On the Interoperability of Distributed Ledgers

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Outline

• Need for Interoperability
• Examples
• Mechanisms for Interoperability
• Challenges in Interoperability
What is Interoperability?

- Exchange of data or value between networks
- Preserve properties of decentralization
Need for Interoperability

• Data and Value Silos

• Drivers
  Ledgers are Application Specific
  Market Competition and Forks
  Partitioning and Scalability
  Confidentiality of Agreements and Data
  Security
  Governance
  Regulations
Examples

• Financial Services
• Supply Chain
Decentralized Asset Exchange (DEX)

- Global network of asset-backed (securities, commodities, real-estate) tokens providing increased liquidity and price discovery and access to investors
  - Retail Investors
  - Institutional Investors

- Crypto currencies representing a store of value and medium of exchange or utility networks that provide decentralized services
  - Anonymous Entities

- Identity
  - Self-sovereign identity network allowing holders to provide verifiable credentials while preserving privacy
  - Identity Owners (legal entity or thing)
  - Identity Issuers
  - Identity Verifiers

- Decentralized Asset Exchange (DEX)

- Private Equity Secondary Market
  - Secondary market for buying and selling equity investments
  - Institutional Investors
  - Private Equity Secondary Funds

- Private Network
- Public Network
Mechanisms for Interoperability

• Interoperability on a Shared Platform
• Interoperability via Message Exchanges (and Accompanying Proofs)
• Interoperability via Protocols
• Interoperability Frameworks
Interoperability on a Shared Platform

Multiple Dapps deployed on the same smart contract platform
(e.g. Ethereum, Fabric*, Corda)
Interoperability via Message Exchanges

Pass messages and accompanying proofs between networks (e.g. Signed records and histories, Merkle proofs)
Interoperability Protocols

Standard protocols for exchanging value
(e.g. HTLCs - Atomic Swaps, Inter-Ledger Protocol)
Interoperability Frameworks

An inter-blockchain framework with guarantees enforced by a shared “relay” chain (e.g. Polkadot, Cosmos, Sidechains, Plasma)
Interoperability Challenges

• Trust and Integrity
• Global Guarantees and Invariants
• Privacy and Confidentiality
• Discovery and Addressability
• Regulation, Law and Compliance
• Standards
• Governance
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Methods to reason about trust and integrity that can be exposed to applications that drive cross-network workflows.
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Mechanisms for preserving guarantees or invariants across disparate networks.
Interoperability Challenges

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Mechanisms for preserving privacy and confidentiality when exchanging messages between networks, preventing leakage.
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The discovery of classes or specific instances of assets and data, and the addressability of assets and data along with their histories and dependencies.
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Complying with regulations and laws when interoperating with networks across different jurisdictions.
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Standards play a key role in driving interoperability. History has shown that driving standardization is always a challenge.
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Independent governance structures around each of the networks poses challenges for each of the above, making interoperability between existing networks difficult.
Summary

- Emerging data and value silos will create challenges in interoperability
- If designing decentralized networks is hard, interoperability is harder
- Designing a set of interoperability primitives that are easy to analyze and reason under different conditions will allows us to construct complex workflows
- Standards will play a key role