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Improving Blockchain Scalability with Parallel Mining

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Outline

- Introduction
- Challenge
- Solutions
- Design of experiment
- Results and analysis
- Conclusion
- Acknowledgement
- Questions and discussion

Introduction

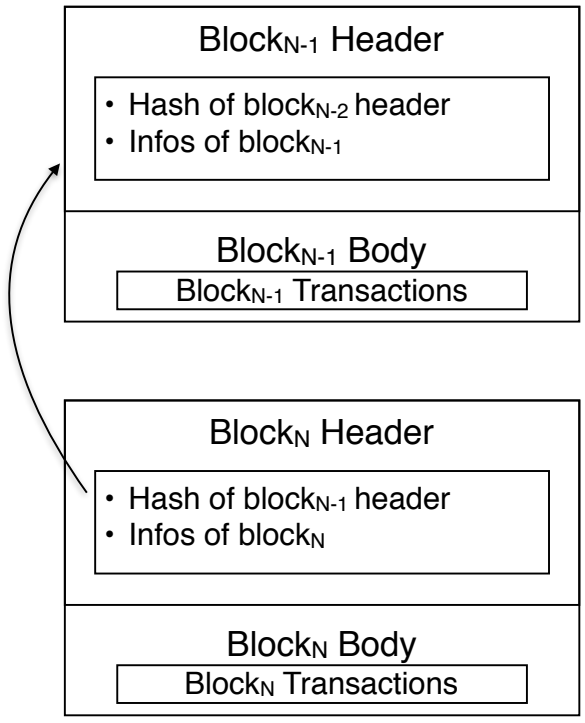
Background

Since the first appearance of Bitcoin in 2009, hundreds of different cryptocurrencies have been created. There are more than 2.5 millions Bitcoin transactions being made every day. Blockchain, a distributed ledger technology that brings cryptocurrencies like Bitcoin and Ethereum to life, also has gained global attention from computer science and finance communities.

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Blockchain Data Structure

- A chain of blocks
- Blocks have a fixed size
- Each block records a group of verified transactions
- Each block is appended to the previous block continually
- Each block contains the hash values of contents of its own and its previous block



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Advantages

- Security
- Very low fees
- Freedom in payment
- Peer-to-peer, decentralization

Applications

- Cryptocurrency
- Trade processing and settlement
- Insurance claims processing
- Supply chain sensors

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Challenge

Blockchain Scalability

- Growing transactions number
- Bottleneck of blockchain transactions processing throughput

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Solutions

- Increasing the block size
  - temporary, inflexible
- Decreasing the mining period
  - unstable, limited
- Off-chain transactions
- Parallel Mining

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Parallel Mining and Sharding

- Partitioning the transactions into disjoint ‘shards’
- Allowing multiple branches to confirm the blocks simultaneously on a disjoint shard of transactions.

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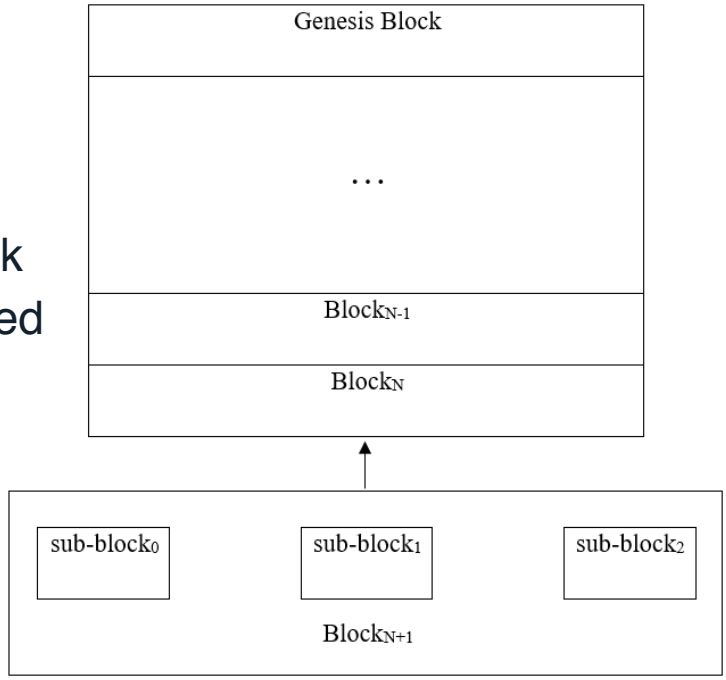
Design of Experiment

- Simulation experiment
- Localized blockchain
- Transactions simulation
- Consensus algorithm
- Mining competition via multithreading
- Sharding implementation

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Sharding Implementation

- Single chain
- Multiple sub-blocks
- sub-blocks of same block are concurrently mined



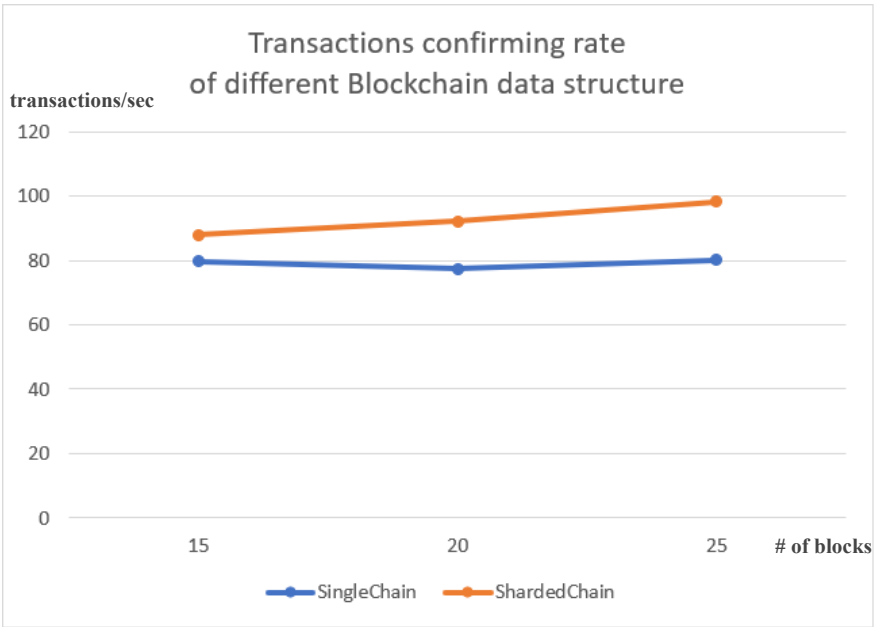
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Design of Experiment

- Metrics:
  - Transactions processing rate
  - Number of backlog transactions
- Control Experiments:
  1. Normal blockchain vs sharded blockchain
     - Difficulty level = 4, miners number = 4
  2. Four miners sharded blockchain vs Six miners sharded blockchain
     - Difficulty level = 4

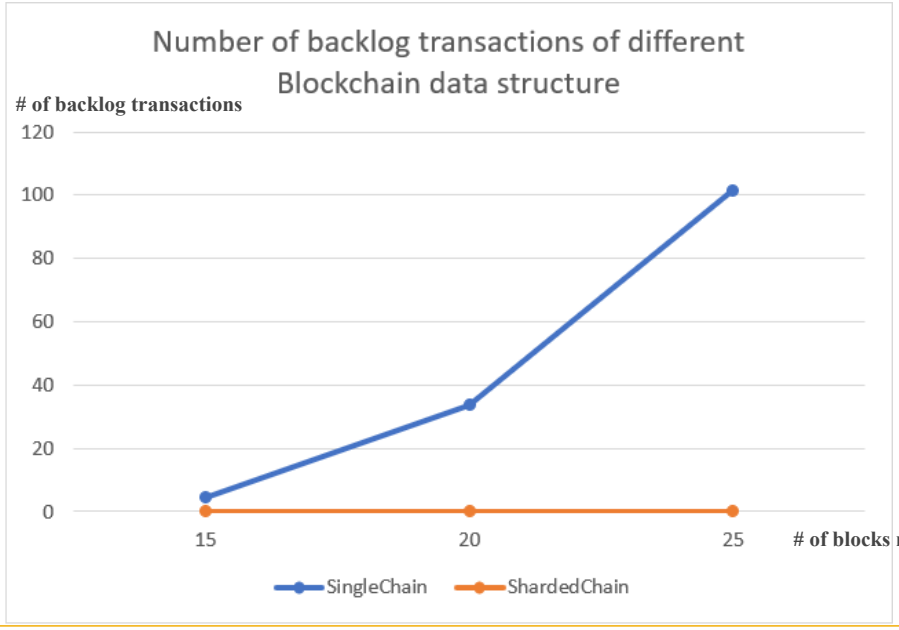
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Results and Analysis



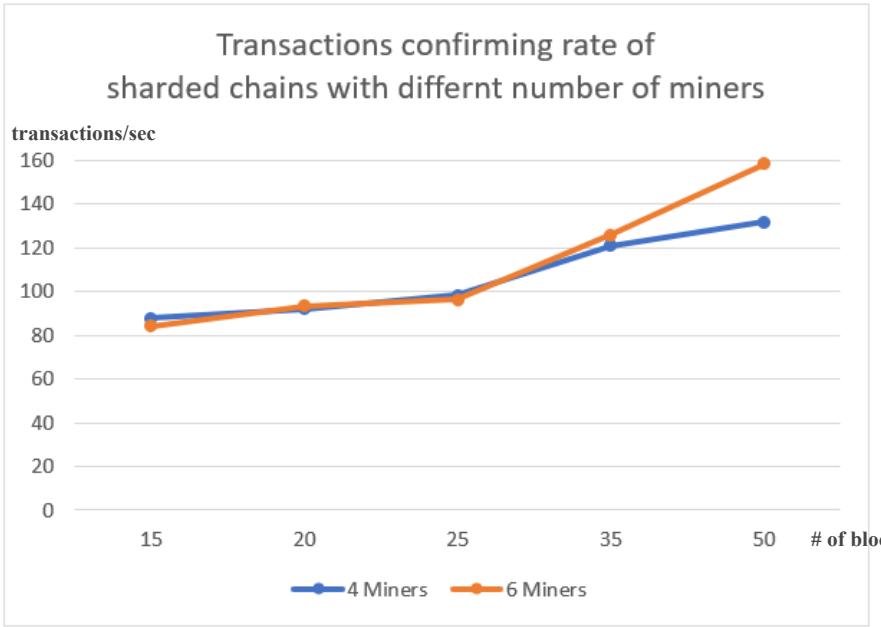
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Results and Analysis



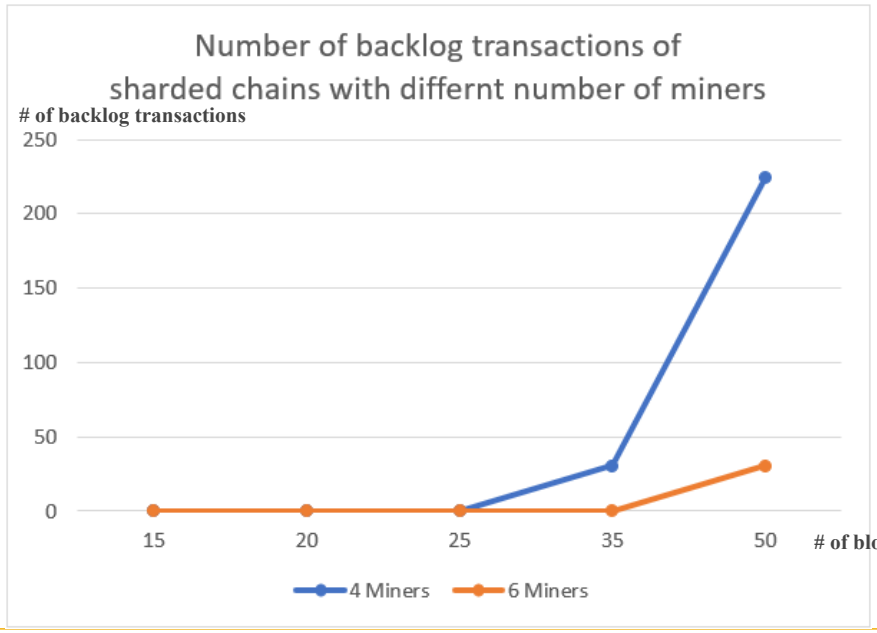
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Results and Analysis



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Results and Analysis



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Conclusion

In this simulation, some assumptions have been made in order to focus on my main concern and avoid unnecessary complexity of the model. As the simulation successfully shows how sharding and parallel mining can dramatically improve the transactions processing capability, it gives us hope that we can apply sharding to the real world blockchain to promote the transactions processing throughput to make it more realistic to apply Blockchain technology to more areas.

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Questions

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Thank you!


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