Liquidity & Token Interchange

Problems in Computational Settlement

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Outline

1. Introduction

1.1 The Problem of Settlement

Introduction to payments settlement as a computational problem; general motivation.

1.2 Liquidity & Tokenisation

Definitions of liquidity, tokens, interchange, money, and the contemporary industry context.

1.3 Computer Science & Digital Finance

Overview of formal methods in Computer Science with application to finance (preview).

1.4 Research Questions

Scope of project and enumeration of primary research questions.

1.5 Structure & Contributions

Outline of subsequent sections; methodologies, publications, and key research outcomes.

2. Liquidity Automata

Liquidity Automata: A Computational Hierarchy of Money Forms

This chapter (and corresponding paper) will propose a correspondence between the Chomsky heirarchy of computational complexity and distinctive forms of money and settlement that have emerged over history. The proposed hierarchy offers a theoretical framework for the relatioship between liqudity and technology that identifies four key innovations in its evolution; a process beginning with the adoption of physical currency and culminating with computationally universal programmable tokens.

The chapter will include a review of the canonical literature relating to computational complexity and monetary theory. It will argue that the undecidability of tokenised monetary systems introduces novel forms of risk and compels the management of settlement operations through the deployment of **keepers** and other types of autonomous agents. Concepts introduced in this chapter will provide a motivation and theoretical foundation for subsequent chapters.

3. Liquidity Logics

Liquidity Logics: Settlement as Computational Resource Allocation

Surveying the broader field of Computer Science, this chapter will adopt formal approaches to computational resource constraints to the problem of settlement. A framework for **Balance State Transition Events** that combines elements from four main fields of theory will aim to model settlement systems that are linearly-constrained, flow-optimized, strategically robust, and privacy-preserving. This chapter will constitute the primary literature review material of the thesis.

Linear Logic and Petri Nets will provide a foundation for resource consumption and conservation, addressing risks of insolvency and rehypothecation. **Network Calculus and Queueing Theory** provide tools for analysing flow and liveness properties. **Consensus Mechanisms and Strategic Game Theory** will survey topics including BFT and MEV - exploring finality of settlement and alignment of participant incentives. **Zero-Knowledge Proofs and Privacy** will examine how settlement can be both private and verifiable, comparing alternative approaches and their respective computational costs.

4. Liquidity Networks

Liquidity Networks: Stylised Facts of Early Tokenised Finance

This empirical chapter will provide a comprehensive analysis of on-chain data from the Ethereum ecosystem (L1 and L2) and other significant networks. The chapter will examine patterns of stablecoin and token usage, major liquidity pools and flows, and the specific token standards (e.g., ERC-4626) driving institutional adoption.

Through network analysis and statistical methods, the research will identify bot networks, quantify wash trading, and estimate the proportion of actual human users in DeFi protocols versus algorithmic actors. Key metrics will include: the percentage of trades representing arbitrage versus organic trading, concentration of liquidity provision, cross-chain flow patterns, and the emergence of institutional-grade infrastructure.

By applying network theory to transaction graphs and liquidity flows, this chapter aims to establish empirical baselines for understanding tokenised financial networks - distinguishing between genuine adoption patterns and artificial activity, while documenting the evolution of on-chain financial primitives from experimental protocols to production-grade systems.

5. Liquidity Schemes

6. Liquidity Agents

7. Conclusion

Review and discussion of results; directions for future research.