Token Composition: A Graph-Based Exploration of Ethereum Event Logs

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***Abstract*—Abstract goes here.** ***Keywords*—blockchain, tokens, tokenisation, decentralised finance**

I. Introduction

Introduction goes here.

II. Related Work

Related work goes here.
[1]

III. Token Composition

Token composition goes here.

IV. Data

A. Ethereum Event Logs and Meta-Events

The Ethereum event log records specific occurrences or outputs generated during the execution of constract code. They enable off-chain applications to react to on-chain events. A popular event is the `Transfer` event emitted by ERC 20 tokens [**?**]:

```
1  event Transfer(address indexed from,
2                 address indexed to,
3                 uint256 value);
```

Listing 1. The ERC 20 `Transfer` event specifies three parameters: `from`, `to`, and `value`.

The event has two special cases. In the first, the `from` address is the zero address (`0x0`) and the contract mints a token. In the second, the `to` address is the zero address and the contract burns a token.

A single transaction can emit multiple events. We define a *meta-event* to be a sequence of events that match some pattern and are emitted by a single transaction. We define a *tokenise meta-event* to be a meta-event where the pattern is two `Transfer` events: one must indicate a transfer of tokens to the contract and another must indicate a new token being minted (*deposit & mint*), or one must indicate a token being burned and another must indicate a transfer of an existing token from the contract (*withdraw & burn*. In the terminology of ERC 4626, a tokenise meta-event corresponds to either a `Deposit` event or a `Withdraw` event. However, our tokenise meta-event does not require the contract to implement ERC 4626.

We extracted all `Transfer` events from Ethereum mainnet from block height 0 to 16 685 101 (February 2023) inclusive using Geth's `eth_getLogs` RPC method [**?**]. From the `Transfer` events, we identified 4 032 033 tokenise meta-events. Table [**?**] shows a sample of the data. The first (resp., last) two rows are the earliest (resp., latest) two occurrences of tokenise meta-events in that data that perform a deposit & mint, and a withdraw & burn.

For example, the first row indicates a transaction that deposited a dust amount of ARC [**?**] in a one-to-one exchange for newly minted SWT [**?**] in January 2017. The third row indicates a transaction that withdrew 5183 BONE [**?**] in exchange for burning 5160 `tBONE` in February 2023. We are not concerned with the individual utility or value of the tokens (or lack thereof); we are only interested in the fact that Token $\mathcal{X}$ can be deposited with a contract to mint Token $\mathcal{Y}$, and/or Token $\mathcal{Y}$ can be burned by a contract to withdraw Token $\mathcal{X}$.

The filtered event logs contain 3 461 723 events.

B. Off-Chain Data

CoinGecko [**?**] is a cryptocurrency data platform that aggregates fundamental analysis of tokens including market price, exchange volume, and market capitalisation.

DEX Screener [**?**] stores, parses, and analyses blockchain data to produce a token screener, charts, and analytics. They cover many blockchains, decentralised exchanges, and tokens.

C. The Directed Graph

It involves 8424 distinct tokens.

We constructed a directed graph from the tokenise meta-events as follows. Each vertex corresponds to a distinct token. Each directed edge from a source to a target corresponds to a set of tokenise meta-events that either deposits the source token and mints the target token, or withdraws the source token and burns the target token. In the terminology of ERC 4626, the source is the *asset* or and the target is the *share*. The graph has 8424 vertices and

V. Analysis

Analysis goes here.

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TABLE I

EACH TOKENISE META-EVENT CONTAINS THE ADDRESS OF THE SOURCE TOKEN, THE ADDRESS OF THE TARGET TOKEN, ONE OF TWO POSSIBLE PAIRS OF ACTIONS (DEPOSIT & MINT OR WITHDRAW & BURN), THE AMOUNT OF THE SOURCE TOKEN THAT WAS DEPOSITED OR WITHDRAWN, THE AMOUNT OF THE TARGET TOKEN THAT WAS MINTED OR BURNED, AND A TRANSACTION HASH. THE TABLE INCLUDES FOUR SAMPLE ENTRIES FROM THE FULL SET OF 4 032 033 TOKENISE META-EVENTS: THEY ARE THE EARLIEST AND LATEST TOKENISE META-EVENTS THAT HAVE DEPOSIT & MINT AND WITHDRAW & BURN ACTIONS.

Source Token	Target Token	Actions	Source Amount	Target Amount	Tx Hash
ARC (0xac709f)	SWT (0xb12a3c)	deposit & mint	*dust*	*dust*	0x549a12
DGZ (0x84178d)	preDGZ (0x18aa6e)	withdraw & burn	1371	150	0x2da232
BONE (0x981303)	tBONE (0xf7a038)	withdraw & burn	5183	5160	0x5dbe32
WETH (0xc02aaa)	aWETH (0x030ba8)	deposit & mint	25	25	0xb4281a

VI. CONCLUSION

Conclusion goes here.

REFERENCES

[1] T. Lloyd, D. O'Broin, and M. Harrigan, "Emergent outcomes of the veToken model," in *The IEEE International Conference on Omni-Layer Intelligent Systems (COINS)*, 2023.