the Self-sovereign Identity system. Alternatives like IPFS, Public-key cryptography and even traditional Certificate Authorities can be used to implement SSI. However, the main advantage of using Blockchain is that it provides a decentralised and immutable ledger that can be used to store and verify credentials.

2.3.1 Conclusion

Self-sovereign identity can potentially revolutionise various industries, including healthcare, voting systems and many more. However, as research and development in SSI progress, it will be crucial to address interoperability, scalability, and usability challenges to realise SSI's potential in a global context fully.

CHAPTER

THREE

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