CERTIK

Performance Analysis Report for Qubic Mainnet

April 20, 2025

Executive Summary

Qubic engaged CertiK to conduct an external performance assessment for Qubic mainnet.

Introduction to Qubic

Qubic represents a Layer 1 blockchain engineered for high performance, characterized by immediate transaction finality, transaction processing devoid of fees, and expedited execution of smart contracts. It is constructed upon the foundational principle of Useful Proof of Work (UPoW) and distinguishes itself as the pioneering blockchain to incorporate artificial neural networks, thereby facilitating advancements in Artificial General Intelligence.

Scope of Engagement

The CetriK Security Team conducted the assessment. Our performance analysis was conducted from February 12th, 2025, to April 1st, 2025, and focused on the following objectives:

- To evaluate the network's capacity to handle high transaction volumes

- To assess the throughput achieved by the system

- To measure response times and latency across different network nodes

- To analyze the network's average performance under sustained high transaction loads

- To evaluate the network's maximum TPS (Transactions* Per Second)

*Note:

Regarding TPS (Transactions Per Second) metrics, where 'T' represents 'Transactions,' we use the standard definition of a transaction—an atomic operation (e.g., a balance change or smart contract execution) whose result is recorded on the blockchain. Unless otherwise specified, the measured transactions primarily refer to transfers executed at high speed against a benchmark smart contract provided by the Qubic team. For further details, please refer to the official technical [post](#) on it.

CertiK Assessment Methodology

Qubic Technology Foundation

Qubic is a groundbreaking solution that combines distributed ledger technology, smart contracts, and decentralized applications to address challenges in various industries. It introduces a quorum-based computer (QBC) system, enabling decentralized computing and finance. Qubic features frictionless microtransactions, uses energy as the transaction medium (Qubic Units or QUs), and supports decentralized quorum-based decision-making and scalable AI solutions. Its innovative use of epoch-based processing and decentralized exchange further enhances its capabilities.

CertiK Methodological Steps

Test Environments Setup

CertiK's engagement was to validate the performance and stability of Qubic's network infrastructure in mainnet. This process encompassed rigorous testing methodologies, beginning with a public testnet environment to establish baseline metrics and refine evaluation tools. The focal point of this phased approach was to ensure comprehensive assessment under controlled conditions before transitioning to the mainnet, where real-world scalability and reliability were further verified.

Usage

CertiK developed a specialized testing framework to comprehensively evaluate Qubic's network performance with precision. This advanced solution builds upon the Qubic CLI by creating an intelligent wrapper that extends its capabilities for sophisticated network analysis and stress testing.

The framework operates by establishing real-time monitoring of Qubic's core network metrics, including tick progression patterns and transaction volumes per tick . This continuous data

collection enables dynamic calculation of critical performance indicators such as network latency, system stability thresholds, and overall throughput efficiency.

At the heart of the system lies a versatile testing engine capable of executing 3 distinct testing methodologies. The framework supports targeted single-instance stress tests for baseline measurements, sequential integrated stress tests for sustained performance evaluation, and stochastic random stress tests that simulate unpredictable network conditions. Each test mode offers granular control parameters including precise duration settings, adjustable interval timing, and customizable load patterns.

For result analysis, the framework automatically generates detailed timestamped logs containing complete test telemetry. These outputs facilitate sophisticated comparative analysis through statistical aggregation, performance trend visualization, and benchmark correlation studies. The system produces both executive summaries and in-depth technical reports to serve different analytical needs.

Test Environment Specifications

This benchmark analysis is predicated on metrics such as transaction count and duration. The testing was conducted on both Qubic's testnet and mainnet, with all configurations set up by the Qubic team. The test tool was deployed on our local machine:

	Model	Memory
Machine 1	MacBook Pro Intel i9	16 GB RAM

Performance Testing Overview

The performance evaluation was conducted across two distinct network environments:

- Integration testing on the Qubic testnet
- Integration testing on the Qubic mainnet

The benchmark testing employed the following parameters:

- Utilized Qubic's native smart contract address to enable single-transaction, multi-recipient transfers

- Established a fixed test duration of 5 minutes per trial

- Configured each transaction to target 16,500,000 recipient addresses

- Implemented a transfer delay setting of 4 ticks between operations

The assessment focused on critical network performance dimensions:

- Tick time analysis

- Aggregate transfer volume capacity

- Transaction throughput metrics:

  - Average TPS

  - Peak TPS

  - Minimum TPS

- Network stability and performance variance

Testnet Testing Result

```
Unset
Starting integration test with following parameters:
Number of tests: 3
Test duration: 5 minutes
Interval: 1 minutes
Accounts per tx: 16500000
-------------------------------------------------
Overall Progress:   0%|                                                              |
0/17 [00:00<?, ?min/s]
Test 1/3
2025-03-26 08:41:52,787 - INFO - Test Parameters:
2025-03-26 08:41:52,788 - INFO -   Duration: 5 minutes
2025-03-26 08:41:52,788 - INFO -   Account Number: 16500000
2025-03-26 08:41:57,394 - INFO - Test Starting At Tick: 22177114

2025-03-26 08:42:05,905 - INFO - Tick 22177114: Duration=5.25s, Transfers=0, TPS=0.00
2025-03-26 08:42:41,174 - INFO - Tick 22177115: Duration=35.02s, Transfers=0, TPS=0.00
2025-03-26 08:42:45,716 - INFO - Tick 22177116: Duration=4.79s, Transfers=0, TPS=0.00
2025-03-26 08:42:49,003 - INFO - Tick 22177117: Duration=3.26s, Transfers=0, TPS=0.00
2025-03-26 08:42:53,721 - INFO - Tick 22177118: Duration=4.52s, Transfers=0, TPS=0.00
2025-03-26 08:43:42,169 - INFO - Tick 22177119: Duration=48.58s, Transfers=99000000, TPS=2038078.55
2025-03-26 08:43:45,538 - INFO - Tick 22177120: Duration=3.36s, Transfers=2060, TPS=613.29
2025-03-26 08:43:48,845 - INFO - Tick 22177121: Duration=3.37s, Transfers=4236202, TPS=1256248.14
2025-03-26 08:44:23,917 - INFO - Tick 22177123: Duration=35.14s, Transfers=78265768, TPS=2227386.61
2025-03-26 08:44:27,186 - INFO - Tick 22177124: Duration=3.24s, Transfers=3545, TPS=1093.14
2025-03-26 08:44:30,376 - INFO - Tick 22177125: Duration=3.26s, Transfers=7154709, TPS=2192052.11
2025-03-26 08:44:33,692 - INFO - Tick 22177126: Duration=3.19s, Transfers=7960892, TPS=2492126.17
2025-03-26 08:44:58,399 - INFO - Tick 22177127: Duration=24.66s, Transfers=50884399, TPS=2063404.57
2025-03-26 08:45:38,317 - INFO - Tick 22177128: Duration=40.03s, Transfers=66011945, TPS=1648956.66
2025-03-26 08:45:42,833 - INFO - Tick 22177129: Duration=4.58s, Transfers=0, TPS=0.00
2025-03-26 08:45:46,065 - INFO - Tick 22177131: Duration=3.17s, Transfers=0, TPS=0.00
2025-03-26 08:46:17,939 - INFO - Tick 22177132: Duration=31.77s, Transfers=66001435, TPS=2077425.70
2025-03-26 08:46:21,165 - INFO - Tick 22177133: Duration=3.35s, Transfers=1160, TPS=346.45
2025-03-26 08:46:24,408 - INFO - Tick 22177134: Duration=3.21s, Transfers=0, TPS=0.00
2025-03-26 08:46:28,916 - INFO - Tick 22177135: Duration=4.44s, Transfers=4781215, TPS=1076561.40
2025-03-26 08:46:59,459 - INFO - Tick 22177136: Duration=30.57s, Transfers=77722115, TPS=2542813.77
2025-03-26 08:47:03,986 - INFO - Tick 22177137: Duration=4.54s, Transfers=0, TPS=0.00
2025-03-26 08:47:08,671 - INFO - Test Ending At Tick: 22177140

2025-03-26 08:47:08,672 - INFO - Total unique TxHashes: 134
Tick data has been written to qubic_benchmark_tick_data20250326_084708_UTC.json
```

```
2025-03-26 08:47:08,676 - INFO - === Summary ===
2025-03-26 08:47:08,676 - INFO - Total Ticks: 27
2025-03-26 08:47:08,676 - INFO - Total TxHashes: 134
2025-03-26 08:47:08,676 - INFO - Total Transfers: 469577006
2025-03-26 08:47:08,677 - INFO - Average Transfers per Tick: 21344409.36
2025-03-26 08:47:08,677 - INFO - Average Tick Time (from duration): 11.11 seconds
2025-03-26 08:47:08,677 - INFO - Average Tick Time (measured): 13.79 seconds
2025-03-26 08:47:08,677 - INFO - Number Of Transfers Per Second (TPS) (from total): 1565256.69
2025-03-26 08:47:08,677 - INFO - Average TPS (from measurements): 891686.66
2025-03-26 08:47:08,677 - INFO - Max Tick TPS: 2542813.77
2025-03-26 08:47:08,677 - INFO - Min Tick TPS: 0.00
2025-03-26 08:47:08,678 - INFO - Max Tick Duration: 48.58 seconds
2025-03-26 08:47:08,678 - INFO - Min Tick Duration: 3.17 seconds
Overall Progress:  29%|█████████████████████████████          | 5/17
[05:15<12:38, 63.18s/min]
Waiting 1 minutes before next test...
Overall Progress:  35%|███████████████████████████████████     | 6/17
[06:15<11:27, 62.47s/min]
Test 2/3
2025-03-26 08:48:08,688 - INFO - Test Parameters:
2025-03-26 08:48:08,688 - INFO -   Duration: 5 minutes
2025-03-26 08:48:08,688 - INFO -   Account Number: 16500000
2025-03-26 08:48:13,687 - INFO - Test Starting At Tick: 22177142

2025-03-26 08:48:29,445 - INFO - Tick 22177142: Duration=12.17s, Transfers=35669963, TPS=2930901.55
2025-03-26 08:48:37,688 - INFO - Tick 22177143: Duration=8.57s, Transfers=15063027, TPS=1758351.94
2025-03-26 08:48:42,217 - INFO - Tick 22177144: Duration=4.49s, Transfers=0, TPS=0.00
2025-03-26 08:48:49,232 - INFO - Tick 22177145: Duration=6.98s, Transfers=760, TPS=108.89
2025-03-26 08:48:57,357 - INFO - Tick 22177146: Duration=8.26s, Transfers=8275, TPS=1002.17
2025-03-26 08:49:13,315 - INFO - Tick 22177147: Duration=15.64s, Transfers=14276789, TPS=913122.85
2025-03-26 08:49:20,385 - INFO - Tick 22177148: Duration=7.41s, Transfers=2224796, TPS=300281.88
2025-03-26 08:49:25,042 - INFO - Tick 22177149: Duration=4.42s, Transfers=1510, TPS=341.30
2025-03-26 08:49:29,752 - INFO - Tick 22177150: Duration=4.65s, Transfers=0, TPS=0.00
2025-03-26 08:49:36,894 - INFO - Tick 22177151: Duration=5.96s, Transfers=0, TPS=0.00
2025-03-26 08:49:41,399 - INFO - Tick 22177152: Duration=6.00s, Transfers=0, TPS=0.00
2025-03-26 08:50:10,443 - INFO - Tick 22177153: Duration=28.83s, Transfers=0, TPS=0.00
2025-03-26 08:50:21,494 - INFO - Tick 22177154: Duration=11.26s, Transfers=0, TPS=0.00
2025-03-26 08:50:27,015 - INFO - Tick 22177155: Duration=4.46s, Transfers=0, TPS=0.00
2025-03-26 08:50:34,212 - INFO - Tick 22177157: Duration=7.96s, Transfers=0, TPS=0.00
2025-03-26 08:50:38,747 - INFO - Tick 22177158: Duration=4.84s, Transfers=0, TPS=0.00
2025-03-26 08:50:52,747 - INFO - Tick 22177159: Duration=13.82s, Transfers=0, TPS=0.00
2025-03-26 08:50:59,717 - INFO - Tick 22177160: Duration=7.04s, Transfers=2955, TPS=419.91
2025-03-26 08:51:04,162 - INFO - Tick 22177161: Duration=4.49s, Transfers=1507467, TPS=335436.92
2025-03-26 08:51:08,591 - INFO - Tick 22177162: Duration=4.45s, Transfers=10667588, TPS=2396453.10
2025-03-26 08:51:40,065 - INFO - Tick 22177163: Duration=31.35s, Transfers=60409785, TPS=1927098.36
2025-03-26 08:51:44,597 - INFO - Tick 22177164: Duration=4.59s, Transfers=9930560, TPS=2163433.98
2025-03-26 08:51:48,093 - INFO - Tick 22177165: Duration=3.29s, Transfers=360, TPS=109.51
2025-03-26 08:51:52,658 - INFO - Tick 22177166: Duration=4.70s, Transfers=6288546, TPS=1338120.25
2025-03-26 08:51:55,974 - INFO - Tick 22177167: Duration=3.35s, Transfers=7997614, TPS=2385748.76
2025-03-26 08:52:38,185 - INFO - Tick 22177168: Duration=42.36s, Transfers=63909361, TPS=1508758.39
2025-03-26 08:52:47,737 - INFO - Tick 22177169: Duration=9.38s, Transfers=22924882, TPS=2445037.51
2025-03-26 08:52:52,209 - INFO - Tick 22177170: Duration=4.55s, Transfers=11516291, TPS=2530932.84
2025-03-26 08:52:56,739 - INFO - Tick 22177171: Duration=4.48s, Transfers=11238668, TPS=2505880.98
2025-03-26 08:53:10,871 - INFO - Tick 22177172: Duration=14.22s, Transfers=8135163, TPS=572152.10
2025-03-26 08:53:15,274 - INFO - Tick 22177173: Duration=4.46s, Transfers=0, TPS=0.00
2025-03-26 08:53:20,066 - INFO - Tick 22177174: Duration=4.64s, Transfers=5318123, TPS=1145291.45
2025-03-26 08:53:24,460 - INFO - Test Ending At Tick: 22177168

2025-03-26 08:53:24,460 - INFO - Total unique TxHashes: 237
Tick data has been written to qubic_benchmark_tick_data20250326_085324_UTC.json
2025-03-26 08:53:24,473 - INFO - === Summary ===
2025-03-26 08:53:24,474 - INFO - Total Ticks: 27
2025-03-26 08:53:24,474 - INFO - Total TxHashes: 237
2025-03-26 08:53:24,474 - INFO - Total Transfers: 297611769
2025-03-26 08:53:24,475 - INFO - Average Transfers per Tick: 9300367.78
2025-03-26 08:53:24,475 - INFO - Average Tick Time (from duration): 11.11 seconds
2025-03-26 08:53:24,475 - INFO - Average Tick Time (measured): 9.47 seconds
2025-03-26 08:53:24,476 - INFO - Number Of Transfers Per Second (TPS) (from total): 992039.23
2025-03-26 08:53:24,476 - INFO - Average TPS (from measurements): 848718.27
2025-03-26 08:53:24,476 - INFO - Max Tick TPS: 2930901.55
2025-03-26 08:53:24,476 - INFO - Min Tick TPS: 0.00
2025-03-26 08:53:24,476 - INFO - Max Tick Duration: 42.36 seconds
2025-03-26 08:53:24,477 - INFO - Min Tick Duration: 3.29 seconds
Overall Progress:  65%|████████████████████████████████████████████████████████       | 11/17
[11:31<06:17, 62.89s/min]
Waiting 1 minutes before next test...
```

```
Overall Progress:  71%|████████████████████████████████████████████████████████              | 12/17
[12:31<05:12, 62.46s/min]
Test 3/3
2025-03-26 08:54:24,498 - INFO - Test Parameters:
2025-03-26 08:54:24,498 - INFO -    Duration: 5 minutes
2025-03-26 08:54:24,499 - INFO -    Account Number: 16500000
2025-03-26 08:54:29,016 - INFO - Test Starting At Tick: 22177183

2025-03-26 08:54:35,980 - INFO - Tick 22177183: Duration=3.80s, Transfers=12594777, TPS=3314264.91
2025-03-26 08:54:42,740 - INFO - Tick 22177184: Duration=6.75s, Transfers=3905858, TPS=578679.83
2025-03-26 08:54:47,459 - INFO - Tick 22177185: Duration=4.49s, Transfers=8594200, TPS=1913398.95
2025-03-26 08:54:52,229 - INFO - Tick 22177186: Duration=5.03s, Transfers=11651028, TPS=2318223.67
2025-03-26 08:54:59,575 - INFO - Tick 22177187: Duration=7.03s, Transfers=18280258, TPS=2598996.23
2025-03-26 08:55:04,542 - INFO - Tick 22177188: Duration=5.03s, Transfers=11629908, TPS=2311631.02
2025-03-26 08:55:14,517 - INFO - Tick 22177189: Duration=10.18s, Transfers=15847041, TPS=1556019.95
2025-03-26 08:55:23,900 - INFO - Tick 22177190: Duration=9.33s, Transfers=5230, TPS=560.45
2025-03-26 08:55:28,546 - INFO - Tick 22177191: Duration=4.61s, Transfers=6265, TPS=1358.83
2025-03-26 08:55:34,581 - INFO - Tick 22177192: Duration=6.04s, Transfers=0, TPS=0.00
2025-03-26 08:55:42,846 - INFO - Tick 22177193: Duration=8.22s, Transfers=9511061, TPS=1156556.14
2025-03-26 08:55:48,586 - INFO - Tick 22177194: Duration=4.68s, Transfers=6992009, TPS=1493569.39
2025-03-26 08:55:53,124 - INFO - Tick 22177195: Duration=5.73s, Transfers=2684377, TPS=468389.69
2025-03-26 08:56:01,135 - INFO - Tick 22177196: Duration=8.02s, Transfers=13817503, TPS=1722028.68
2025-03-26 08:56:05,590 - INFO - Tick 22177197: Duration=4.46s, Transfers=10691058, TPS=2397021.43
2025-03-26 08:56:16,893 - INFO - Tick 22177198: Duration=10.88s, Transfers=5813444, TPS=534445.52
2025-03-26 08:56:26,414 - INFO - Tick 22177199: Duration=9.93s, Transfers=16499813, TPS=1661608.23
2025-03-26 08:56:29,619 - INFO - Tick 22177200: Duration=3.18s, Transfers=0, TPS=0.00
2025-03-26 08:56:34,166 - INFO - Tick 22177201: Duration=4.45s, Transfers=743830, TPS=167095.77
2025-03-26 08:56:42,214 - INFO - Tick 22177202: Duration=8.18s, Transfers=15756170, TPS=1927198.95
2025-03-26 08:56:45,433 - INFO - Tick 22177203: Duration=3.17s, Transfers=0, TPS=0.00
2025-03-26 08:56:54,687 - INFO - Tick 22177204: Duration=9.25s, Transfers=16501295, TPS=1784415.13
2025-03-26 08:57:16,502 - INFO - Tick 22177205: Duration=21.65s, Transfers=26804280, TPS=1238202.12
2025-03-26 08:57:21,025 - INFO - Tick 22177206: Duration=4.72s, Transfers=6195720, TPS=1312456.23
2025-03-26 08:57:26,734 - INFO - Tick 22177207: Duration=4.55s, Transfers=7073441, TPS=1555169.44
2025-03-26 08:57:34,832 - INFO - Tick 22177208: Duration=9.27s, Transfers=9427719, TPS=1016493.92
2025-03-26 08:57:39,273 - INFO - Tick 22177209: Duration=4.45s, Transfers=6788805, TPS=1525243.75
2025-03-26 08:57:59,358 - INFO - Tick 22177210: Duration=19.92s, Transfers=42711765, TPS=2144249.11
2025-03-26 08:58:06,409 - INFO - Tick 22177211: Duration=7.17s, Transfers=1920, TPS=267.76
2025-03-26 08:58:10,821 - INFO - Tick 22177212: Duration=4.42s, Transfers=2088382, TPS=472346.95
2025-03-26 08:58:14,003 - INFO - Tick 22177213: Duration=3.20s, Transfers=7662702, TPS=2392374.82
2025-03-26 08:58:34,685 - INFO - Tick 22177214: Duration=20.43s, Transfers=33206820, TPS=1625381.40
2025-03-26 08:58:39,445 - INFO - Tick 22177215: Duration=4.75s, Transfers=6545016, TPS=1377260.53
2025-03-26 08:58:46,180 - INFO - Tick 22177217: Duration=7.01s, Transfers=120, TPS=17.12
2025-03-26 08:58:51,960 - INFO - Tick 22177218: Duration=5.67s, Transfers=0, TPS=0.00
2025-03-26 08:59:14,954 - INFO - Tick 22177219: Duration=23.02s, Transfers=44864311, TPS=1948642.41
2025-03-26 08:59:21,794 - INFO - Tick 22177220: Duration=6.88s, Transfers=4640944, TPS=674765.71
2025-03-26 08:59:26,306 - INFO - Tick 22177221: Duration=4.51s, Transfers=0, TPS=0.00
2025-03-26 08:59:34,767 - INFO - Tick 22177223: Duration=8.46s, Transfers=8389130, TPS=991497.27
2025-03-26 08:59:39,184 - INFO - Test Ending At Tick: 22177219

2025-03-26 08:59:39,184 - INFO - Total unique TxHashes: 332
Tick data has been written to qubic_benchmark_tick_data20250326_085939_UTC.json
2025-03-26 08:59:39,188 - INFO - === Summary ===
2025-03-26 08:59:39,188 - INFO - Total Ticks: 37
2025-03-26 08:59:39,188 - INFO - Total TxHashes: 332
2025-03-26 08:59:39,188 - INFO - Total Transfers: 397216430
2025-03-26 08:59:39,189 - INFO - Average Transfers per Tick: 10185036.67
2025-03-26 08:59:39,189 - INFO - Average Tick Time (from duration): 8.11 seconds
2025-03-26 08:59:39,189 - INFO - Average Tick Time (measured): 7.76 seconds
2025-03-26 08:59:39,189 - INFO - Number Of Transfers Per Second (TPS) (from total): 1324054.77
2025-03-26 08:59:39,189 - INFO - Average TPS (from measurements): 1184098.24
2025-03-26 08:59:39,189 - INFO - Max Tick TPS: 3314264.91
2025-03-26 08:59:39,189 - INFO - Min Tick TPS: 0.00
2025-03-26 08:59:39,190 - INFO - Max Tick Duration: 23.02 seconds
2025-03-26 08:59:39,190 - INFO - Min Tick Duration: 3.17 seconds
Overall Progress: 100%|██████████████████████████████████████████████████████████████████████| 17/17 [17:46<00:00,
62.73s/min]

All tests completed. Comparing results...
Log files generated: qubic_benchmark_integrate_1_20250326_084152_UTC.log, qubic_benchmark_integrate_2_20250326_084808_UTC.log, qubic_benchmark_integrate_3_20250326_085424_UTC.log

Benchmark Comparison (Sorted by TPS):

Test Information:
+--------+---------------------+---------------------+------------+---------------+
| Test   | Start Time          | End Time            | Duration   |   Account Num |
+========+=====================+=====================+============+===============+
```
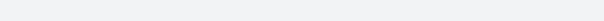
```
| Test 1 | 2025-03-26 08:41:57 | 2025-03-26 08:47:08 | 5 minutes  |     16500000 |
+--------+---------------------+---------------------+------------+--------------+
| Test 2 | 2025-03-26 08:54:29 | 2025-03-26 08:59:39 | 5 minutes  |     16500000 |
+--------+---------------------+---------------------+------------+--------------+
| Test 3 | 2025-03-26 08:48:13 | 2025-03-26 08:53:24 | 5 minutes  |     16500000 |
+--------+---------------------+---------------------+------------+--------------+
```

Tick Information:

```
+--------+-------------+------------+--------------+--------------+---------------+-------------------+--------------------+
| Test   | Start Tick  | End Tick   | Tick Range   | Total Ticks  | Avg Tick Time | Min Tick Duration | Max Tick Duration  |
+========+=============+============+==============+==============+===============+===================+====================+
| Test 1 |    22177114 |   22177140 |           26 |           27 | 11.11s        | 3.17s             | 48.58s             |
+--------+-------------+------------+--------------+--------------+---------------+-------------------+--------------------+
| Test 2 |    22177183 |   22177219 |           36 |           37 | 8.11s         | 3.17s             | 23.02s             |
+--------+-------------+------------+--------------+--------------+---------------+-------------------+--------------------+
| Test 3 |    22177142 |   22177168 |           26 |           27 | 11.11s        | 3.29s             | 42.36s             |
+--------+-------------+------------+--------------+--------------+---------------+-------------------+--------------------+
```

Performance Metrics:

```
+--------+-----------------+------------------+---------------+---------------+--------------+------------------+------------------+----------------------+
| Test   | Total Transfers | Avg Transfers/Tick | Overall TPS | Min Tick TPS | Max Tick TPS | Transfer/Tick Min | Transfer/Tick Max | Transfer/Tick Variance |
+========+=================+==================+===============+===============+==============+==================+==================+======================+
| Test 1 |       469577006 |       2.13444e+07 |   1.56526e+06 |            0 |  2.54281e+06 |                0 |          9.9e+07 |           1.0783e+15 |
+--------+-----------------+------------------+---------------+---------------+--------------+------------------+------------------+----------------------+
| Test 2 |       397216430 |        1.0185e+07 |   1.32405e+06 |            0 |  3.31426e+06 |                0 |      4.48643e+07 |          1.18046e+14 |
+--------+-----------------+------------------+---------------+---------------+--------------+------------------+------------------+----------------------+
| Test 3 |       297611769 |       9.30037e+06 | 992039        |            0 |   2.9309e+06 |                0 |      6.39094e+07 |          2.51975e+14 |
+--------+-----------------+------------------+---------------+---------------+--------------+------------------+------------------+----------------------+
```

Test report saved to: qubic_benchmark_integration_report_20250326_085939_UTC.json

```
====================================================
Test Report (INTEGRATION)
====================================================
```

Timestamp: 20250326_085939
Number of tests: 3

Test Information:

```
+--------+---------------------+---------------------+------------+----------------+
| Test   | Start Time          | End Time            | Duration   | Account Num    |
+========+=====================+=====================+============+================+
| Test 1 | 2025-03-26 08:41:57 | 2025-03-26 08:47:08 | 5 minutes  |       16500000 |
+--------+---------------------+---------------------+------------+----------------+
| Test 2 | 2025-03-26 08:54:29 | 2025-03-26 08:59:39 | 5 minutes  |       16500000 |
+--------+---------------------+---------------------+------------+----------------+
| Test 3 | 2025-03-26 08:48:13 | 2025-03-26 08:53:24 | 5 minutes  |       16500000 |
+--------+---------------------+---------------------+------------+----------------+
```

Tick Information:

```
+--------+-------------+------------+--------------+--------------+---------------+-------------------+--------------------+
| Test   | Start Tick  | End Tick   | Tick Range   | Total Ticks  | Avg Tick Time | Min Tick Duration | Max Tick Duration  |
+========+=============+============+==============+==============+===============+===================+====================+
| Test 1 |    22177114 |   22177140 |           26 |           27 | 11.11s        | 3.17s             | 48.58s             |
+--------+-------------+------------+--------------+--------------+---------------+-------------------+--------------------+
| Test 2 |    22177183 |   22177219 |           36 |           37 | 8.11s         | 3.17s             | 23.02s             |
+--------+-------------+------------+--------------+--------------+---------------+-------------------+--------------------+
| Test 3 |    22177142 |   22177168 |           26 |           27 | 11.11s        | 3.29s             | 42.36s             |
+--------+-------------+------------+--------------+--------------+---------------+-------------------+--------------------+
```

Performance Metrics:

```
+--------+-----------------+------------------+---------------+---------------+--------------+------------------+------------------+----------------------+
| Test   | Total Transfers | Avg Transfers/Tick | Overall TPS | Min Tick TPS | Max Tick TPS | Transfer/Tick Min | Transfer/Tick Max | Transfer/Tick Variance |
+========+=================+==================+===============+===============+==============+==================+==================+======================+
| Test 1 |       469577006 |       2.13444e+07 |   1.56526e+06 |            0 |  2.54281e+06 |                0 |          9.9e+07 |           1.0783e+15 |
+--------+-----------------+------------------+---------------+---------------+--------------+------------------+------------------+----------------------+
| Test 2 |       397216430 |        1.0185e+07 |   1.32405e+06 |            0 |  3.31426e+06 |                0 |      4.48643e+07 |          1.18046e+14 |
+--------+-----------------+------------------+---------------+---------------+--------------+------------------+------------------+----------------------+
| Test 3 |       297611769 |       9.30037e+06 | 992039        |            0 |   2.9309e+06 |                0 |      6.39094e+07 |          2.51975e+14 |
+--------+-----------------+------------------+---------------+---------------+--------------+------------------+------------------+----------------------+
```

Comparative Analysis:

```
+--------+-------------------+------------------+----------------+-----------------+----------------------+---------------------+
| Test   | Overall TPS       | TPS Diff (Avg)   | TPS Diff (Max) | Total Transfers | Transfers Diff (Avg) | Transfers Diff (Max) |
+========+===================+==================+================+=================+======================+=====================+
| Test 1 | 1.56526e+06       | 271473           |              0 |       469577006 |          8.14419e+07 |                   0 |
```

```
+--------+-------------------+-----------------+-----------------+-----------------+---------------------+----------------------+
| Test 2 |      1.32405e+06  |          30271.2 |         -241202 |       397216430 |          9.08136e+06 |          -7.23606e+07 |
+--------+-------------------+-----------------+-----------------+-----------------+---------------------+----------------------+
| Test 3 | 992039            |         -301744 |         -573217 |       297611769 |         -9.05233e+07 |          -1.71965e+08 |
+--------+-------------------+-----------------+-----------------+-----------------+---------------------+----------------------+

Summary Statistics:
+--------------------------+---------------+
| Metric                   | Value         |
+==========================+===============+
| Average TPS              | 1293783.56    |
+--------------------------+---------------+
| Maximum TPS              | 1565256.69    |
+--------------------------+---------------+
| Average Total Transfers  | 388135068.33  |
+--------------------------+---------------+
| Maximum Total Transfers  | 469577006.00  |
+--------------------------+---------------+
| Highest Tick TPS         | 3314264.91    |
+--------------------------+---------------+
| Lowest Tick TPS          | 0.00          |
+--------------------------+---------------+
| Longest Tick Duration    | 48.58s        |
+--------------------------+---------------+
| Shortest Tick Duration   | 3.17s         |
+--------------------------+---------------+

Detailed logs stored in:
  - qubic_benchmark_integrate_1_20250326_084152_UTC.log
  - qubic_benchmark_integrate_2_20250326_084808_UTC.log
  - qubic_benchmark_integrate_3_20250326_085424_UTC.log
```

During the testing on testnet, the highest average TPS reached **1.56 million**, while the peak tick TPS achieved **3.31 million**. The detailed experimental results data can be found in the appendix.

Mainnet Testing Result

Unset

Starting integration test with following parameters:
Number of tests: 2
Test duration: 5 minutes
Interval: 10 minutes
Accounts per tx: 16500000

Overall Progress: 0%|
| 0/20 [00:00<?, ?min/s]
Test 1/2
2025-04-01 06:41:35,937 - INFO - Test Parameters:
2025-04-01 06:41:35,937 - INFO -   Duration: 5 minutes
2025-04-01 06:41:35,937 - INFO -   Account Number: 16500000
2025-04-01 06:41:40,361 - INFO - Test Starting At Tick: 22584476

2025-04-01 06:41:44,709 - INFO - Tick 22584476: Duration=1.18s, Transfers=0, TPS=0.00
2025-04-01 06:41:47,914 - INFO - Tick 22584480: Duration=3.17s, Transfers=0, TPS=0.00
2025-04-01 06:41:51,078 - INFO - Tick 22584481: Duration=3.21s, Transfers=0, TPS=0.00
2025-04-01 06:41:54,524 - INFO - Tick 22584482: Duration=3.16s, Transfers=0, TPS=0.00
2025-04-01 06:41:57,732 - INFO - Tick 22584483: Duration=3.45s, Transfers=0, TPS=0.00
2025-04-01 06:42:17,529 - INFO - Tick 22584486: Duration=19.81s, Transfers=33000000, TPS=1665413.15
2025-04-01 06:42:20,928 - INFO - Tick 22584487: Duration=3.19s, Transfers=31578553, TPS=9902048.71
2025-04-01 06:42:24,091 - INFO - Tick 22584488: Duration=3.40s, Transfers=1421447, TPS=418346.54
2025-04-01 06:42:33,577 - INFO - Tick 22584490: Duration=9.50s, Transfers=23171352, TPS=2440137.18
2025-04-01 06:43:18,937 - INFO - Tick 22584491: Duration=45.32s, Transfers=108828648, TPS=2401423.47
2025-04-01 06:43:22,104 - INFO - Tick 22584492: Duration=3.20s, Transfers=0, TPS=0.00
2025-04-01 06:43:27,657 - INFO - Tick 22584494: Duration=5.54s, Transfers=33000918, TPS=5954317.32
2025-04-01 06:44:07,156 - INFO - Tick 22584495: Duration=39.50s, Transfers=82499082, TPS=2088784.40
2025-04-01 06:44:10,327 - INFO - Tick 22584496: Duration=3.18s, Transfers=0, TPS=0.00
2025-04-01 06:44:13,500 - INFO - Tick 22584497: Duration=3.17s, Transfers=13436680, TPS=4233513.69
2025-04-01 06:44:16,690 - INFO - Tick 22584498: Duration=3.17s, Transfers=47502439, TPS=14998030.39
2025-04-01 06:44:53,178 - INFO - Tick 22584499: Duration=36.36s, Transfers=54560881, TPS=1500591.62
2025-04-01 06:44:57,343 - INFO - Tick 22584500: Duration=4.15s, Transfers=14420412, TPS=3476244.10
2025-04-01 06:45:00,528 - INFO - Tick 22584502: Duration=3.33s, Transfers=47685514, TPS=14305234.01
2025-04-01 06:45:25,767 - INFO - Tick 22584503: Duration=25.29s, Transfers=20394074, TPS=806440.42
2025-04-01 06:45:29,825 - INFO - Tick 22584504: Duration=4.05s, Transfers=0, TPS=0.00
2025-04-01 06:45:32,976 - INFO - Tick 22584505: Duration=3.15s, Transfers=36319757, TPS=11524151.72
2025-04-01 06:45:36,151 - INFO - Tick 22584506: Duration=3.15s, Transfers=47534215, TPS=15103139.36
2025-04-01 06:46:06,296 - INFO - Tick 22584507: Duration=30.14s, Transfers=15146028, TPS=502539.17
2025-04-01 06:46:09,757 - INFO - Tick 22584508: Duration=3.41s, Transfers=16500000, TPS=4832291.54
2025-04-01 06:46:13,035 - INFO - Tick 22584510: Duration=3.23s, Transfers=49500000, TPS=15332862.80
2025-04-01 06:46:38,754 - INFO - Tick 22584511: Duration=25.82s, Transfers=16500000, TPS=638959.25
2025-04-01 06:46:41,999 - INFO - Tick 22584512: Duration=3.18s, Transfers=16500000, TPS=5193590.08
2025-04-01 06:46:45,168 - INFO - Tick 22584513: Duration=3.24s, Transfers=47500316, TPS=14649140.03
2025-04-01 06:46:51,109 - INFO - Tick 22584515: Duration=5.54s, Transfers=34999684, TPS=6316143.23
2025-04-01 06:46:56,522 - INFO - Test Ending At Tick: 22584515
2025-04-01 06:46:56,523 - INFO - Total unique TxHashes: 144
Tick data has been written to qubic_benchmark_tick_data20250401_064656_UTC.json
2025-04-01 06:46:56,524 - INFO - === Summary ===
2025-04-01 06:46:56,524 - INFO - Total Ticks: 40
2025-04-01 06:46:56,524 - INFO - Total TxHashes: 144
2025-04-01 06:46:56,524 - INFO - Total Transfers: 792000000
2025-04-01 06:46:56,524 - INFO - Average Transfers per Tick: 26400000.00
2025-04-01 06:46:56,524 - INFO - Average Tick Time (from duration): 7.50 seconds
2025-04-01 06:46:56,524 - INFO - Average Tick Time (measured): 10.24 seconds
2025-04-01 06:46:56,525 - INFO - Number Of Transfers Per Second (TPS) (from total): 2640000.00
2025-04-01 06:46:56,525 - INFO - Average TPS (from measurements): 4609444.74
2025-04-01 06:46:56,525 - INFO - Max Tick TPS: 15332862.80
2025-04-01 06:46:56,525 - INFO - Min Tick TPS: 0.00
2025-04-01 06:46:56,525 - INFO - Max Tick Duration: 45.32 seconds
2025-04-01 06:46:56,525 - INFO - Min Tick Duration: 1.18 seconds
Overall Progress: 25%|
| 5/20 [05:20<16:01, 64.12s/min]
Waiting 10 minutes before next test...
Overall Progress: 30%|
| 6/20 [06:Overall Progress: 35%|
| 7/20 [07:Overall Progress: 40%|
| 8/20 [08:Overall Progress: 45%|
| 9/20 [09:Overall Progress: 50%|
| 10/20 [10:Overall Progress: 55%|
| 11/20 [11:Overall Progress: 60%|

```
| 12/20 [12:Overall Progress:  65%|█████████████████████████████████████████|
| 13/20 [13:Overall Progress:  70%|███████████████████████████████████████████|
| 14/20 [14:Overall Progress:  75%|███████████████████████████████████████████████|
| 15/20 [15:20<05:00, 60.18s/min]
Test 2/2
2025-04-01 06:56:56,588 - INFO - Test Parameters:
2025-04-01 06:56:56,589 - INFO -   Duration: 5 minutes
2025-04-01 06:56:56,589 - INFO -   Account Number: 16500000
2025-04-01 06:57:02,043 - INFO - Test Starting At Tick: 22584967
2025-04-01 06:57:06,414 - INFO - Tick 22584967: Duration=1.20s, Transfers=0, TPS=0.00
2025-04-01 06:57:09,634 - INFO - Tick 22584971: Duration=3.19s, Transfers=0, TPS=0.00
2025-04-01 06:57:14,118 - INFO - Tick 22584972: Duration=4.47s, Transfers=3519484, TPS=786943.41
2025-04-01 06:57:17,434 - INFO - Tick 22584977: Duration=3.23s, Transfers=50082113, TPS=15527637.74
2025-04-01 06:57:50,423 - INFO - Tick 22584978: Duration=33.11s, Transfers=45398403, TPS=1371175.33
2025-04-01 06:57:54,829 - INFO - Tick 22584979: Duration=4.43s, Transfers=13373959, TPS=3020839.21
2025-04-01 06:58:17,802 - INFO - Tick 22584983: Duration=23.01s, Transfers=52626041, TPS=2287257.88
2025-04-01 06:58:21,028 - INFO - Tick 22584984: Duration=3.14s, Transfers=0, TPS=0.00
2025-04-01 06:58:24,317 - INFO - Tick 22584985: Duration=3.22s, Transfers=18441538, TPS=5730362.77
2025-04-01 06:58:27,762 - INFO - Tick 22584986: Duration=3.30s, Transfers=31058462, TPS=9421950.46
2025-04-01 06:58:30,945 - INFO - Tick 22584987: Duration=3.44s, Transfers=0, TPS=0.00
2025-04-01 06:58:42,340 - INFO - Tick 22584988: Duration=11.41s, Transfers=0, TPS=0.00
2025-04-01 06:58:46,708 - INFO - Tick 22584989: Duration=4.38s, Transfers=8038839, TPS=1833561.68
2025-04-01 06:59:04,529 - INFO - Tick 22584990: Duration=17.78s, Transfers=41461161, TPS=2332385.41
2025-04-01 06:59:07,791 - INFO - Tick 22584992: Duration=3.19s, Transfers=16500000, TPS=5164873.58
2025-04-01 06:59:11,073 - INFO - Tick 22584993: Duration=3.27s, Transfers=49500000, TPS=15152743.90
2025-04-01 06:59:32,010 - INFO - Tick 22584994: Duration=20.92s, Transfers=0, TPS=0.00
2025-04-01 06:59:36,870 - INFO - Tick 22584995: Duration=4.51s, Transfers=16500000, TPS=3657094.74
2025-04-01 06:59:41,280 - INFO - Tick 22584996: Duration=4.84s, Transfers=0, TPS=0.00
2025-04-01 06:59:46,025 - INFO - Tick 22584997: Duration=4.41s, Transfers=33000000, TPS=7475751.67
2025-04-01 06:59:56,179 - INFO - Tick 22584998: Duration=10.46s, Transfers=0, TPS=0.00
2025-04-01 07:00:00,591 - INFO - Tick 22584999: Duration=4.46s, Transfers=14680306, TPS=3290103.91
2025-04-01 07:00:11,260 - INFO - Tick 22585000: Duration=10.68s, Transfers=18319694, TPS=1715897.97
2025-04-01 07:00:14,452 - INFO - Tick 22585001: Duration=3.18s, Transfers=0, TPS=0.00
2025-04-01 07:00:17,635 - INFO - Tick 22585002: Duration=3.18s, Transfers=30587358, TPS=9615962.99
2025-04-01 07:00:20,788 - INFO - Tick 22585003: Duration=3.18s, Transfers=47133628, TPS=14823964.75
2025-04-01 07:00:55,075 - INFO - Tick 22585004: Duration=34.29s, Transfers=37779014, TPS=1101726.55
2025-04-01 07:00:58,245 - INFO - Tick 22585005: Duration=3.15s, Transfers=0, TPS=0.00
2025-04-01 07:01:01,424 - INFO - Tick 22585006: Duration=3.16s, Transfers=33562024, TPS=10609645.75
2025-04-01 07:01:33,737 - INFO - Tick 22585008: Duration=32.21s, Transfers=65437976, TPS=2031673.73
2025-04-01 07:01:37,092 - INFO - Tick 22585009: Duration=3.29s, Transfers=0, TPS=0.00
2025-04-01 07:01:40,299 - INFO - Tick 22585010: Duration=3.35s, Transfers=23359709, TPS=6980817.97
2025-04-01 07:01:43,546 - INFO - Tick 22585011: Duration=3.21s, Transfers=48633037, TPS=15150950.14
2025-04-01 07:02:10,777 - INFO - Tick 22585012: Duration=27.11s, Transfers=27007254, TPS=996219.45
2025-04-01 07:02:16,324 - INFO - Test Ending At Tick: 22585012


2025-04-01 07:02:16,324 - INFO - Total unique TxHashes: 169
Tick data has been written to qubic_benchmark_tick_data20250401_070216_UTC.json
2025-04-01 07:02:16,326 - INFO - === Summary ===
2025-04-01 07:02:16,326 - INFO - Total Ticks: 46
2025-04-01 07:02:16,326 - INFO - Total TxHashes: 169
2025-04-01 07:02:16,326 - INFO - Total Transfers: 726000000
2025-04-01 07:02:16,326 - INFO - Average Transfers per Tick: 21352941.18
2025-04-01 07:02:16,326 - INFO - Average Tick Time (from duration): 6.52 seconds
2025-04-01 07:02:16,326 - INFO - Average Tick Time (measured): 8.98 seconds
2025-04-01 07:02:16,326 - INFO - Number Of Transfers Per Second (TPS) (from total): 2420000.00
2025-04-01 07:02:16,326 - INFO - Average TPS (from measurements): 4119986.50
2025-04-01 07:02:16,326 - INFO - Max Tick TPS: 15527637.74
2025-04-01 07:02:16,327 - INFO - Min Tick TPS: 0.00
2025-04-01 07:02:16,327 - INFO - Max Tick Duration: 34.29 seconds
2025-04-01 07:02:16,327 - INFO - Min Tick Duration: 1.20 seconds
Overall Progress:
100%|████████████████████████████████████████████████████████████████████████| 20/20
[20:Overall Progress:
100%|████████████████████████████████████████████████████████████████████████| 20/20
[20:40<00:00, 62.02s/min]

All tests completed. Comparing results...
Log files generated: qubic_benchmark_integrate_1_20250401_064135_UTC.log, qubic_benchmark_integrate_2_20250401_065656_UTC.log

Benchmark Comparison (Sorted by TPS):

Test Information:
+--------+---------------------+---------------------+------------+---------------+
| Test   | Start Time          | End Time            | Duration   | Account Num   |
+========+=====================+=====================+============+===============+
| Test 1 | 2025-04-01 06:41:40 | 2025-04-01 06:46:56 | 5 minutes  |   16500000    |
```

```
+---------+-----------------------+-----------------------+-------------+-----------------+
| Test 2  | 2025-04-01 06:57:02   | 2025-04-01 07:02:16   | 5 minutes   |     16500000    |
+---------+-----------------------+-----------------------+-------------+-----------------+
```

Tick Information:

```
+--------+---------------+------------+--------------+--------------+---------------+--------------------+--------------------+
| Test   |   Start Tick  |  End Tick  |  Tick Range  |  Total Ticks |  Avg Tick Time | Min Tick Duration  | Max Tick Duration  |
+========+===============+============+==============+==============+===============+====================+====================+
| Test 1 |   22584476    |  22584515  |       39     |      40      | 7.50s         | 1.18s              | 45.32s             |
+--------+---------------+------------+--------------+--------------+---------------+--------------------+--------------------+
| Test 2 |   22584967    |  22585012  |       45     |      46      | 6.52s         | 1.20s              | 34.29s             |
+--------+---------------+------------+--------------+--------------+---------------+--------------------+--------------------+
```

Performance Metrics:

```
+--------+------------------+---------------------+-------------+--------------+---------------+------------------+------------------+----------------------+
| Test   |  Total Transfers |  Avg Transfers/Tick |  Overall TPS | Min Tick TPS |  Max Tick TPS | Transfer/Tick Min | Transfer/Tick Max | Transfer/Tick Variance |
+========+==================+=====================+=============+==============+===============+==================+==================+======================+
| Test 1 |    792000000     |     2.64e+07        |  2.64e+06   |      0       | 1.53329e+07   |       0          | 1.08829e+08      |    6.77438e+14       |
+--------+------------------+---------------------+-------------+--------------+---------------+------------------+------------------+----------------------+
| Test 2 |    726000000     |     2.13529e+07     |  2.42e+06   |      0       | 1.55276e+07   |       0          | 6.5438e+07       |    3.93653e+14       |
+--------+------------------+---------------------+-------------+--------------+---------------+------------------+------------------+----------------------+
```

Test report saved to: qubic_benchmark_integration_report_20250401_070216_UTC.json

```
=================================================
Test Report (INTEGRATION)
=================================================
```

Timestamp: 20250401_070216
Number of tests: 2

Test Information:

```
+--------+-----------------------+-----------------------+-------------+-----------------+
| Test   | Start Time            | End Time              | Duration    |  Account Num    |
+========+=======================+=======================+=============+=================+
| Test 1 | 2025-04-01 06:41:40   | 2025-04-01 06:46:56   | 5 minutes   |     16500000    |
+--------+-----------------------+-----------------------+-------------+-----------------+
| Test 2 | 2025-04-01 06:57:02   | 2025-04-01 07:02:16   | 5 minutes   |     16500000    |
+--------+-----------------------+-----------------------+-------------+-----------------+
```

Tick Information:

```
+--------+---------------+------------+--------------+--------------+---------------+--------------------+--------------------+
| Test   |   Start Tick  |  End Tick  |  Tick Range  |  Total Ticks |  Avg Tick Time | Min Tick Duration  | Max Tick Duration  |
+========+===============+============+==============+==============+===============+====================+====================+
| Test 1 |   22584476    |  22584515  |       39     |      40      | 7.50s         | 1.18s              | 45.32s             |
+--------+---------------+------------+--------------+--------------+---------------+--------------------+--------------------+
| Test 2 |   22584967    |  22585012  |       45     |      46      | 6.52s         | 1.20s              | 34.29s             |
+--------+---------------+------------+--------------+--------------+---------------+--------------------+--------------------+
```

Performance Metrics:

```
+--------+------------------+---------------------+-------------+--------------+---------------+------------------+------------------+----------------------+
| Test   |  Total Transfers |  Avg Transfers/Tick |  Overall TPS | Min Tick TPS |  Max Tick TPS | Transfer/Tick Min | Transfer/Tick Max | Transfer/Tick Variance |
+========+==================+=====================+=============+==============+===============+==================+==================+======================+
| Test 1 |    792000000     |     2.64e+07        |  2.64e+06   |      0       | 1.53329e+07   |       0          | 1.08829e+08      |    6.77438e+14       |
+--------+------------------+---------------------+-------------+--------------+---------------+------------------+------------------+----------------------+
| Test 2 |    726000000     |     2.13529e+07     |  2.42e+06   |      0       | 1.55276e+07   |       0          | 6.5438e+07       |    3.93653e+14       |
+--------+------------------+---------------------+-------------+--------------+---------------+------------------+------------------+----------------------+
```

Comparative Analysis:

```
+--------+---------------+------------------+-----------------+-----------------+----------------------+----------------------+
| Test   |  Overall TPS  |  TPS Diff (Avg)  |  TPS Diff (Max) |  Total Transfers | Transfers Diff (Avg) |  Transfers Diff (Max) |
+========+===============+==================+=================+=================+======================+======================+
| Test 1 |   2.64e+06    |     110000       |       0         |    792000000    |     3.3e+07          |        0             |
+--------+---------------+------------------+-----------------+-----------------+----------------------+----------------------+
| Test 2 |   2.42e+06    |     -110000      |    -220000      |    726000000    |     -3.3e+07         |    -6.6e+07          |
+--------+---------------+------------------+-----------------+-----------------+----------------------+----------------------+
```

Summary Statistics:

```
+--------------------------+---------------+
| Metric                   | Value         |
+==========================+===============+
| Average TPS              | 2530000.00    |
+--------------------------+---------------+
| Maximum TPS              | 2640000.00    |
+--------------------------+---------------+
| Average Total Transfers  | 759000000.00  |
```

```
+---------------------------+--------------+
| Maximum Total Transfers | 792000000.00 |
+---------------------------+--------------+
| Highest Tick TPS        | 15527637.74  |
+---------------------------+--------------+
| Lowest Tick TPS         | 0.00         |
+---------------------------+--------------+
| Longest Tick Duration   | 45.32s       |
+---------------------------+--------------+
| Shortest Tick Duration  | 1.18s        |
+---------------------------+--------------+

Detailed logs stored in:
   - qubic_benchmark_integrate_1_20250401_064135_UTC.log
   - qubic_benchmark_integrate_2_20250401_065656_UTC.log
```

During the testing on mainnet, the highest average TPS reached **2.64 million**, while the peak tick TPS achieved **15.52 million**. The detailed experimental results data can be found in the appendix.

Data Analysis

Testnet Performance Testing

The testnet evaluation revealed significant performance variability across three 5-minute stress tests.

- **Tick Duration Performance:**
  - Average: 6.52s to 7.50s
  - Range: 3.17s (minimum) to 48.58s (maximum)
- **Transaction Per Second (TPS):**
  - Peak TPS: 3.31 million
  - Average TPS: 0.99 million to 1.57 million
- **Transaction Volume:**
  - Total transfers: 297 million to 470 million
  - Per-tick variance range: 1.18×10^{14} to 1.08×10^{15}

Observed instability may be partially attributed to debugging overhead, such as instrumentation in testnet nodes, rather than inherent core protocol limitations. Mainnet performance may differ due to the diagnostic constraints of the testnet.

Mainnet Performance Testing

- **Tick Duration Performance:**
    - Average: 8.11s to 11.11s
    - Range: 1.18s (minimum) to 45.32s (maximum)
- **Transaction Per Second (TPS):**
    - Peak TPS: ~15.52 million(consistent in both 2 tests)
    - Average TPS: 2.42 million to 2.64 million
- **Transaction Volume:**
    - Total transfers: 726 million to 792 million
    - Per-tick variance range: 3.93×10^{14} to 6.77×10^{14}

The tests demonstrate Qubic's robust capacity to handle high transaction volumes, with consistent peak throughput of ~15.52M TPS and stable average performance (2.42–2.64M TPS). While tick durations show variability (1.18s–45.32s) and intermittent zero-TPS ticks occur, the network maintains efficient processing under load. Test 2's improved metrics (shorter max tick duration and lower variance) suggest optimizations are effective, though systemic factors like network congestion may still impact stability. The ability to process up to 108M transfers per tick underscores Qubic's high-throughput potential, with room for further refinement in consistency.

In conclusion, the network demonstrates a robust peak throughput, registering approximately **15.52 million TPS**, Qubic demonstrates robust performance in handling massive transaction volumes, showcasing its strong capability to process high-throughput workloads effectively.

Results

The performance tests conducted by CertiK on Qubic's mainnet demonstrate the network's exceptional capability in handling massive transaction volumes under real-world conditions, processing over 1.5 billion transactions cumulatively while maintaining an impressive average throughput of 2.53 million TPS and peaking at **15.52 million TPS**.

These mainnet results are particularly noteworthy as they reflect the network's true production performance without testnet limitations, showcasing Qubic's operational readiness for large-scale deployment. Despite observed fluctuations in tick durations (ranging from 1.18s to 45.32s) and occasional empty ticks - common challenges in live blockchain environments - the network exhibited remarkable resilience under sustained 5-minute stress tests.

The mainnet environment proved the robustness of Qubic's architecture, which successfully maintained sub-10 second average tick times (6.52s-7.50s) while processing up to 108 million transfers per tick, demonstrating reliable performance for enterprise-grade applications requiring high-volume transaction processing.

These results, achieved on the live network with real economic stakes, confirm Qubic's position as a production-ready blockchain solution capable of supporting financial systems and other high-throughput use cases, while the consistent performance across tests indicates a solid foundation for further optimizations in tick consistency and stability under mainnet conditions.

Appendix

This section contains all the output results

Testnet Performance Testing Result

1. qubic_benchmark_integrate_1_20250326_084152_UTC.log

```
Unset
2025-03-26 08:41:52,787 - INFO - Test Parameters:
2025-03-26 08:41:52,788 - INFO -   Duration: 5 minutes
2025-03-26 08:41:52,788 - INFO -   Account Number: 16500000
2025-03-26 08:41:57,394 - INFO - Test Starting At Tick: 22177114

2025-03-26 08:42:05,905 - INFO - Tick 22177114: Duration=5.25s, Transfers=0, TPS=0.00
2025-03-26 08:42:41,174 - INFO - Tick 22177115: Duration=35.02s, Transfers=0, TPS=0.00
2025-03-26 08:42:45,716 - INFO - Tick 22177116: Duration=4.79s, Transfers=0, TPS=0.00
2025-03-26 08:42:49,003 - INFO - Tick 22177117: Duration=3.26s, Transfers=0, TPS=0.00
2025-03-26 08:42:53,721 - INFO - Tick 22177118: Duration=4.52s, Transfers=0, TPS=0.00
2025-03-26 08:43:42,169 - INFO - Tick 22177119: Duration=48.58s, Transfers=99000000, TPS=2038078.55
2025-03-26 08:43:45,538 - INFO - Tick 22177120: Duration=3.36s, Transfers=2060, TPS=613.29
2025-03-26 08:43:48,845 - INFO - Tick 22177121: Duration=3.37s, Transfers=4236202, TPS=1256248.14
2025-03-26 08:44:23,917 - INFO - Tick 22177123: Duration=35.14s, Transfers=78265768, TPS=2227386.61
2025-03-26 08:44:27,186 - INFO - Tick 22177124: Duration=3.24s, Transfers=3545, TPS=1093.14
2025-03-26 08:44:30,376 - INFO - Tick 22177125: Duration=3.26s, Transfers=7154709, TPS=2192052.11
2025-03-26 08:44:33,692 - INFO - Tick 22177126: Duration=3.19s, Transfers=7960892, TPS=2492126.17
2025-03-26 08:44:58,399 - INFO - Tick 22177127: Duration=24.66s, Transfers=50884399, TPS=2063404.57
2025-03-26 08:45:38,317 - INFO - Tick 22177128: Duration=40.03s, Transfers=66011945, TPS=1648956.66
2025-03-26 08:45:42,833 - INFO - Tick 22177129: Duration=4.58s, Transfers=0, TPS=0.00
2025-03-26 08:45:46,065 - INFO - Tick 22177131: Duration=3.17s, Transfers=0, TPS=0.00
2025-03-26 08:46:17,939 - INFO - Tick 22177132: Duration=31.77s, Transfers=66001435, TPS=2077425.70
2025-03-26 08:46:21,165 - INFO - Tick 22177133: Duration=3.35s, Transfers=1160, TPS=346.45
2025-03-26 08:46:24,408 - INFO - Tick 22177134: Duration=3.21s, Transfers=0, TPS=0.00
2025-03-26 08:46:28,916 - INFO - Tick 22177135: Duration=4.44s, Transfers=4781215, TPS=1076561.40
2025-03-26 08:46:59,459 - INFO - Tick 22177136: Duration=30.57s, Transfers=77722115, TPS=2542813.77
2025-03-26 08:47:03,986 - INFO - Tick 22177137: Duration=4.54s, Transfers=0, TPS=0.00
2025-03-26 08:47:08,671 - INFO - Test Ending At Tick: 22177140

2025-03-26 08:47:08,672 - INFO - Total unique TxHashes: 134
2025-03-26 08:47:08,676 - INFO - === Summary ===
2025-03-26 08:47:08,676 - INFO - Total Ticks: 27
2025-03-26 08:47:08,676 - INFO - Total TxHashes: 134
2025-03-26 08:47:08,676 - INFO - Total Transfers: 469577006
2025-03-26 08:47:08,677 - INFO - Average Transfers per Tick: 21344409.36
2025-03-26 08:47:08,677 - INFO - Average Tick Time (from duration): 11.11 seconds
2025-03-26 08:47:08,677 - INFO - Average Tick Time (measured): 13.79 seconds
2025-03-26 08:47:08,677 - INFO - Number Of Transfers Per Second (TPS) (from total): 1565256.69
2025-03-26 08:47:08,677 - INFO - Average TPS (from measurements): 891686.66
2025-03-26 08:47:08,677 - INFO - Max Tick TPS: 2542813.77
2025-03-26 08:47:08,678 - INFO - Min Tick TPS: 0.00
2025-03-26 08:47:08,678 - INFO - Max Tick Duration: 48.58 seconds
2025-03-26 08:47:08,678 - INFO - Min Tick Duration: 3.17 seconds
```

2. qubic_benchmark_integrate_2_20250326_084808_UTC.log

```
Unset
2025-03-26 08:48:08,688 - INFO - Test Parameters:
2025-03-26 08:48:08,688 - INFO -    Duration: 5 minutes
2025-03-26 08:48:08,688 - INFO -    Account Number: 16500000
2025-03-26 08:48:13,687 - INFO - Test Starting At Tick: 22177142

2025-03-26 08:48:29,445 - INFO - Tick 22177142: Duration=12.17s, Transfers=35669963, TPS=2930901.55
2025-03-26 08:48:37,688 - INFO - Tick 22177143: Duration=8.57s, Transfers=15063027, TPS=1758351.94
2025-03-26 08:48:42,217 - INFO - Tick 22177144: Duration=4.49s, Transfers=0, TPS=0.00
2025-03-26 08:48:49,232 - INFO - Tick 22177145: Duration=6.98s, Transfers=760, TPS=108.89
2025-03-26 08:48:57,357 - INFO - Tick 22177146: Duration=8.26s, Transfers=8275, TPS=1002.17
2025-03-26 08:49:13,315 - INFO - Tick 22177147: Duration=15.64s, Transfers=14276789, TPS=913122.85
2025-03-26 08:49:20,385 - INFO - Tick 22177148: Duration=7.41s, Transfers=2224796, TPS=300281.88
2025-03-26 08:49:25,042 - INFO - Tick 22177149: Duration=4.42s, Transfers=1510, TPS=341.30
2025-03-26 08:49:29,752 - INFO - Tick 22177150: Duration=4.65s, Transfers=0, TPS=0.00
2025-03-26 08:49:36,894 - INFO - Tick 22177151: Duration=5.96s, Transfers=0, TPS=0.00
2025-03-26 08:49:41,399 - INFO - Tick 22177152: Duration=6.00s, Transfers=0, TPS=0.00
2025-03-26 08:50:10,443 - INFO - Tick 22177153: Duration=28.83s, Transfers=0, TPS=0.00
2025-03-26 08:50:21,494 - INFO - Tick 22177154: Duration=11.26s, Transfers=0, TPS=0.00
2025-03-26 08:50:27,015 - INFO - Tick 22177155: Duration=4.46s, Transfers=0, TPS=0.00
2025-03-26 08:50:34,212 - INFO - Tick 22177157: Duration=7.96s, Transfers=0, TPS=0.00
2025-03-26 08:50:38,747 - INFO - Tick 22177158: Duration=4.84s, Transfers=0, TPS=0.00
2025-03-26 08:50:52,747 - INFO - Tick 22177159: Duration=13.82s, Transfers=0, TPS=0.00
2025-03-26 08:50:59,717 - INFO - Tick 22177160: Duration=7.04s, Transfers=2955, TPS=419.91
2025-03-26 08:51:04,162 - INFO - Tick 22177161: Duration=4.49s, Transfers=1507467, TPS=335436.92
2025-03-26 08:51:08,591 - INFO - Tick 22177162: Duration=4.45s, Transfers=10667588, TPS=2396453.10
2025-03-26 08:51:40,065 - INFO - Tick 22177163: Duration=31.35s, Transfers=60409785, TPS=1927098.36
2025-03-26 08:51:44,597 - INFO - Tick 22177164: Duration=4.59s, Transfers=9930560, TPS=2163433.98
2025-03-26 08:51:48,093 - INFO - Tick 22177165: Duration=3.29s, Transfers=360, TPS=109.51
2025-03-26 08:51:52,658 - INFO - Tick 22177166: Duration=4.70s, Transfers=6288546, TPS=1338120.25
2025-03-26 08:51:55,974 - INFO - Tick 22177167: Duration=3.35s, Transfers=7997614, TPS=2385748.76
2025-03-26 08:52:38,185 - INFO - Tick 22177168: Duration=42.36s, Transfers=63909361, TPS=1508758.39
2025-03-26 08:52:47,737 - INFO - Tick 22177169: Duration=9.38s, Transfers=22924882, TPS=2445037.51
2025-03-26 08:52:52,209 - INFO - Tick 22177170: Duration=4.55s, Transfers=11516291, TPS=2530932.84
2025-03-26 08:52:56,739 - INFO - Tick 22177171: Duration=4.48s, Transfers=11238668, TPS=2505880.98
2025-03-26 08:53:10,871 - INFO - Tick 22177172: Duration=14.22s, Transfers=8135163, TPS=572152.10
2025-03-26 08:53:15,274 - INFO - Tick 22177173: Duration=4.46s, Transfers=0, TPS=0.00
2025-03-26 08:53:20,066 - INFO - Tick 22177174: Duration=4.64s, Transfers=5318123, TPS=1145291.45
2025-03-26 08:53:24,460 - INFO - Test Ending At Tick: 22177168

2025-03-26 08:53:24,460 - INFO - Total unique TxHashes: 237
2025-03-26 08:53:24,473 - INFO - === Summary ===
2025-03-26 08:53:24,474 - INFO - Total Ticks: 27
2025-03-26 08:53:24,474 - INFO - Total TxHashes: 237
2025-03-26 08:53:24,474 - INFO - Total Transfers: 297611769
2025-03-26 08:53:24,475 - INFO - Average Transfers per Tick: 9300367.78
2025-03-26 08:53:24,475 - INFO - Average Tick Time (from duration): 11.11 seconds
2025-03-26 08:53:24,475 - INFO - Average Tick Time (measured): 9.47 seconds
2025-03-26 08:53:24,476 - INFO - Number Of Transfers Per Second (TPS) (from total): 992039.23
2025-03-26 08:53:24,476 - INFO - Average TPS (from measurements): 848718.27
2025-03-26 08:53:24,476 - INFO - Max Tick TPS: 2930901.55
2025-03-26 08:53:24,476 - INFO - Min Tick TPS: 0.00
2025-03-26 08:53:24,476 - INFO - Max Tick Duration: 42.36 seconds
2025-03-26 08:53:24,477 - INFO - Min Tick Duration: 3.29 seconds
```

3. qubic_benchmark_integrate_3_20250326_085424_UTC.log

```
Unset
2025-03-26 08:54:24,498 - INFO - Test Parameters:
2025-03-26 08:54:24,498 - INFO -   Duration: 5 minutes
2025-03-26 08:54:24,499 - INFO -   Account Number: 16500000
2025-03-26 08:54:29,016 - INFO - Test Starting At Tick: 22177183

2025-03-26 08:54:35,980 - INFO - Tick 22177183: Duration=3.80s, Transfers=12594777, TPS=3314264.91
2025-03-26 08:54:42,740 - INFO - Tick 22177184: Duration=6.75s, Transfers=3905858, TPS=578679.83
2025-03-26 08:54:47,459 - INFO - Tick 22177185: Duration=4.49s, Transfers=8594200, TPS=1913398.95
2025-03-26 08:54:52,229 - INFO - Tick 22177186: Duration=5.03s, Transfers=11651028, TPS=2318223.67
2025-03-26 08:54:59,575 - INFO - Tick 22177187: Duration=7.03s, Transfers=18280258, TPS=2598996.23
2025-03-26 08:55:04,542 - INFO - Tick 22177188: Duration=5.03s, Transfers=11629908, TPS=2311631.02
2025-03-26 08:55:14,517 - INFO - Tick 22177189: Duration=10.18s, Transfers=15847041, TPS=1556019.95
2025-03-26 08:55:23,900 - INFO - Tick 22177190: Duration=9.33s, Transfers=5230, TPS=560.45
2025-03-26 08:55:28,546 - INFO - Tick 22177191: Duration=4.61s, Transfers=6265, TPS=1358.83
2025-03-26 08:55:34,581 - INFO - Tick 22177192: Duration=6.04s, Transfers=0, TPS=0.00
2025-03-26 08:55:42,846 - INFO - Tick 22177193: Duration=8.22s, Transfers=9511061, TPS=1156556.14
2025-03-26 08:55:48,586 - INFO - Tick 22177194: Duration=4.68s, Transfers=6992009, TPS=1493569.39
2025-03-26 08:55:53,124 - INFO - Tick 22177195: Duration=5.73s, Transfers=2684377, TPS=468389.69
2025-03-26 08:56:01,135 - INFO - Tick 22177196: Duration=8.02s, Transfers=13817503, TPS=1722028.68
2025-03-26 08:56:05,590 - INFO - Tick 22177197: Duration=4.46s, Transfers=10691058, TPS=2397021.43
2025-03-26 08:56:16,893 - INFO - Tick 22177198: Duration=10.88s, Transfers=5813444, TPS=534445.52
2025-03-26 08:56:26,414 - INFO - Tick 22177199: Duration=9.93s, Transfers=16499813, TPS=1661608.23
2025-03-26 08:56:29,619 - INFO - Tick 22177200: Duration=3.18s, Transfers=0, TPS=0.00
2025-03-26 08:56:34,166 - INFO - Tick 22177201: Duration=4.45s, Transfers=743830, TPS=167095.77
2025-03-26 08:56:42,214 - INFO - Tick 22177202: Duration=8.18s, Transfers=15756170, TPS=1927198.95
2025-03-26 08:56:45,433 - INFO - Tick 22177203: Duration=3.17s, Transfers=0, TPS=0.00
2025-03-26 08:56:54,687 - INFO - Tick 22177204: Duration=9.25s, Transfers=16501295, TPS=1784415.13
2025-03-26 08:57:16,502 - INFO - Tick 22177205: Duration=21.65s, Transfers=26804280, TPS=1238202.12
2025-03-26 08:57:21,025 - INFO - Tick 22177206: Duration=4.72s, Transfers=6195720, TPS=1312456.23
2025-03-26 08:57:26,734 - INFO - Tick 22177207: Duration=4.55s, Transfers=7073441, TPS=1555169.44
2025-03-26 08:57:34,832 - INFO - Tick 22177208: Duration=9.27s, Transfers=9427719, TPS=1016493.92
2025-03-26 08:57:39,273 - INFO - Tick 22177209: Duration=4.45s, Transfers=6788805, TPS=1525243.75
2025-03-26 08:57:59,358 - INFO - Tick 22177210: Duration=19.92s, Transfers=42711765, TPS=2144249.11
2025-03-26 08:58:06,409 - INFO - Tick 22177211: Duration=7.17s, Transfers=1920, TPS=267.76
2025-03-26 08:58:10,821 - INFO - Tick 22177212: Duration=4.42s, Transfers=2088382, TPS=472346.95
2025-03-26 08:58:14,003 - INFO - Tick 22177213: Duration=3.20s, Transfers=7662702, TPS=2392374.82
2025-03-26 08:58:34,685 - INFO - Tick 22177214: Duration=20.43s, Transfers=33206820, TPS=1625381.40
2025-03-26 08:58:39,445 - INFO - Tick 22177215: Duration=4.75s, Transfers=6545016, TPS=1377260.53
2025-03-26 08:58:46,180 - INFO - Tick 22177217: Duration=7.01s, Transfers=120, TPS=17.12
2025-03-26 08:58:51,960 - INFO - Tick 22177218: Duration=5.67s, Transfers=0, TPS=0.00
2025-03-26 08:59:14,954 - INFO - Tick 22177219: Duration=23.02s, Transfers=44864311, TPS=1948642.41
2025-03-26 08:59:21,794 - INFO - Tick 22177220: Duration=6.88s, Transfers=4640944, TPS=674765.71
2025-03-26 08:59:26,306 - INFO - Tick 22177221: Duration=4.51s, Transfers=0, TPS=0.00
2025-03-26 08:59:34,767 - INFO - Tick 22177223: Duration=8.46s, Transfers=8389130, TPS=991497.27
2025-03-26 08:59:39,184 - INFO - Test Ending At Tick: 22177219
2025-03-26 08:59:39,184 - INFO - Total unique TxHashes: 332
2025-03-26 08:59:39,188 - INFO - === Summary ===
2025-03-26 08:59:39,188 - INFO - Total Ticks: 37
2025-03-26 08:59:39,188 - INFO - Total TxHashes: 332
2025-03-26 08:59:39,188 - INFO - Total Transfers: 397216430
2025-03-26 08:59:39,189 - INFO - Average Transfers per Tick: 10185036.67
2025-03-26 08:59:39,189 - INFO - Average Tick Time (from duration): 8.11 seconds
2025-03-26 08:59:39,189 - INFO - Average Tick Time (measured): 7.76 seconds
2025-03-26 08:59:39,189 - INFO - Number Of Transfers Per Second (TPS) (from total): 1324054.77
2025-03-26 08:59:39,189 - INFO - Average TPS (from measurements): 1184098.24
2025-03-26 08:59:39,189 - INFO - Max Tick TPS: 3314264.91
2025-03-26 08:59:39,189 - INFO - Min Tick TPS: 0.00
2025-03-26 08:59:39,190 - INFO - Max Tick Duration: 23.02 seconds
2025-03-26 08:59:39,190 - INFO - Min Tick Duration: 3.17 seconds
```

CERTIK

4. qubic_benchmark_integration_report_20250326_085939_UTC.json

```
Unset
{
    "test_type": "integration",
    "timestamp": "20250326_085939",
    "log_files": [
        "qubic_benchmark_integrate_1_20250326_084152_UTC.log",
        "qubic_benchmark_integrate_2_20250326_084808_UTC.log",
        "qubic_benchmark_integrate_3_20250326_085424_UTC.log"
    ],
    "comparison_data": {
        "headers": [
            "Filename",
            "Test Start Time",
            "Test End Time",
            "Test Duration",
            "Account Num",
            "Start Tick",
            "End Tick",
            "Tick Range",
            "Average Tick Time",
            "Min Tick Duration",
            "Max Tick Duration",
            "Total Unique TxHashes",
            "Total Ticks",
            "Total Transfers",
            "Avg Transfers/Tick",
            "Overall TPS",
            "Min Tick TPS",
            "Max Tick TPS",
            "Transfer/Tick Min",
            "Transfer/Tick Max",
            "Transfer/Tick Variance",
            "Total Transfers Diff from Avg",
            "Total Transfers Diff from Max",
            "TPS Diff from Avg",
            "TPS Diff from Max"
        ],
        "data": [
            {
                "Filename": "qubic_benchmark_integrate_1_20250326_084152_UTC.log",
                "Test Start Time": "2025-03-26 08:41:57",
                "Test End Time": "2025-03-26 08:47:08",
                "Test Duration": "5 minutes",
                "Account Num": 16500000,
                "Start Tick": 22177114,
                "End Tick": 22177140,
                "Tick Range": 26,
                "Average Tick Time": "11.11s",
                "Min Tick Duration": "3.17s",
                "Max Tick Duration": "48.58s",
                "Total Unique TxHashes": 134,
                "Total Ticks": 27,
                "Total Transfers": 469577006,
                "Avg Transfers/Tick": "21344409.36",
                "Overall TPS": "1565256.69",
                "Min Tick TPS": "0.00",
                "Max Tick TPS": "2542813.77",
                "Transfer/Tick Min": "0.00",
                "Transfer/Tick Max": "99000000.00",
                "Transfer/Tick Variance": "1078297652378847.25",
```

```
                    "Total Transfers Diff from Avg": "+81441937.67",
                    "Total Transfers Diff from Max": "+0.00",
                    "TPS Diff from Avg": "+271473.13",
                    "TPS Diff from Max": "+0.00"
                },
                {
                    "Filename": "qubic_benchmark_integrate_3_20250326_085424_UTC.log",
                    "Test Start Time": "2025-03-26 08:54:29",
                    "Test End Time": "2025-03-26 08:59:39",
                    "Test Duration": "5 minutes",
                    "Account Num": 16500000,
                    "Start Tick": 22177183,
                    "End Tick": 22177219,
                    "Tick Range": 36,
                    "Average Tick Time": "8.11s",
                    "Min Tick Duration": "3.17s",
                    "Max Tick Duration": "23.02s",
                    "Total Unique TxHashes": 332,
                    "Total Ticks": 37,
                    "Total Transfers": 399216430,
                    "Avg Transfers/Tick": "10185036.67",
                    "Overall TPS": "1324054.77",
                    "Min Tick TPS": "0.00",
                    "Max Tick TPS": "3314264.91",
                    "Transfer/Tick Min": "0.00",
                    "Transfer/Tick Max": "44864311.00",
                    "Transfer/Tick Variance": "118046476870116.33",
                    "Total Transfers Diff from Avg": "+9081361.67",
                    "Total Transfers Diff from Max": "-72360576.00",
                    "TPS Diff from Avg": "+30271.21",
                    "TPS Diff from Max": "-241201.92"
                },
                {
                    "Filename": "qubic_benchmark_integrate_2_20250326_084808_UTC.log",
                    "Test Start Time": "2025-03-26 08:48:13",
                    "Test End Time": "2025-03-26 08:53:24",
                    "Test Duration": "5 minutes",
                    "Account Num": 16500000,
                    "Start Tick": 22177142,
                    "End Tick": 22177168,
                    "Tick Range": 26,
                    "Average Tick Time": "11.11s",
                    "Min Tick Duration": "3.29s",
                    "Max Tick Duration": "42.36s",
                    "Total Unique TxHashes": 237,
                    "Total Ticks": 27,
                    "Total Transfers": 297611769,
                    "Avg Transfers/Tick": "9300367.78",
                    "Overall TPS": "992039.23",
                    "Min Tick TPS": "0.00",
                    "Max Tick TPS": "2930901.55",
                    "Transfer/Tick Min": "0.00",
                    "Transfer/Tick Max": "63909361.00",
                    "Transfer/Tick Variance": "251975479818367.62",
                    "Total Transfers Diff from Avg": "-90523299.33",
                    "Total Transfers Diff from Max": "-171965237.00",
                    "TPS Diff from Avg": "-301744.33",
                    "TPS Diff from Max": "-573217.46"
                }
            ],
            "summary": {
```

```
            "total_transfers_avg": "388135068.33",
            "total_transfers_max": "469577006.00",
            "tps_avg": "1293783.56",
            "tps_max": "1565256.69",
            "test_count": 3
        }
    },
    "summary": {
        "total_tests": 3,
        "avg_tps": "1293783.56",
        "max_tps": "1565256.69",
        "avg_transfers": "388135068.33",
        "max_transfers": "469577006.00"
    }
}
```

Mainnet Performance Testing Result

1. qubic_benchmark_integrate_1_20250401_064135_UTC.log

```
Unset
2025-04-01 06:41:35,937 - INFO - Test Parameters:
2025-04-01 06:41:35,937 - INFO -   Duration: 5 minutes
2025-04-01 06:41:35,937 - INFO -   Account Number: 16500000
2025-04-01 06:41:40,361 - INFO - Test Starting At Tick: 22584476

2025-04-01 06:41:44,709 - INFO - Tick 22584476: Duration=1.18s, Transfers=0, TPS=0.00
2025-04-01 06:41:47,914 - INFO - Tick 22584480: Duration=3.17s, Transfers=0, TPS=0.00
2025-04-01 06:41:51,078 - INFO - Tick 22584481: Duration=3.21s, Transfers=0, TPS=0.00
2025-04-01 06:41:54,524 - INFO - Tick 22584482: Duration=3.16s, Transfers=0, TPS=0.00
2025-04-01 06:41:57,732 - INFO - Tick 22584483: Duration=3.45s, Transfers=0, TPS=0.00
2025-04-01 06:42:17,529 - INFO - Tick 22584486: Duration=19.81s, Transfers=33000000, TPS=1665413.15
2025-04-01 06:42:20,928 - INFO - Tick 22584487: Duration=3.19s, Transfers=31578553, TPS=9902048.71
2025-04-01 06:42:24,091 - INFO - Tick 22584488: Duration=3.40s, Transfers=1421447, TPS=418346.54
2025-04-01 06:42:33,577 - INFO - Tick 22584490: Duration=9.50s, Transfers=23171352, TPS=2440137.18
2025-04-01 06:43:18,937 - INFO - Tick 22584491: Duration=45.32s, Transfers=108828648, TPS=2401423.47
2025-04-01 06:43:22,104 - INFO - Tick 22584492: Duration=3.20s, Transfers=0, TPS=0.00
2025-04-01 06:43:27,657 - INFO - Tick 22584494: Duration=5.54s, Transfers=33000918, TPS=5954317.32
2025-04-01 06:44:07,156 - INFO - Tick 22584495: Duration=39.50s, Transfers=82499082, TPS=2088784.40
2025-04-01 06:44:10,327 - INFO - Tick 22584496: Duration=3.18s, Transfers=0, TPS=0.00
2025-04-01 06:44:13,500 - INFO - Tick 22584497: Duration=3.17s, Transfers=13436680, TPS=4233513.69
2025-04-01 06:44:16,690 - INFO - Tick 22584498: Duration=3.17s, Transfers=47502439, TPS=14998030.39
2025-04-01 06:44:53,178 - INFO - Tick 22584499: Duration=36.36s, Transfers=54560881, TPS=1500591.62
2025-04-01 06:44:57,343 - INFO - Tick 22584500: Duration=4.15s, Transfers=14420412, TPS=3476244.10
2025-04-01 06:45:00,528 - INFO - Tick 22584502: Duration=3.33s, Transfers=47685514, TPS=14305234.01
2025-04-01 06:45:25,767 - INFO - Tick 22584503: Duration=25.29s, Transfers=20394074, TPS=806440.42
2025-04-01 06:45:29,825 - INFO - Tick 22584504: Duration=4.05s, Transfers=0, TPS=0.00
2025-04-01 06:45:32,976 - INFO - Tick 22584505: Duration=3.15s, Transfers=36319757, TPS=11524151.72
2025-04-01 06:45:36,151 - INFO - Tick 22584506: Duration=3.15s, Transfers=47534215, TPS=15103139.36
2025-04-01 06:46:06,296 - INFO - Tick 22584507: Duration=30.14s, Transfers=15146028, TPS=502539.17
2025-04-01 06:46:09,757 - INFO - Tick 22584508: Duration=3.41s, Transfers=16500000, TPS=4832291.54
2025-04-01 06:46:13,035 - INFO - Tick 22584510: Duration=3.23s, Transfers=49500000, TPS=15332862.80
2025-04-01 06:46:38,754 - INFO - Tick 22584511: Duration=25.82s, Transfers=16500000, TPS=638959.25
2025-04-01 06:46:41,999 - INFO - Tick 22584512: Duration=3.18s, Transfers=16500000, TPS=5193590.08
2025-04-01 06:46:45,168 - INFO - Tick 22584513: Duration=3.24s, Transfers=47500316, TPS=14649140.03
2025-04-01 06:46:51,109 - INFO - Tick 22584515: Duration=5.54s, Transfers=34999684, TPS=6316143.23
2025-04-01 06:46:56,522 - INFO - Test Ending At Tick: 22584515

2025-04-01 06:46:56,523 - INFO - Total unique TxHashes: 144
2025-04-01 06:46:56,524 - INFO - === Summary ===
2025-04-01 06:46:56,524 - INFO - Total Ticks: 40
2025-04-01 06:46:56,524 - INFO - Total TxHashes: 144
2025-04-01 06:46:56,524 - INFO - Total Transfers: 792000000
2025-04-01 06:46:56,524 - INFO - Average Transfers per Tick: 26400000.00
2025-04-01 06:46:56,524 - INFO - Average Tick Time (from duration): 7.50 seconds
2025-04-01 06:46:56,524 - INFO - Average Tick Time (measured): 10.24 seconds
2025-04-01 06:46:56,525 - INFO - Number Of Transfers Per Second (TPS) (from total): 2640000.00
2025-04-01 06:46:56,525 - INFO - Average TPS (from measurements): 4609444.74
2025-04-01 06:46:56,525 - INFO - Max Tick TPS: 15332862.80
2025-04-01 06:46:56,525 - INFO - Min Tick TPS: 0.00
2025-04-01 06:46:56,525 - INFO - Max Tick Duration: 45.32 seconds
2025-04-01 06:46:56,525 - INFO - Min Tick Duration: 1.18 seconds
```

2. qubic_benchmark_integrate_2_20250401_065656_UTC.log

```
Unset
2025-04-01 06:56:56,588 - INFO - Test Parameters:
2025-04-01 06:56:56,589 - INFO -   Duration: 5 minutes
2025-04-01 06:56:56,589 - INFO -   Account Number: 16500000
2025-04-01 06:57:02,043 - INFO - Test Starting At Tick: 22584967

2025-04-01 06:57:06,414 - INFO - Tick 22584967: Duration=1.20s, Transfers=0, TPS=0.00
2025-04-01 06:57:09,634 - INFO - Tick 22584971: Duration=3.19s, Transfers=0, TPS=0.00
2025-04-01 06:57:14,118 - INFO - Tick 22584972: Duration=4.47s, Transfers=3519484, TPS=786943.41
2025-04-01 06:57:17,434 - INFO - Tick 22584977: Duration=3.23s, Transfers=50082113, TPS=15527637.74
2025-04-01 06:57:50,423 - INFO - Tick 22584978: Duration=33.11s, Transfers=45398403, TPS=1371175.33
2025-04-01 06:57:54,829 - INFO - Tick 22584979: Duration=4.43s, Transfers=13373959, TPS=3020839.21
2025-04-01 06:58:17,802 - INFO - Tick 22584983: Duration=23.01s, Transfers=52626041, TPS=2287257.88
2025-04-01 06:58:21,028 - INFO - Tick 22584984: Duration=3.14s, Transfers=0, TPS=0.00
2025-04-01 06:58:24,317 - INFO - Tick 22584985: Duration=3.22s, Transfers=18441538, TPS=5730362.77
2025-04-01 06:58:27,762 - INFO - Tick 22584986: Duration=3.30s, Transfers=31058462, TPS=9421950.46
2025-04-01 06:58:30,945 - INFO - Tick 22584987: Duration=3.44s, Transfers=0, TPS=0.00
2025-04-01 06:58:42,340 - INFO - Tick 22584988: Duration=11.41s, Transfers=0, TPS=0.00
2025-04-01 06:58:46,708 - INFO - Tick 22584989: Duration=4.38s, Transfers=8038839, TPS=1833561.68
2025-04-01 06:59:04,529 - INFO - Tick 22584990: Duration=17.78s, Transfers=41461161, TPS=2332385.41
2025-04-01 06:59:07,791 - INFO - Tick 22584992: Duration=3.19s, Transfers=16500000, TPS=5164873.58
2025-04-01 06:59:11,073 - INFO - Tick 22584993: Duration=3.27s, Transfers=49500000, TPS=15152743.90
2025-04-01 06:59:32,010 - INFO - Tick 22584994: Duration=20.92s, Transfers=0, TPS=0.00
2025-04-01 06:59:36,870 - INFO - Tick 22584995: Duration=4.51s, Transfers=16500000, TPS=3657094.74
2025-04-01 06:59:41,280 - INFO - Tick 22584996: Duration=4.84s, Transfers=0, TPS=0.00
2025-04-01 06:59:46,025 - INFO - Tick 22584997: Duration=4.41s, Transfers=33000000, TPS=7475751.67
2025-04-01 06:59:56,179 - INFO - Tick 22584998: Duration=10.46s, Transfers=0, TPS=0.00
2025-04-01 07:00:00,591 - INFO - Tick 22584999: Duration=4.46s, Transfers=14680306, TPS=3290103.91
2025-04-01 07:00:11,260 - INFO - Tick 22585000: Duration=10.68s, Transfers=18319694, TPS=1715897.97
2025-04-01 07:00:14,452 - INFO - Tick 22585001: Duration=3.18s, Transfers=0, TPS=0.00
2025-04-01 07:00:17,635 - INFO - Tick 22585002: Duration=3.18s, Transfers=30587358, TPS=9615962.99
2025-04-01 07:00:20,788 - INFO - Tick 22585003: Duration=3.18s, Transfers=47133628, TPS=14823964.75
2025-04-01 07:00:55,075 - INFO - Tick 22585004: Duration=34.29s, Transfers=37779014, TPS=1101726.55
2025-04-01 07:00:58,245 - INFO - Tick 22585005: Duration=3.15s, Transfers=0, TPS=0.00
2025-04-01 07:01:01,424 - INFO - Tick 22585006: Duration=3.16s, Transfers=33562024, TPS=10609645.75
2025-04-01 07:01:33,737 - INFO - Tick 22585008: Duration=32.21s, Transfers=65437976, TPS=2031673.73
2025-04-01 07:01:37,092 - INFO - Tick 22585009: Duration=3.29s, Transfers=0, TPS=0.00
2025-04-01 07:01:40,299 - INFO - Tick 22585010: Duration=3.35s, Transfers=23359709, TPS=6980817.97
2025-04-01 07:01:43,546 - INFO - Tick 22585011: Duration=3.21s, Transfers=48633037, TPS=15150950.14
2025-04-01 07:02:10,777 - INFO - Tick 22585012: Duration=27.11s, Transfers=27007254, TPS=996219.45
2025-04-01 07:02:16,324 - INFO - Test Ending At Tick: 22585012

2025-04-01 07:02:16,324 - INFO - Total unique TxHashes: 169
2025-04-01 07:02:16,326 - INFO - === Summary ===
2025-04-01 07:02:16,326 - INFO - Total Ticks: 46
2025-04-01 07:02:16,326 - INFO - Total TxHashes: 169
2025-04-01 07:02:16,326 - INFO - Total Transfers: 726000000
2025-04-01 07:02:16,326 - INFO - Average Transfers per Tick: 21352941.18
2025-04-01 07:02:16,326 - INFO - Average Tick Time (from duration): 6.52 seconds
2025-04-01 07:02:16,326 - INFO - Average Tick Time (measured): 8.98 seconds
2025-04-01 07:02:16,326 - INFO - Number Of Transfers Per Second (TPS) (from total): 2420000.00
2025-04-01 07:02:16,326 - INFO - Average TPS (from measurements): 4119986.50
2025-04-01 07:02:16,326 - INFO - Max Tick TPS: 15527637.74
2025-04-01 07:02:16,327 - INFO - Min Tick TPS: 0.00
2025-04-01 07:02:16,327 - INFO - Max Tick Duration: 34.29 seconds
2025-04-01 07:02:16,327 - INFO - Min Tick Duration: 1.20 seconds
```

3. qubic_benchmark_integration_report_20250401_070216_UTC.json

```
Unset
{
    "test_type": "integration",
    "timestamp": "20250401_070216",
    "log_files": [
        "qubic_benchmark_integrate_1_20250401_064135_UTC.log",
        "qubic_benchmark_integrate_2_20250401_065656_UTC.log"
    ],
    "comparison_data": {
        "headers": [
            "Filename",
            "Test Start Time",
            "Test End Time",
            "Test Duration",
            "Account Num",
            "Start Tick",
            "End Tick",
            "Tick Range",
            "Average Tick Time",
            "Min Tick Duration",
            "Max Tick Duration",
            "Total Unique TxHashes",
            "Total Ticks",
            "Total Transfers",
            "Avg Transfers/Tick",
            "Overall TPS",
            "Min Tick TPS",
            "Max Tick TPS",
            "Transfer/Tick Min",
            "Transfer/Tick Max",
            "Transfer/Tick Variance",
            "Total Transfers Diff from Avg",
            "Total Transfers Diff from Max",
            "TPS Diff from Avg",
            "TPS Diff from Max"
        ],
        "data": [
            {
                "Filename": "qubic_benchmark_integrate_1_20250401_064135_UTC.log",
                "Test Start Time": "2025-04-01 06:41:40",
                "Test End Time": "2025-04-01 06:46:56",
                "Test Duration": "5 minutes",
                "Account Num": 16500000,
                "Start Tick": 22584476,
                "End Tick": 22584515,
                "Tick Range": 39,
                "Average Tick Time": "7.50s",
                "Min Tick Duration": "1.18s",
                "Max Tick Duration": "45.32s",
                "Total Unique TxHashes": 144,
                "Total Ticks": 40,
                "Total Transfers": 792000000,
                "Avg Transfers/Tick": "26400000.00",
                "Overall TPS": "2640000.00",
                "Min Tick TPS": "0.00",
```

```
                "Max Tick TPS": "15332862.80",
                "Transfer/Tick Min": "0.00",
                "Transfer/Tick Max": "108828648.00",
                "Transfer/Tick Variance": "677438260876978.00",
                "Total Transfers Diff from Avg": "+33000000.00",
                "Total Transfers Diff from Max": "+0.00",
                "TPS Diff from Avg": "+110000.00",
                "TPS Diff from Max": "+0.00"
            },
            {
                "Filename": "qubic_benchmark_integrate_2_20250401_065656_UTC.log",
                "Test Start Time": "2025-04-01 06:57:02",
                "Test End Time": "2025-04-01 07:02:16",
                "Test Duration": "5 minutes",
                "Account Num": 16500000,
                "Start Tick": 22584967,
                "End Tick": 22585012,
                "Tick Range": 45,
                "Average Tick Time": "6.52s",
                "Min Tick Duration": "1.20s",
                "Max Tick Duration": "34.29s",
                "Total Unique TxHashes": 169,
                "Total Ticks": 46,
                "Total Transfers": 726000000,
                "Avg Transfers/Tick": "21352941.18",
                "Overall TPS": "2420000.00",
                "Min Tick TPS": "0.00",
                "Max Tick TPS": "15527637.74",
                "Transfer/Tick Min": "0.00",
                "Transfer/Tick Max": "65437976.00",
                "Transfer/Tick Variance": "393652550570047.44",
                "Total Transfers Diff from Avg": "-33000000.00",
                "Total Transfers Diff from Max": "-66000000.00",
                "TPS Diff from Avg": "-110000.00",
                "TPS Diff from Max": "-220000.00"
            }
        ],
        "summary": {
            "total_transfers_avg": "759000000.00",
            "total_transfers_max": "792000000.00",
            "tps_avg": "2530000.00",
            "tps_max": "2640000.00",
            "test_count": 2
        }
    },
    "summary": {
        "total_tests": 2,
        "avg_tps": "2530000.00",
        "max_tps": "2640000.00",
        "avg_transfers": "759000000.00",
        "max_transfers": "792000000.00"
    }
}
```

4. qubic_benchmark_tick_data20250401_064656_UTC.json

```
Unset
{
```

```
    "22584472": [
        "paxehedixkolreaiuybifhzghkpchkrvwovdtqcemcrbrsxqmpuhikcabpmn"
    ],
    "22584474": [
        "rjeqekddojycdedxuhjhqibkthbdkohulemondbgxdeyyqbnkotjjmvgtfog",
        "zyoqhzhnvinieevwvjbaxtptsibdlchrgkzjjaybieduopsvhotscobalmaj"
    ],
    "22584486": [
        "xxxdgphgwfsbeayyzygteweaejlewpveanxiagnelhijqtbfiwkfkcievhzk",
        "tyzenmeycmsqvgtexcyrprhobklfsdsxutrnhykxbghtjgkodilbqdjgvvpn",
        "qfznjujdultqzfdtydgxeaknsnfftdrsypkydiucicwjtxzustttrwnawatb"
    ],
    "22584475": [
        "rtlqxdwvqsygefzhrnrwyvbkstjaykmfcmymkbvgfaykafxpsrrkaaqceaui"
    ],
    "22584487": [
        "yalolbgounqnwcbcyjddzivtlunedxktqoslibehkgmsrctbrwzyfsrexokj"
    ],
    "22584490": [
        "ehkubmhkbeaieegrdsbjmfxdorzgwgztucesmhyfugemqkudtxcsxiiannvg",
        "uleszhjwcdgxafwpjwmtmtfhfmnbmqxpeijhgrqrjeqaxuplckjnmacfsnze",
        "qiricszhclqouatttvodbicucjeetuknsxeajnwzhfksrqqygenzlzydcyun",
        "oxmzzaqbmuugkcnzbsdqutwhruocfxjjpzzncgddmavzdnoclhdlzizcjnte",
        "dkukwowcsieogfoukurlyucwjiydpoznhwruyaxwicpspnvjibpfwrgaitnh",
        "qwjznicramufegrragfmmxujdqtatnejioodqdibygnxwkqylkrbhofevdge",
        "jwkmbaidmdeoebvblzmauptldsganunuquxhimpawgisxzgcfazituvbhwvl",
        "fyxbymasxvxhgaygttdxumqpuphfdbcrvxvppyjmrfkglcodajjhcfodrfje",
        "gtysgcnmjjcldeysudskkbejczyflgwvxjgyzjeslgjxbarvgspiluiddznm",
        "gmwgkfuqzqqbmesvpnyympumlyygxhatwsbdwownecrrbqfhhhpxubmacazm"
    ],
    "22584479": [
        "mkditrncdfrtdazybooybovoeegdhkzezkoidtvzrdmnyxcihexadqbgqwwl"
    ],
    "22584483": [
        "gmanjptzfeqdtfrypsosfutdubseyrgrvertapswoaeutuqytgulicxfozre"
    ],
    "22584491": [
        "vzvrpvylrihlxcufdjfemaymwfycpnziygkgvhftsajutgnnahgothpbmqrn",
        "iathcslswcumaeozcxupbaqlekffamtlolpvgzavhgdixsmxbnxsduhdvudo",
        "xkchqiyaamfrraewnnvtzpjansqdomkakiwndzmbhalqkdxncapksyvfpxjd",
        "veriqylmnuqhldfsewtmyqsfjiifvwybhgufhgltzgxhhohldcflnknapayn",
        "xwviojychnxngbjrxwugxuhyoaqdkamvzdklvzymmgoexjalzkfrzmcfjmjd",
        "oyvveyuofppqybqslefdaqdrjbtgwctlumsiblcircggnbvdmrzcirgejbqa",
        "vqszodjcsupapdhvqsdxhaihyfggmbqdfphaalqrueufzpvndclbzkdcofqa",
        "obxlnhpkrpnxgcllldchrlprrsweowwltorzcjrsiauisfcdntajyobaydhf"
    ],
    "22584494": [
        "baoubgviwemzxfmsurxmaakcuixazikuhgpottcnfayxtckmxsymhercngub",
        "hymdvovelmlevacdaiwcxhacbubdjknjbwuxqfwlbcxvaemfplkdodcdsmui",
        "amosgvgxxzhlcaedcinddovinxwckqqdgkzbktqxtgakbnfpzafmjnqbscab",
        "axgqamxiltramaqzjvtdcdanvnfameubslpdhzoqmgnogmnhoyfwohsewwac",
        "zwmazivewohsndxkqznhwsynbpggqfcslyeqfccjmgpkibumlroyyjzbpfwe",
        "dgkmkyajmftqkcccfvxlythmlbcaqjcskksxcoakagznqirooqsoxelgytbg",
        "behxixvojybsagjvopivzjqpvomdnxxghgxznlkmrehljoviewepwkiawxpm",
        "kwqaintitpmktcplddnukcollqjafxobmehckydaebxsisqjhhwjxpbepote",
        "jijtzzzxxxbqfduqmjndcgyhevrbkdmvxqacvtrdgcuafmjlzxipzygfamzh",
        "oapuwtpqwbwbxephhywueheafnhhdcqqvltkkthkcbtehjcjymxaljjdseik"
    ],
    "22584495": [
        "runoqqxsxjvtkarbtyktytildvgcmxxshwwiiplwfcyhiqlyxztzzyzgubfo",
        "iltsjbpkqgkfvakqlnwivibrajdgpspcdnbssoavxenwphngwprvbcmgmtki",
```

```
        "yusubgeapnsdwfmvxvctzjfspnsgsayauixffppxwbdwkgupyjzccpafbeeg",
        "ernagcndcylanetvszbldnkyjjgduspmzewqpeplmadvueaddhblfivbryog",
        "hakhfatwbkhdfgulvjgywvdnesqdbfyfrxoxhtizibgiupdkpvyocstfiqpc",
        "pamrljbydbmytbcpxzgtezltkdtaqqaatjtutxawsenxsjpacoonqeibpvqn",
        "qsvlgtcjxsjffhmufxlyvbvjiatetaejpfsfjdblwatvhyhzmpvlaqmduosa",
        "jlhmycyfaqwllbjnnkbzzkoitnxfrwlkdomquurtrbufnxsztvasnizglesc",
        "xrylplsvskyraduafrcceidngulbqoyqqlpuztdycdklrlywpomqqluclavn",
        "pybbwtrxnyimkcitxtlefuelzqzdwotstkeexaehwguesymvsfrdtfkdmiqc"
    ],
    "22584496": [
        "eujlbwuqybosidtsjomjpqakeiugufoixsewyxhjrcsulupmdkbmfysdvjfn",
        "vrjxqpxoyjvdvellsenpjvwadgrderdnvfrphpndrcpypdbnezzowdkcfhwm",
        "lgeelrcsjkvudhfqnrzlfjkshkedstrwniqnlciidajrspytqblwvelhfmro"
    ],
    "22584497": [
        "xikwcpdpttdeofyviijreatkfrxgcrhtioemiytgqdsqkuygnnxtakbbmctc",
        "mllsklfeilhpccfcrypwvywopqvclhbgmywwijdbqbribohpcfxxswheqtxe",
        "cjecxnvrespwjdoalelpftddxjjcafrtugrdbuagugqsveojcrjugmfgnudl"
    ],
    "22584498": [
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5.   qubic_benchmark_tick_data20250401_070216_UTC.json

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