



**UCDAVIS**

# RESILIENT CONSENSUS SUSTAINED COLLABORATIVELY

**Mohammad Sadoghi**

*Coinbase Machine Learning and Blockchain Research Summit*

May 5, 2023



**Mohammad Sadoghi**  
*Exploratory Systems Lab*  
*Department of Computer Science*  
**UCDAVIS**  
UNIVERSITY OF CALIFORNIA

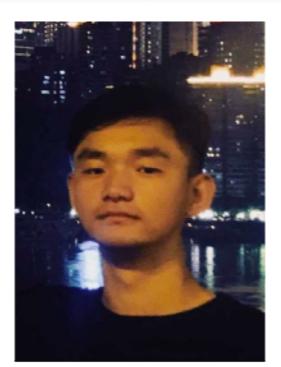




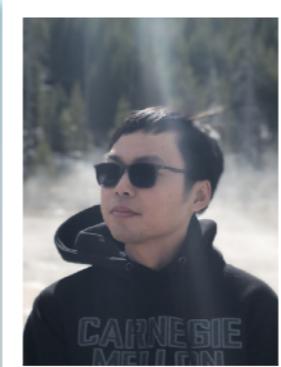
# ExpoLab Team



**Mohammad Sadoghi**  
*(Principal Investigator)*



**Dakai Kang, PhD**  
*(View-change-less Protocols)*



**Junchao Chen, PhD**  
*(Hybrid BFT Protocols)*



**Shesha Vishnu Prasad, MSc** **Jinxiao Yu, MSc**  
*(Resilient Wallet) (Performance Analyst)*



**Wayne Wang, MSc**  
*(Global Consensus)*



**Arindaam Roy, Mac**  
*(Toolkit & Integration)*



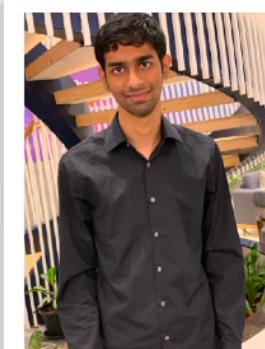
**Divjeet Singh Jas, MSc** **Julieta Duarte, BSc**  
*(dApp Developer) (System Storage)*



**Glenn Chen, BSc**  
*(System Storage)*



**Kaustubh Shete, Mac** **Apratim Shukla, MSc**  
*(Resilient NFT) (Resilient Wallet)*



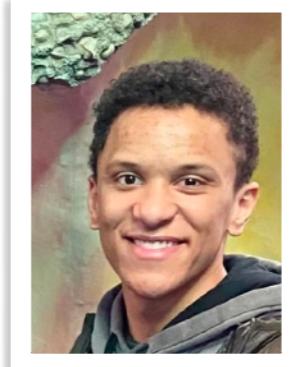
**Priyal Soni, MSc** **Gopal Nambiar, MSc**  
*(Resilient Debitable) (Full Stack Developer)*



**Steve Chen, BSc**  
*(Resilient Wallet)*



**Haskell Lark Macaraig, BSc** **Jared Givens, BSc** **Saipranav Kotamreddy, BSc**  
*(Concurrency Control) (Concurrency Control) (Concurrency Control)*



**Jelle Hellings, PostDoc**  
*(Fault-tolerant Complexity)*



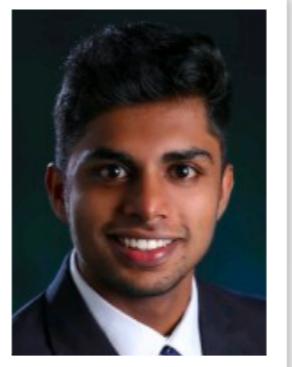
**Suyash Gupta, PhD**  
*(Scalable Consensus)*



**Sajjad Rahnama, PhD** **Thamir Qadah, PhD**  
*(Global Consensus) (Coordination-free Concurrency)*



**Dhruv Krishnan, MSc**  
*(Scaling Fabric via Sharding)*



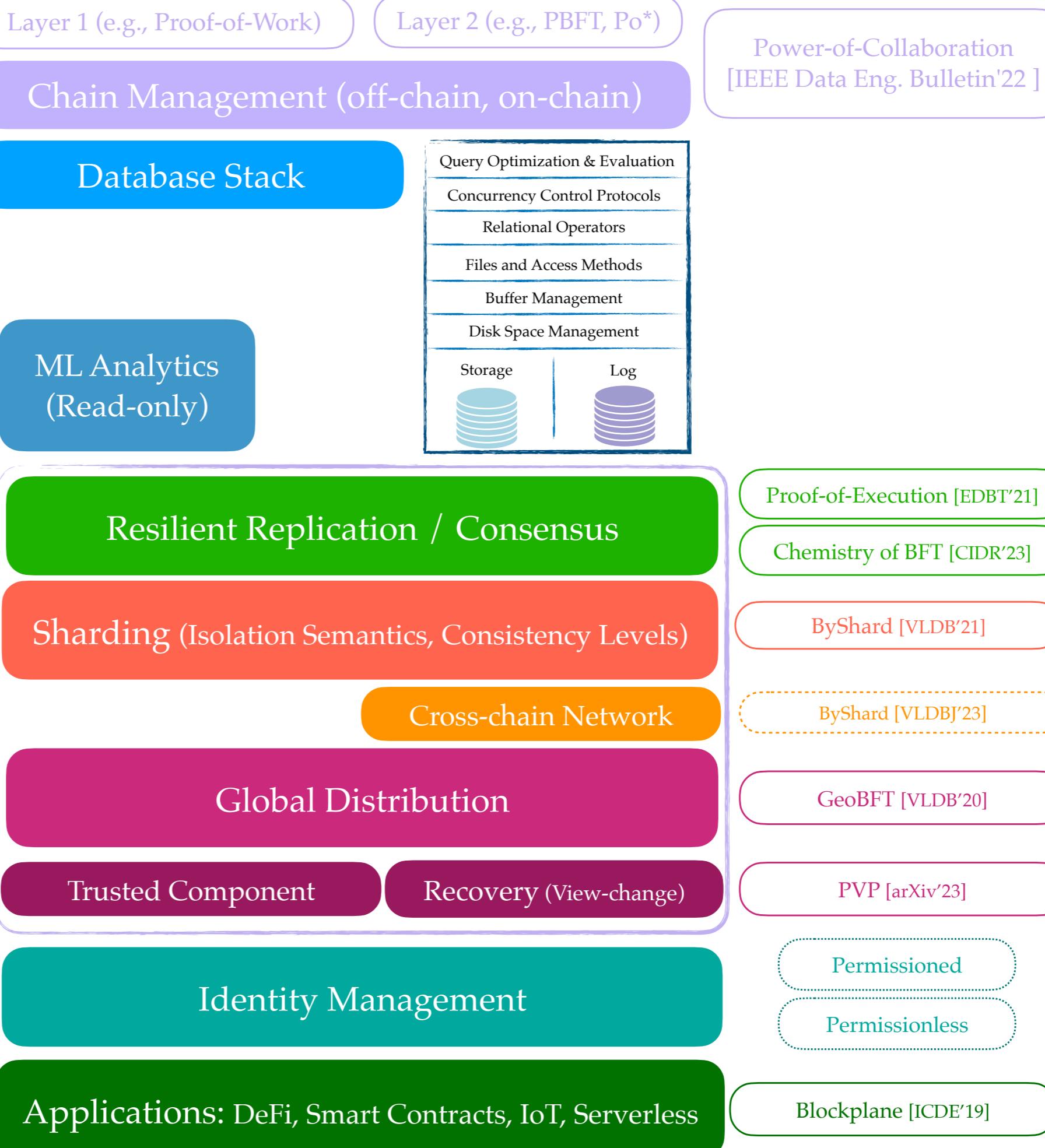
**Priya Holani, MSc**  
*(Scaling Fabric via Sharding)*

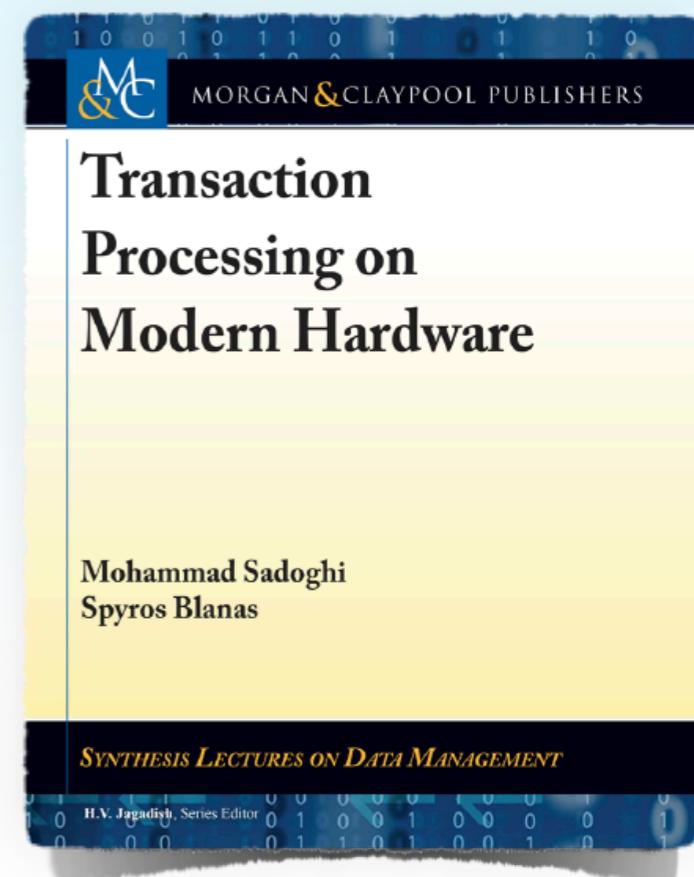
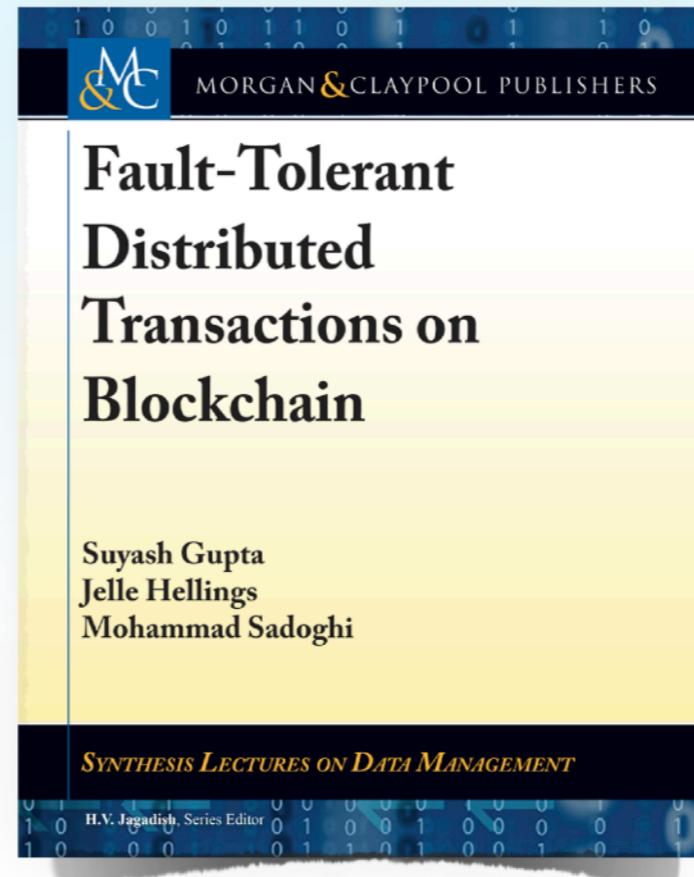
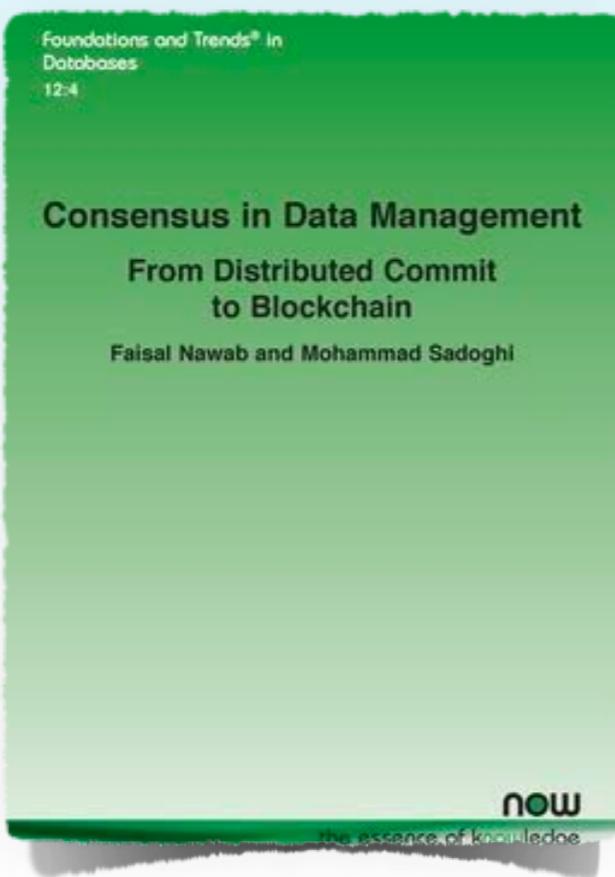


**Shubham Pandey, MSc**  
*(Scaling Fabric via RDMA)*



**Rohan Sogani, MSc**  
*(Scaling Fabric via Sharding)*





# Books

[Consensus in Data Management: From Distributed Commit to Blockchain.](#)  
*Foundations and Trends® in Databases.* Now Publisher. 2023

**Fault-Tolerant Distributed Transactions on Blockchain.**

*Synthesis Lectures on Data Management*, Morgan & Claypool / Springer Publisher. 2021

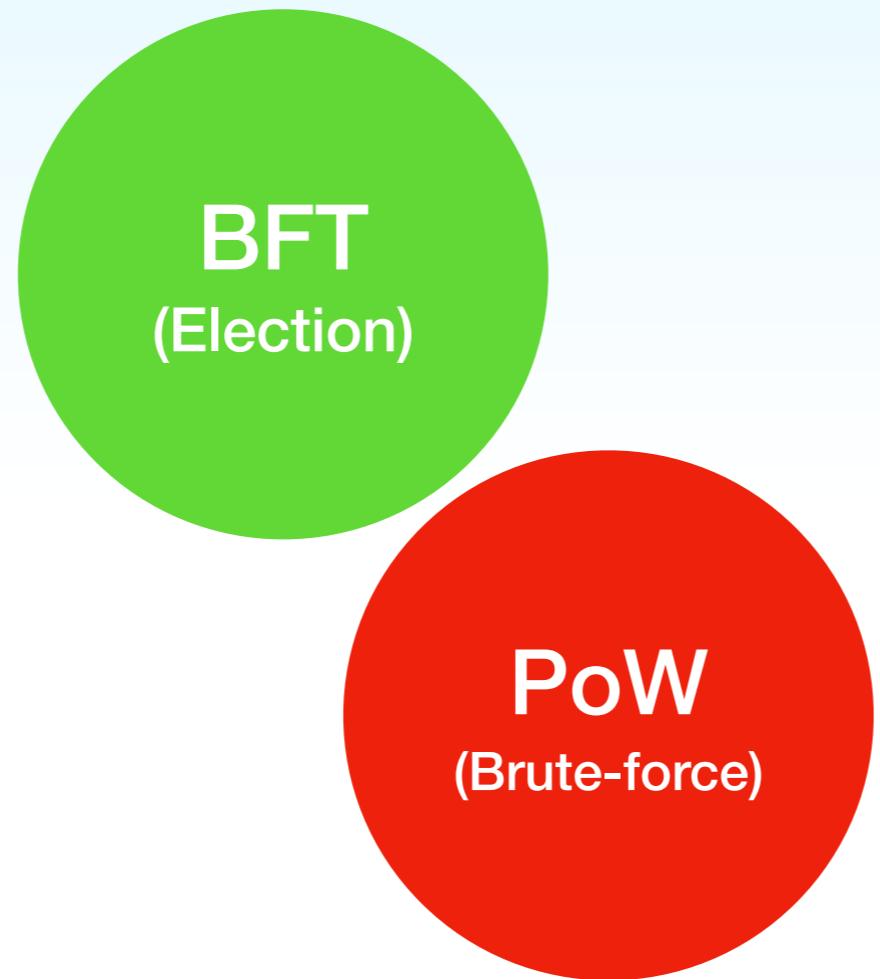
**Transaction Processing on Modern Hardware.**

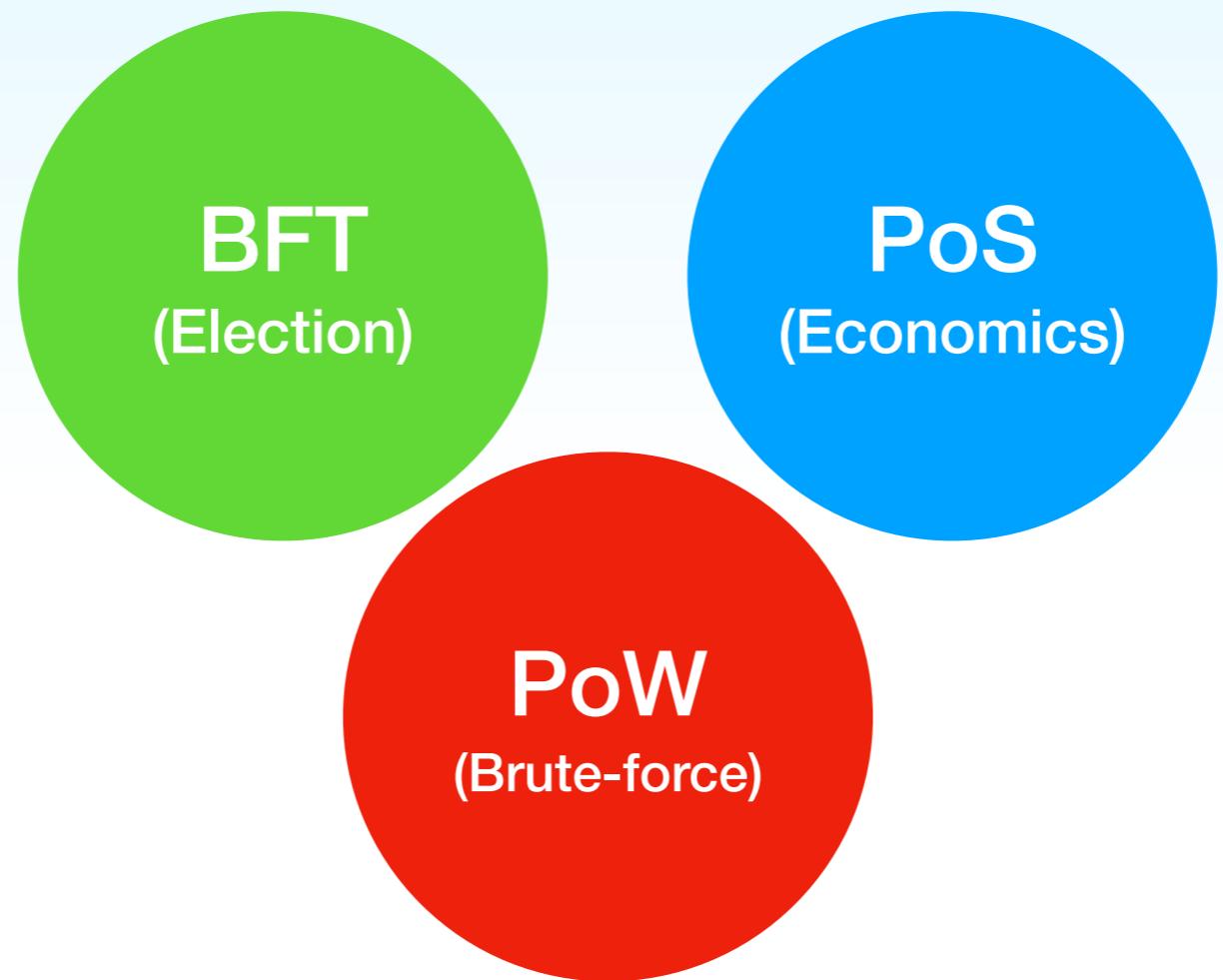
*Synthesis Lectures on Data Management*, Morgan & Claypool / Springer Publishers. 2019

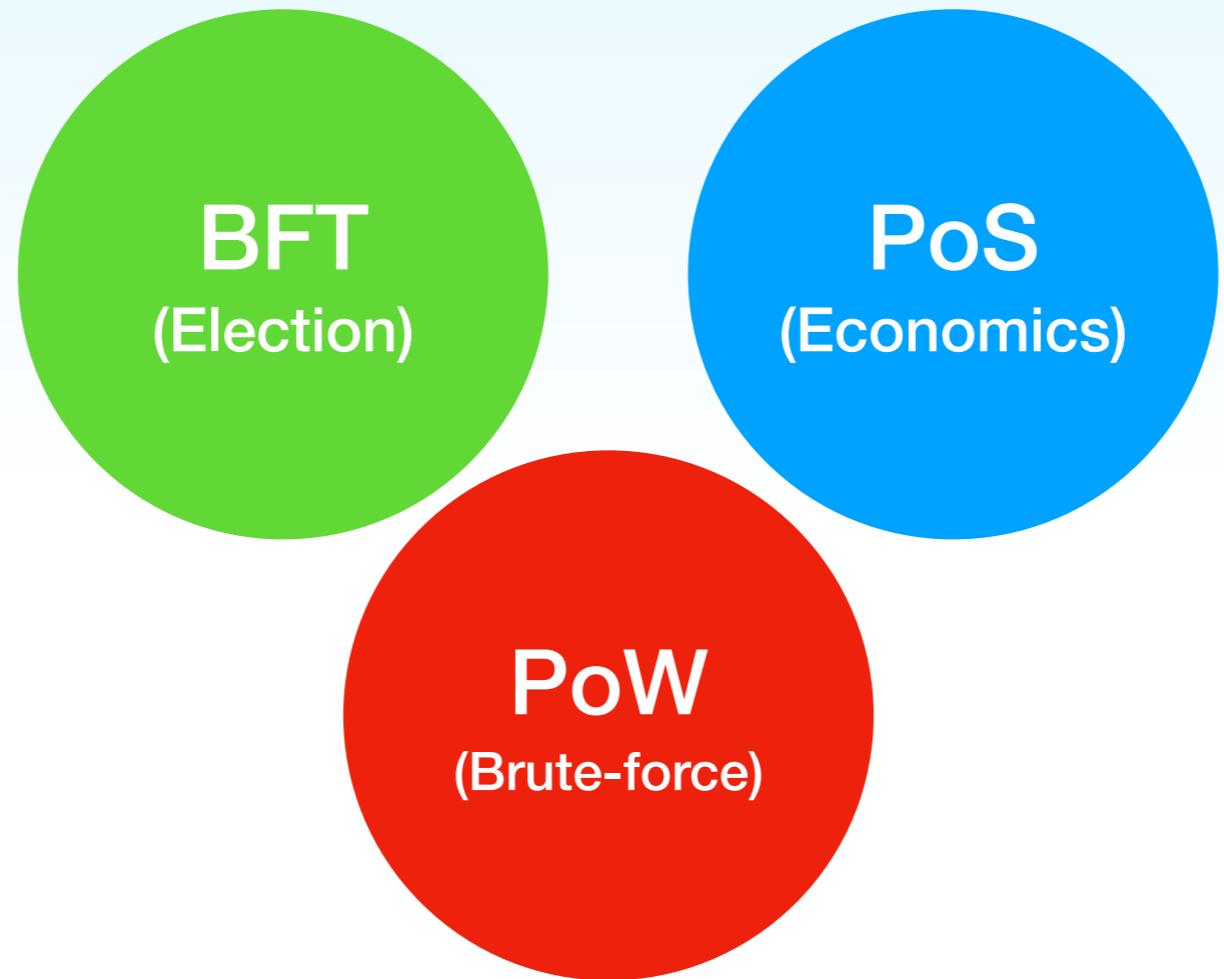
# Chain Resiliency



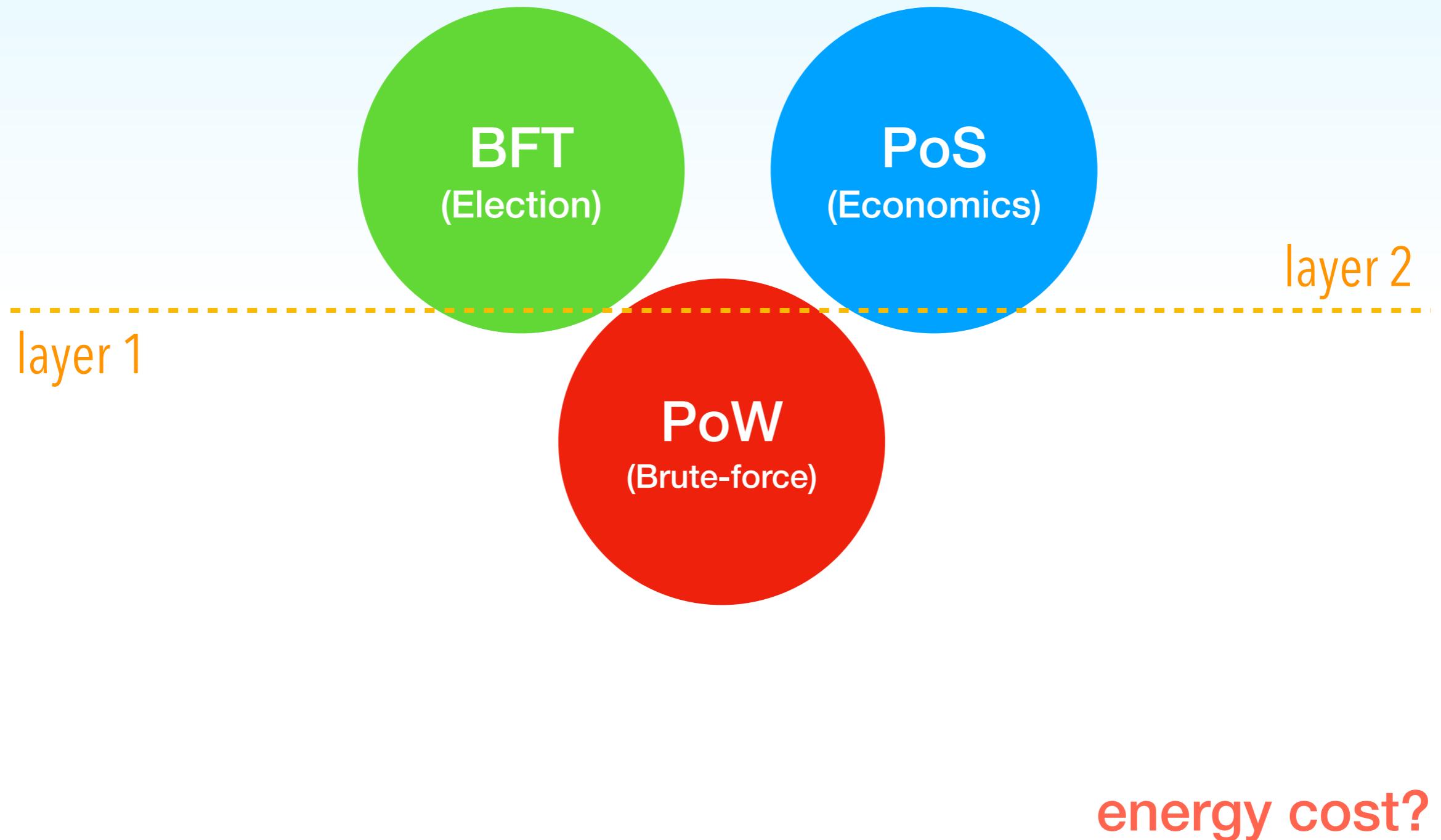
**BFT**  
(Election)







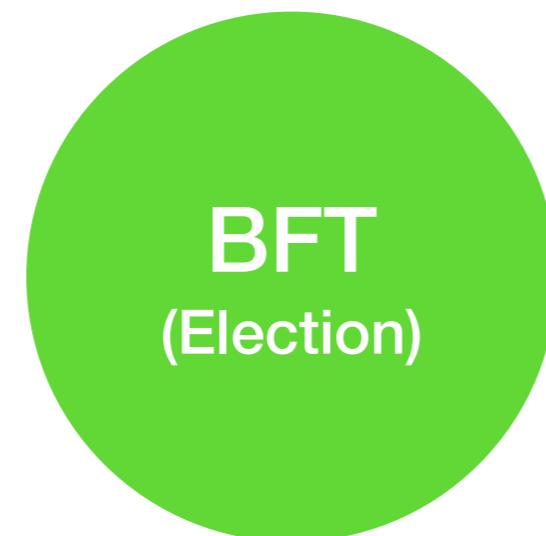
long-range attacks?



layer 2

## collaboration vs. competition

layer 1

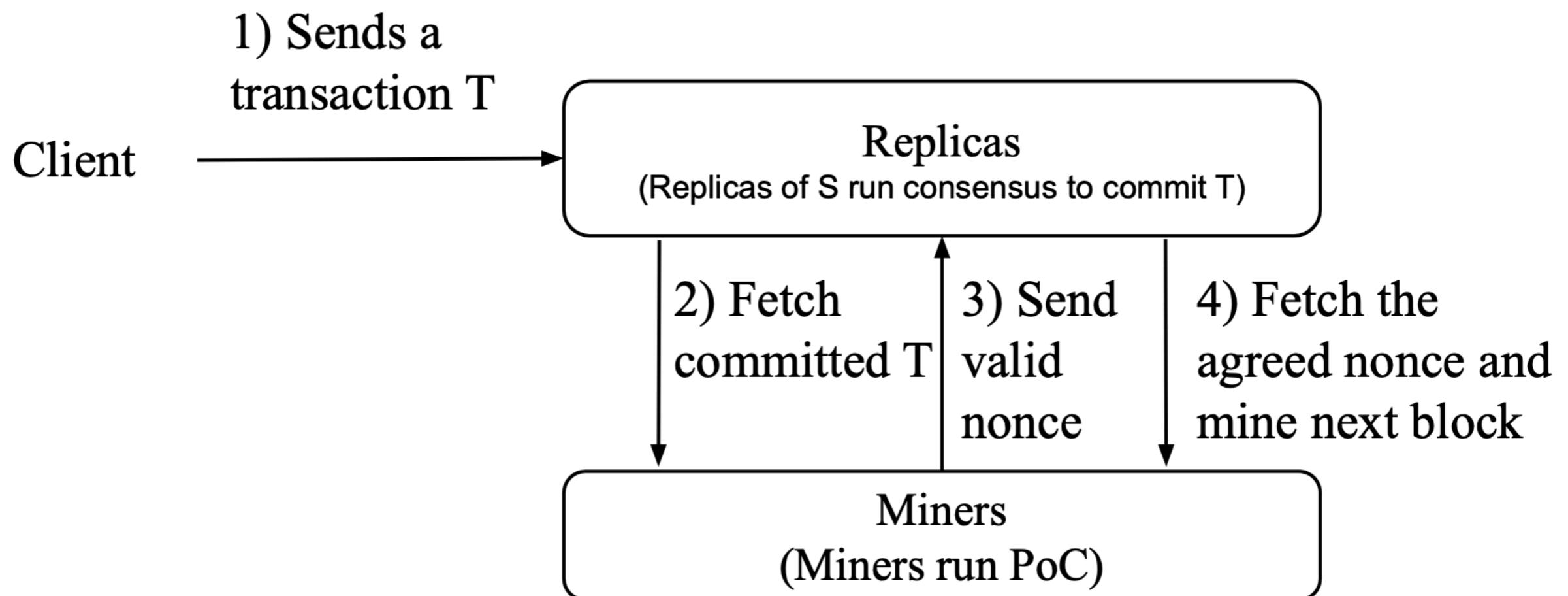






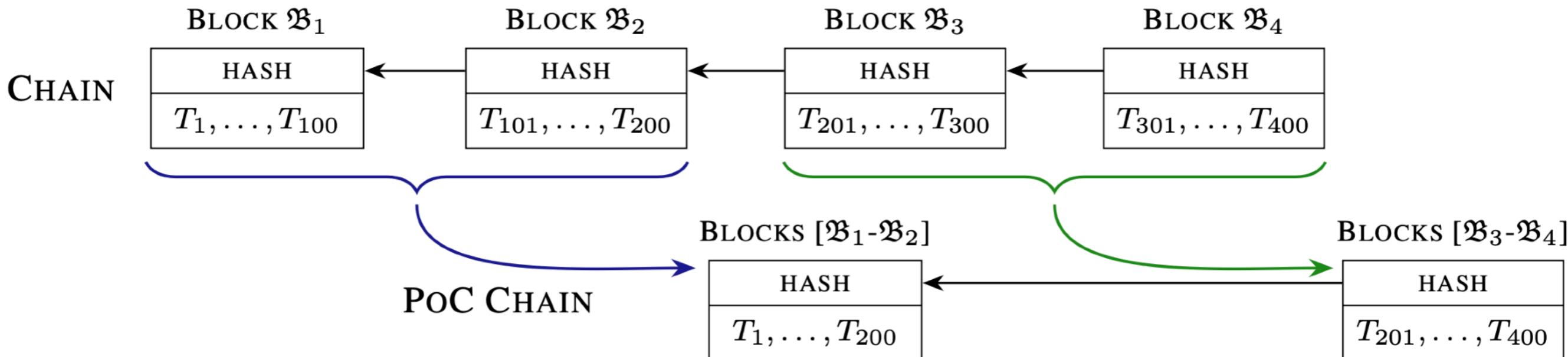
# Hybrid Chain Application Flow

Every generated block is first finalized by consensus,  
then notarized by collaborative mining.



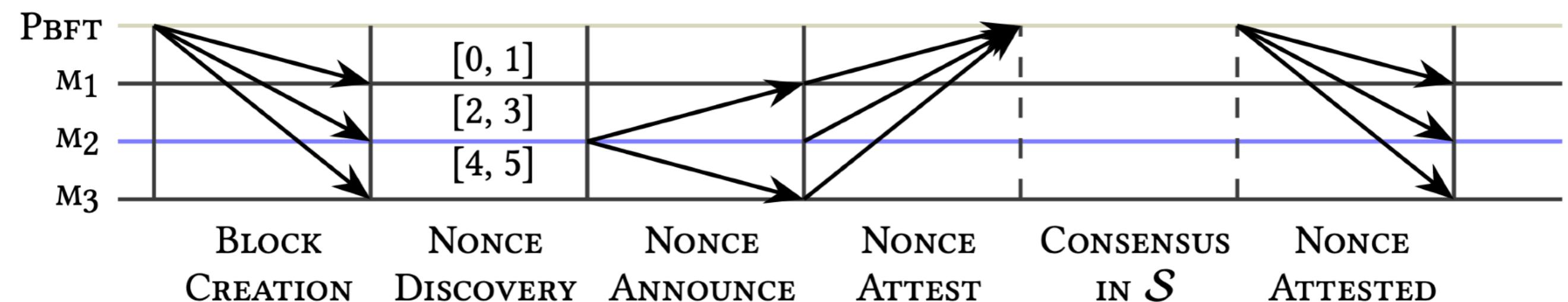
# Hybrid Chain Architecture

Every agreed-upon block through consensus  
has a dual block notarized by collaborative mining



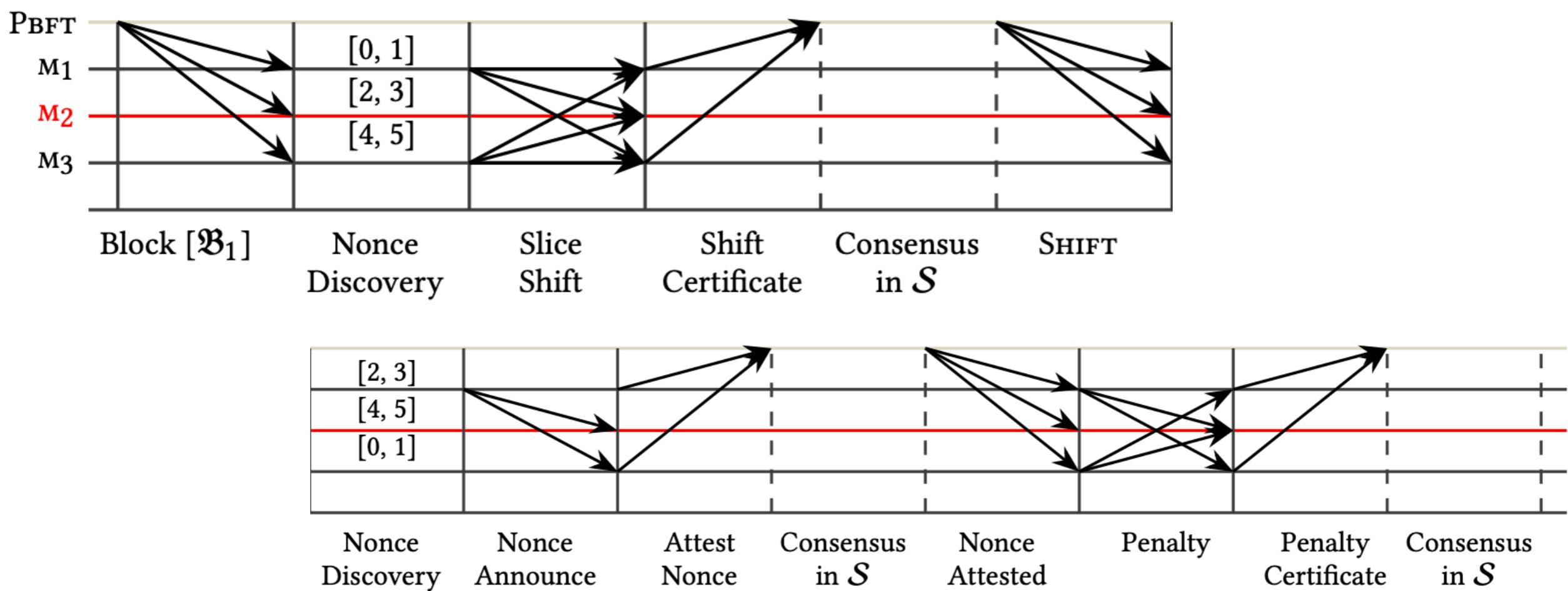
# Hybrid Chain Protocol Flow

The consensus chain brings finality to transactions,  
notary attestation, and reward.



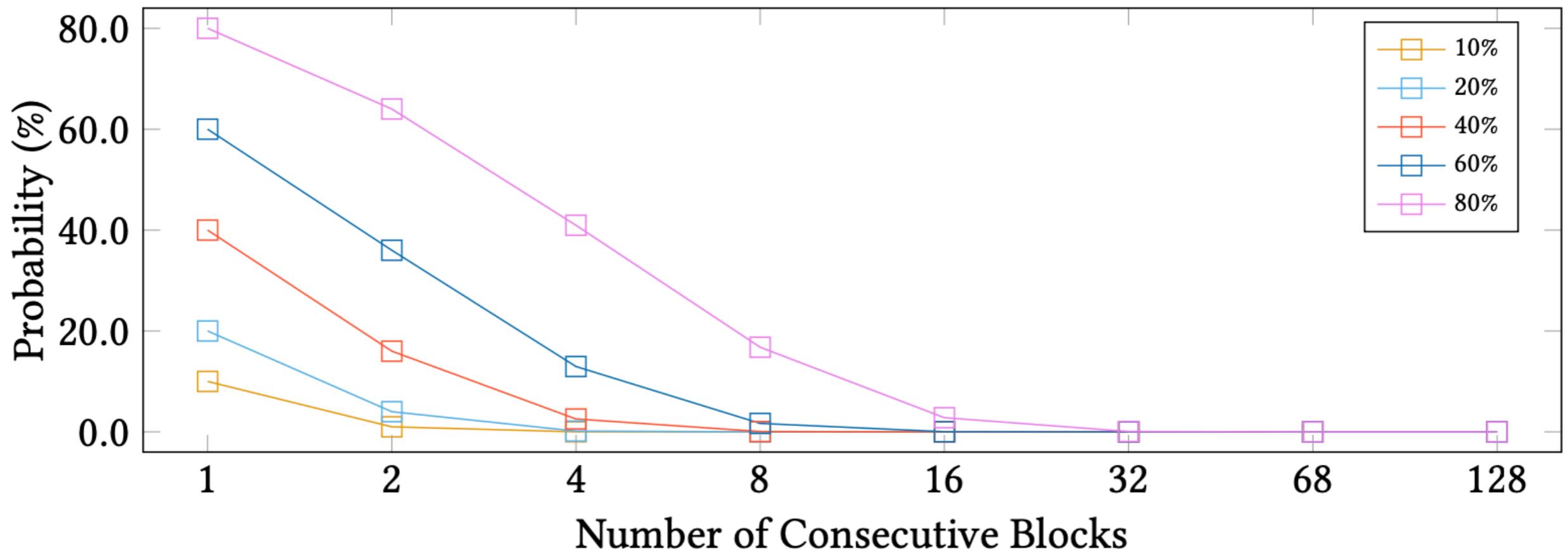
# Hybrid Chain Recovery Flow

The consensus chain brings finality to mining failures and penalty attestation.



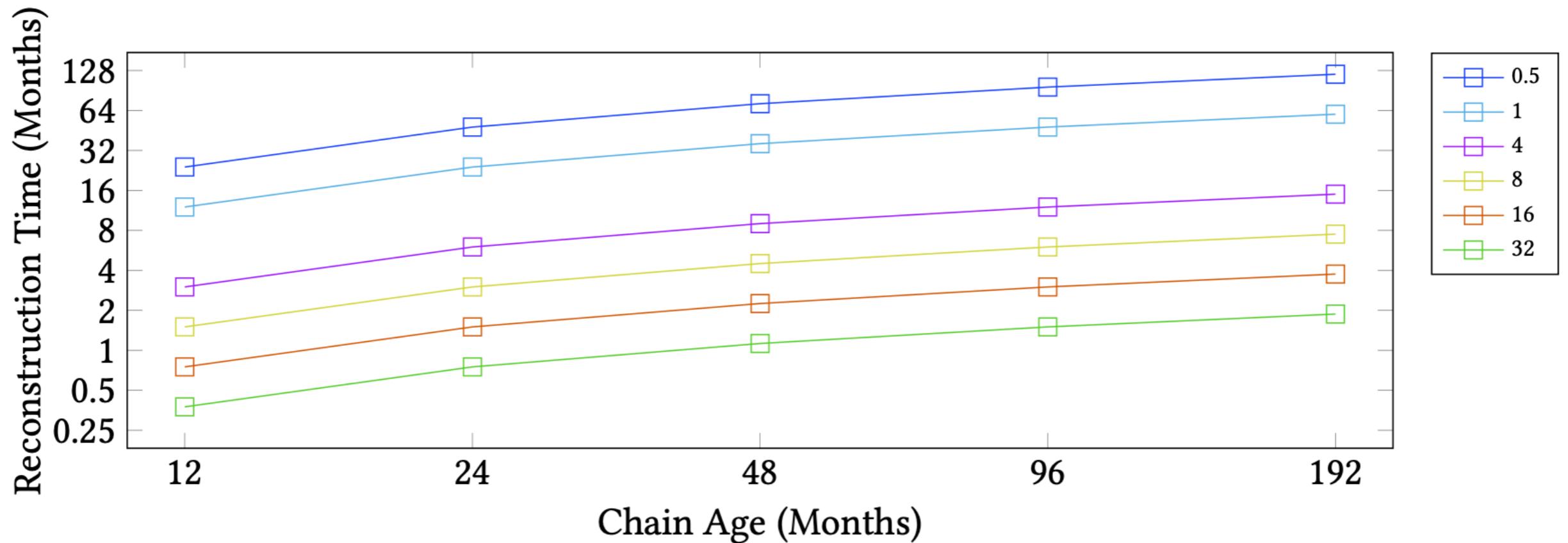
# Long-Range Attacks Feasibility

In Power-of-Collaboration, the probability of successfully mining **b-consecutive blocks** decreases exponentially.



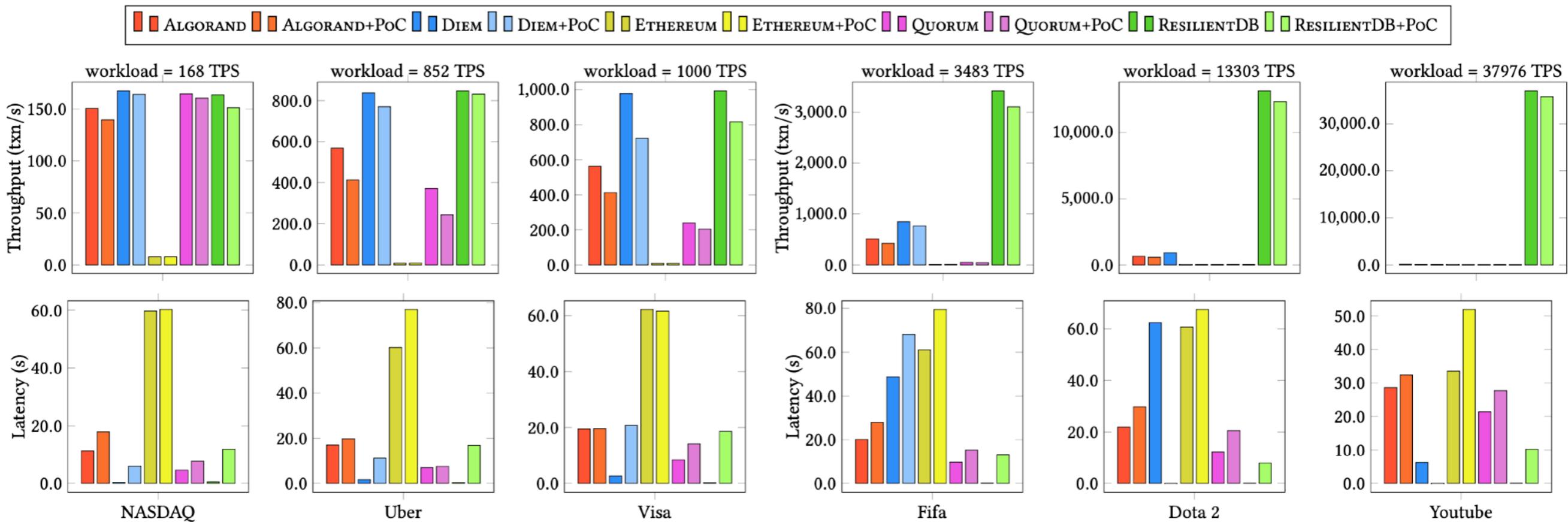
# Long-Range Attacks Feasibility

In Power-of-Collaboration, rewriting history becomes prohibitively more expensive as the chain ages.



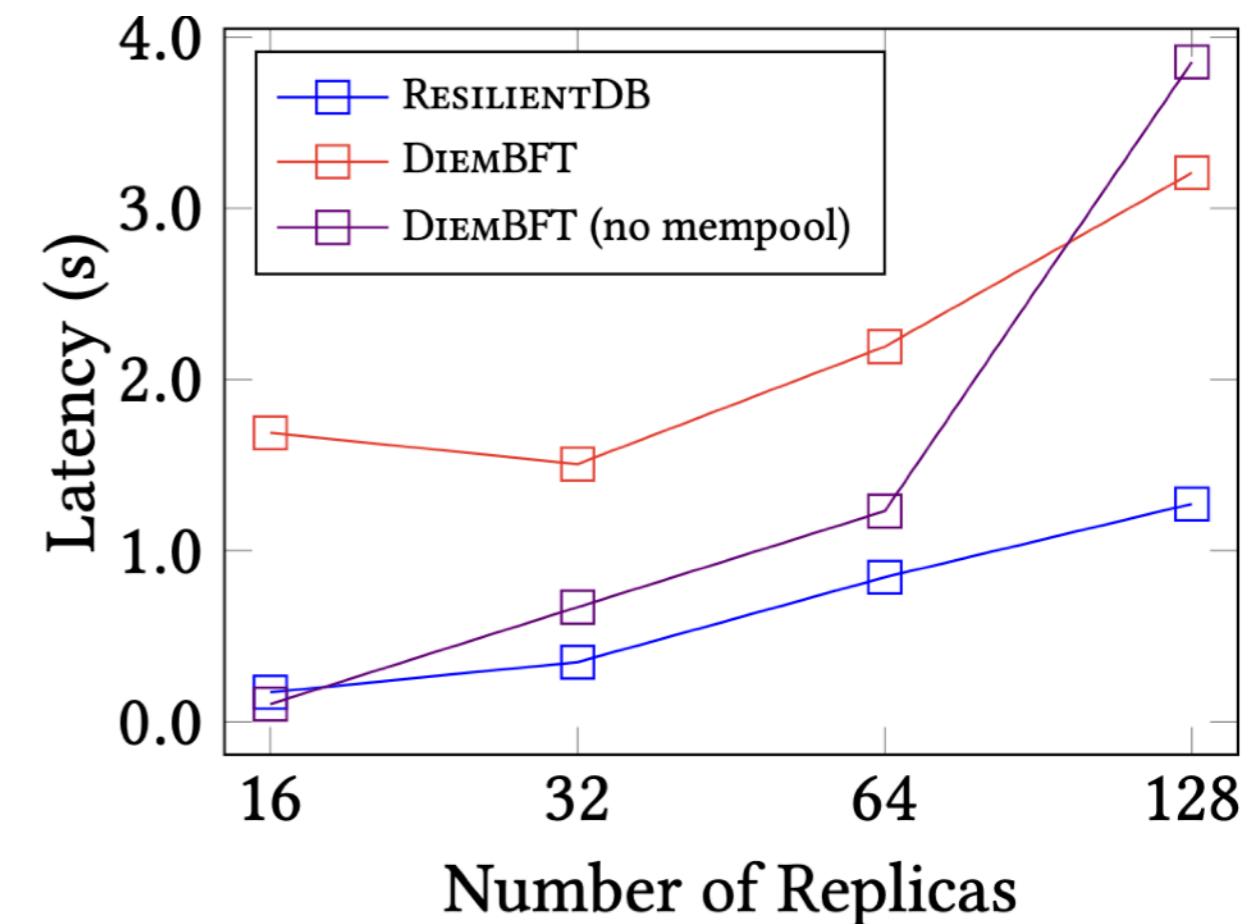
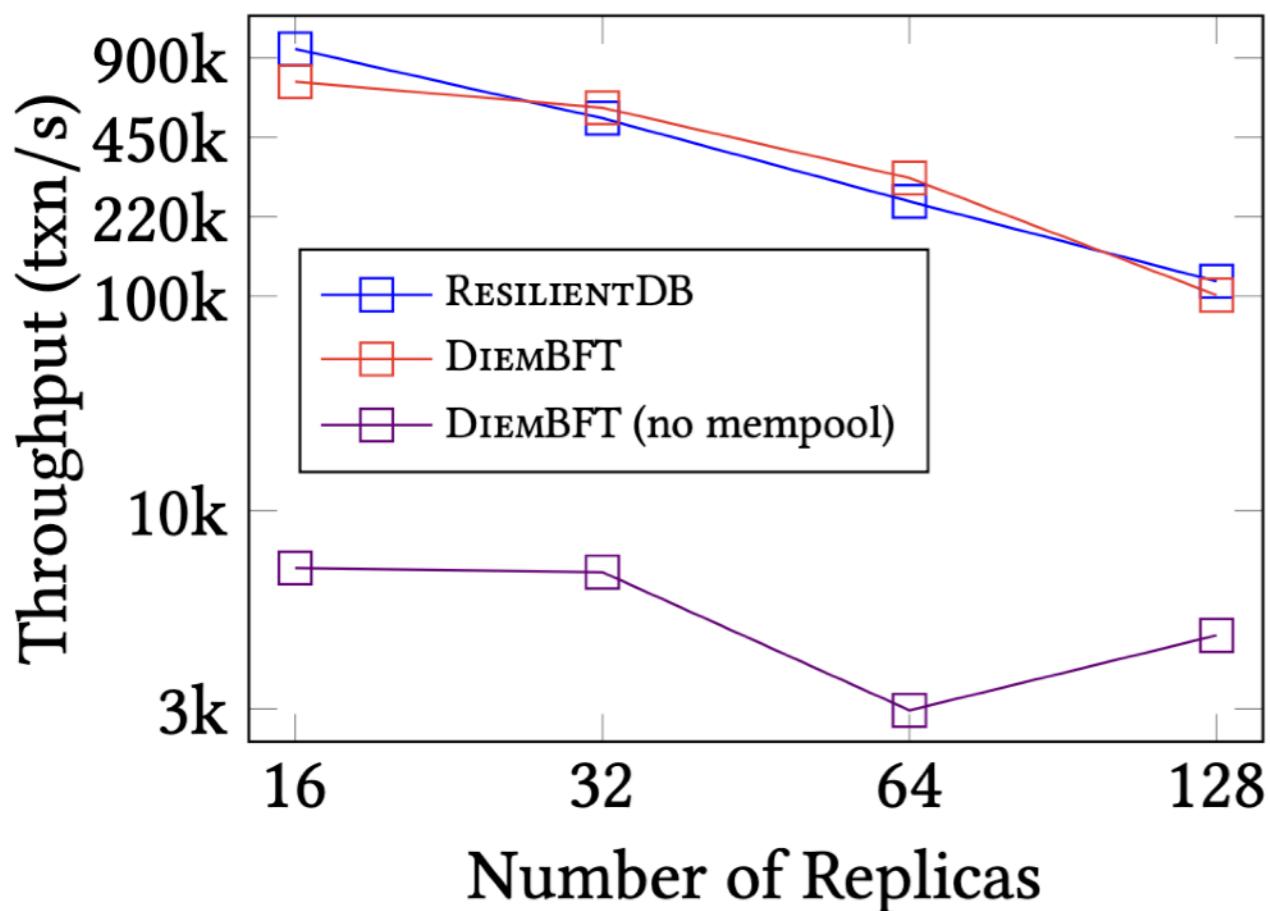
# Power-of-Collaboration + System X

Collaborative mining as notary service results in negligible throughput and latency overheads.



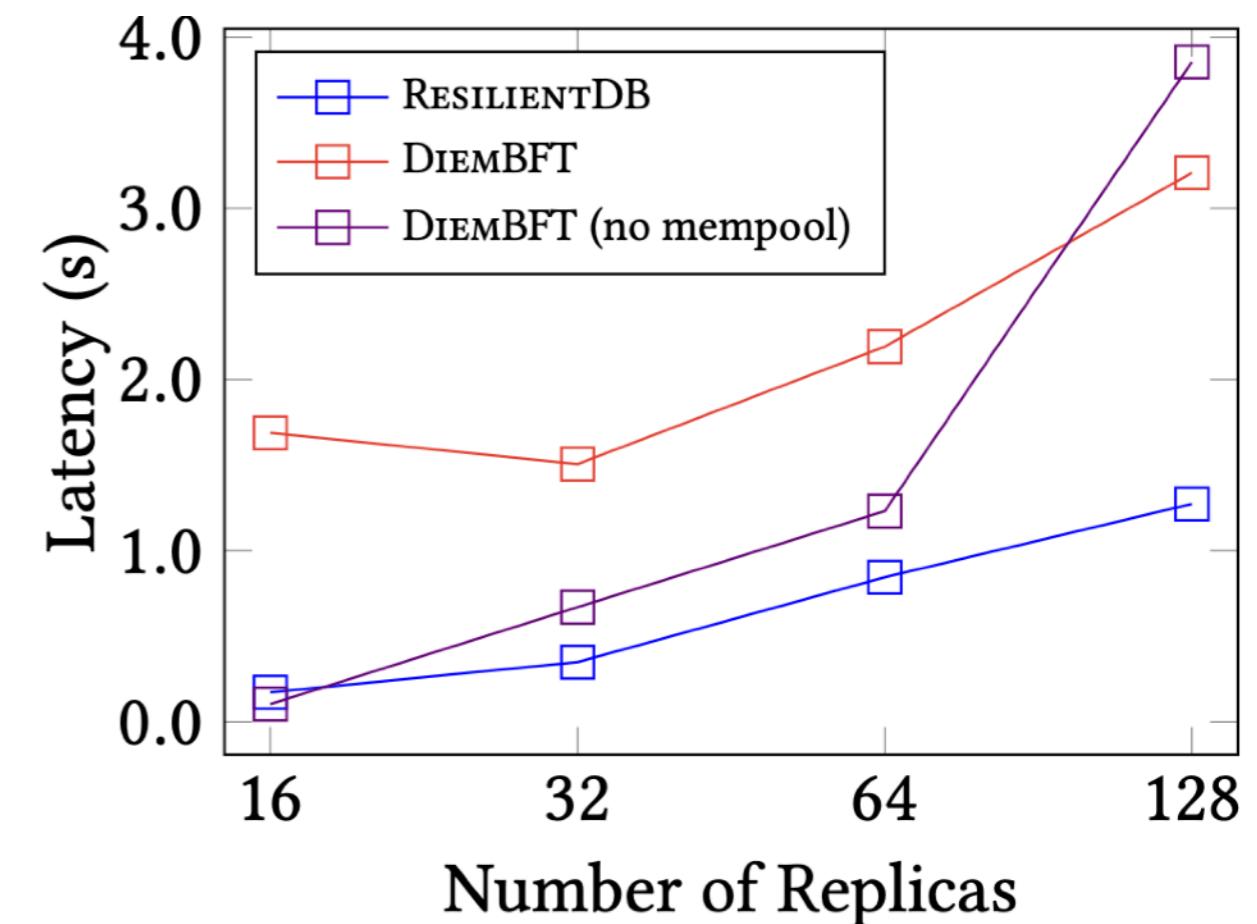
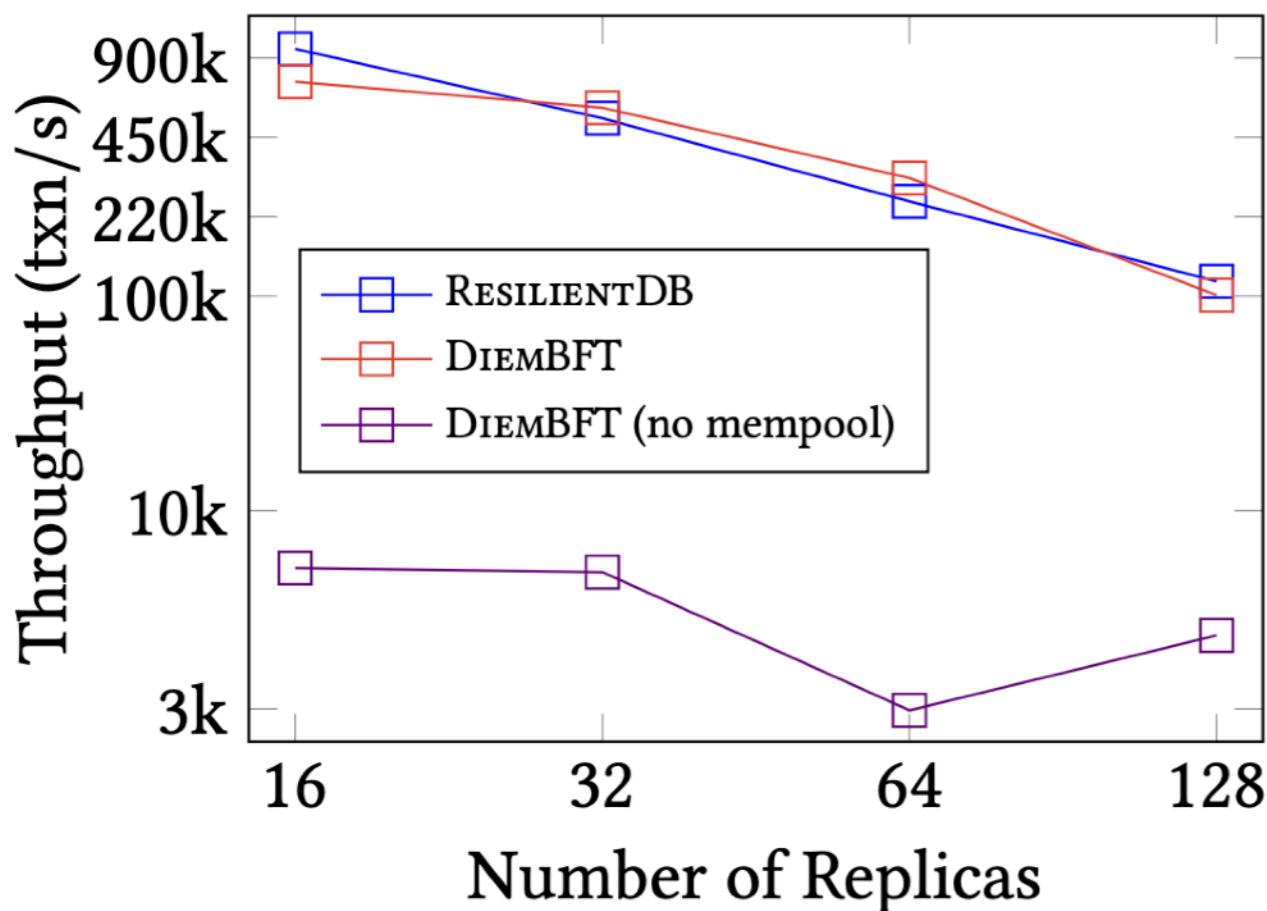
# ResilientDB Performance

Highly optimized PBFT implementation in ResilientDB can sustain up to 900,000 transactions per seconds and scales up to hundreds of replicas.



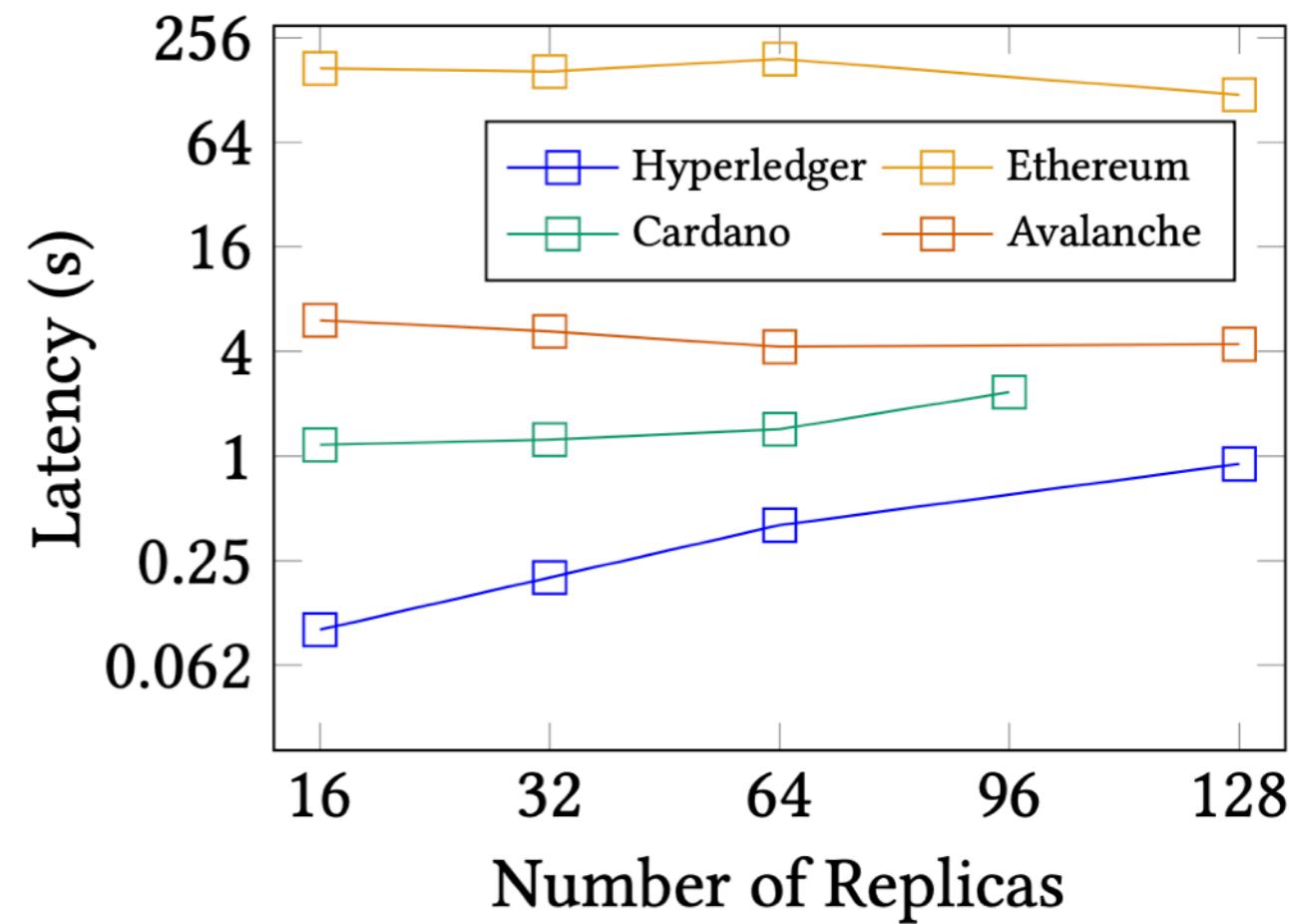
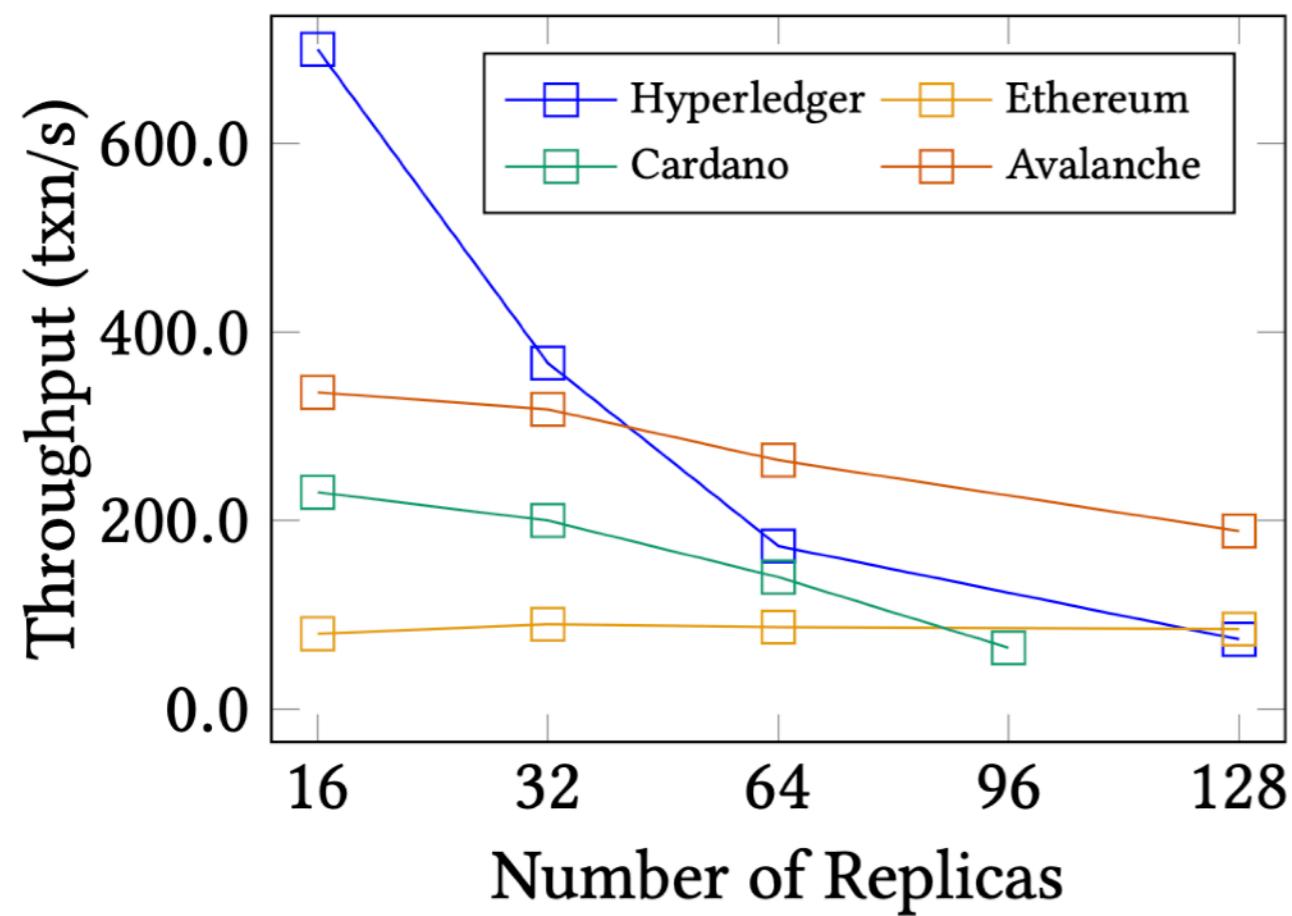
# ResilientDB Performance

Highly optimized PBFT implementation in ResilientDB can sustain up to 900,000 transactions per seconds and scales up to hundreds of replicas.



# ResilientDB Performance

Highly optimized PBFT implementation in ResilientDB + PoC can sustain up to 900,000 transactions per seconds and scales up to hundreds of replicas.



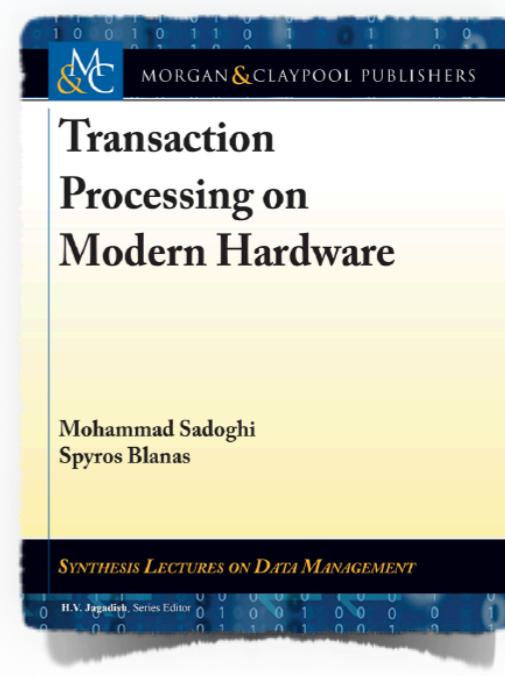
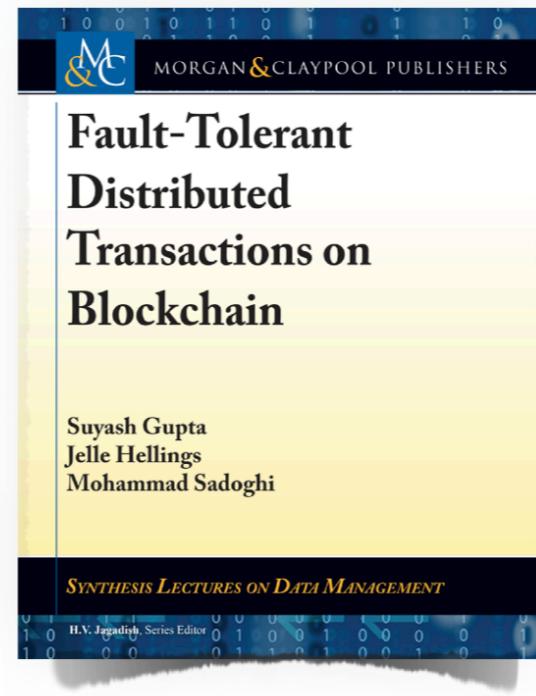
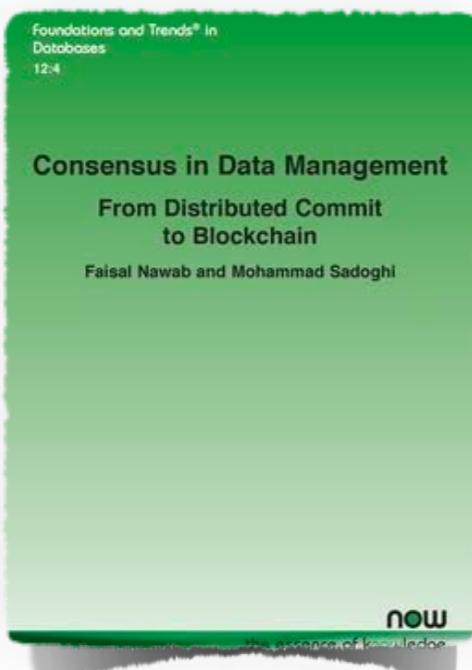
# ResilientDB Performance

Transactions costs is orders of magnitude cheaper on ResilientDB

Blockchain	Cost Per 1000 Transactions
RESILIENTDB	\$0.00007
RESILIENTDB + PoC	\$0.000136
DIEMBFT	\$0.00019
HYPERLEDGER	\$0.08
AVALANCHE	\$0.155
CARDANO	\$0.239
ETHEREUM	\$14.66



# THANK YOU



## FOR COMPLETE REFERENCES

