

# MINIATURE WORLD: AN EMULATION PLATFORM FOR LARGE-SCALE NETWORKS

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# Blockchain Technology

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- ✓ Promise to revolutionize Fintech
- ✓ Trustless auditability
- ✓ Innovative use-cases
- ✗ Scalability and efficiency barriers

# Evaluating Blockchain Protocols

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What is the state-of-the-art  
for the evaluation of  
blockchain proposals?

## EVALUATION BY DISCUSSION





# Evaluation by Discussion

3



Technical Tradeoffs

# Evaluation by Discussion

3



Technical Tradeoffs

Potential Economic Impacts

# Evaluation by Discussion

3



Technical Tradeoffs

Potential Economic Impacts

Individual Preferences

# Evaluation by Discussion

3



Technical Tradeoffs

Potential Economic Impacts

Individual Preferences

Concerns



# Evaluation by Discussion

3

Technical Tradeoffs

Potential Economic Impacts

Individual Preferences

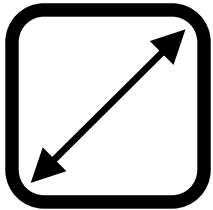
Concerns\*

*\*My proposal is better than yours!*

# Evaluation by Discussion

4

2009



**1MB**

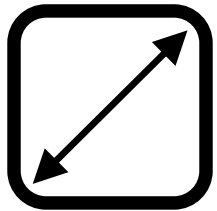
—  $t$  —→

# Evaluation by Discussion

4

2009

Reparameterization Debate\*

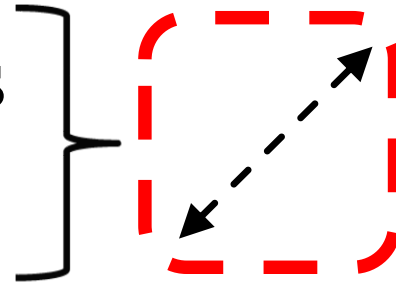


**1MB**

#bitcoin-dev:

849 discussions

65 threads

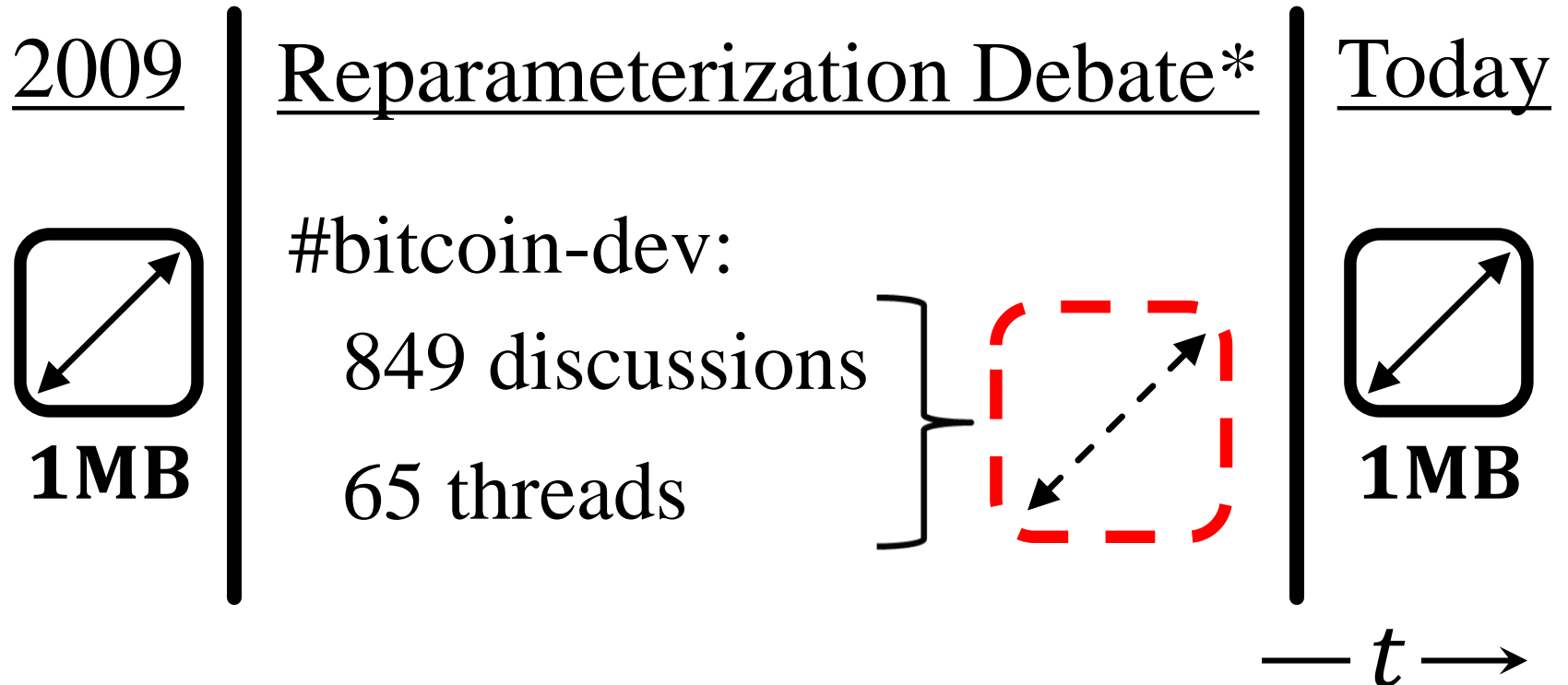


—  $t$  —→

\* BIPs 100, 101, 102, 103, 105, 106, 107, ...

# Evaluation by Discussion

4



\* BIPs 100, 101, 102, 103, 105, 106, 107, ...

## EVALUATION BY RELEASING



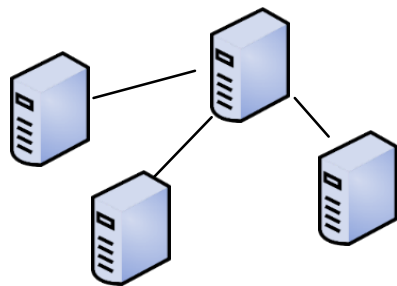


# Evaluation by Releasing

5



: Alternate cryptocurrencies



: Custom testnets

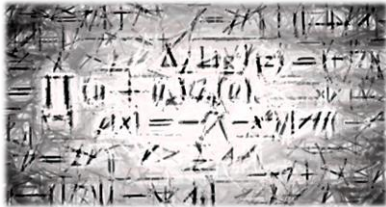


# EVALUATION ON THE PAPER

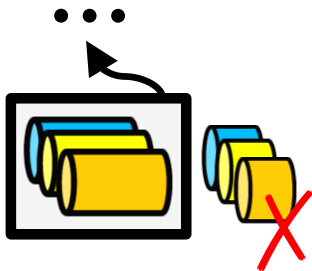


# Evaluation on the Paper

6



: Better signatures



: More efficient use of blocks

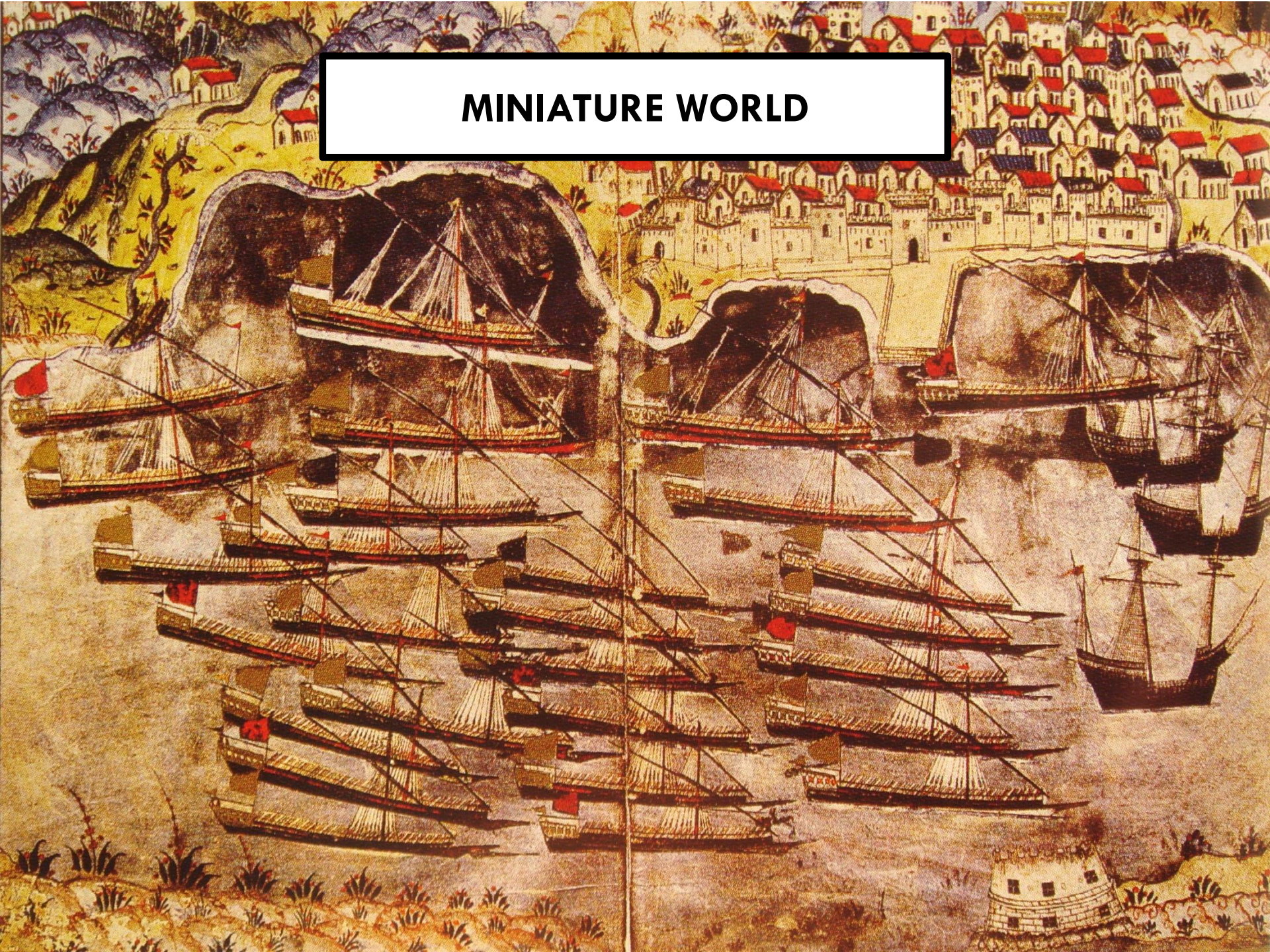
# Challenges

7

- Reaching a consensus
- Providing a representative environment
- Risk-free evaluation
- Evaluation under different scenarios and constraints



# MINIATURE WORLD





# Miniature World

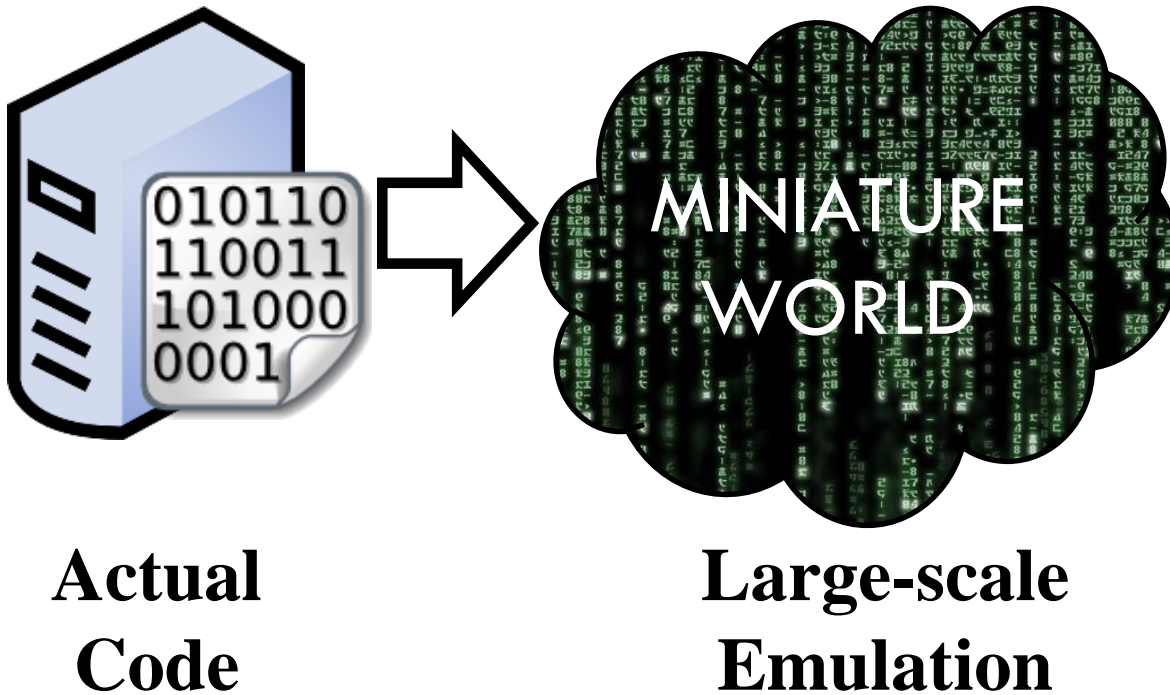
8



**Actual  
Code**

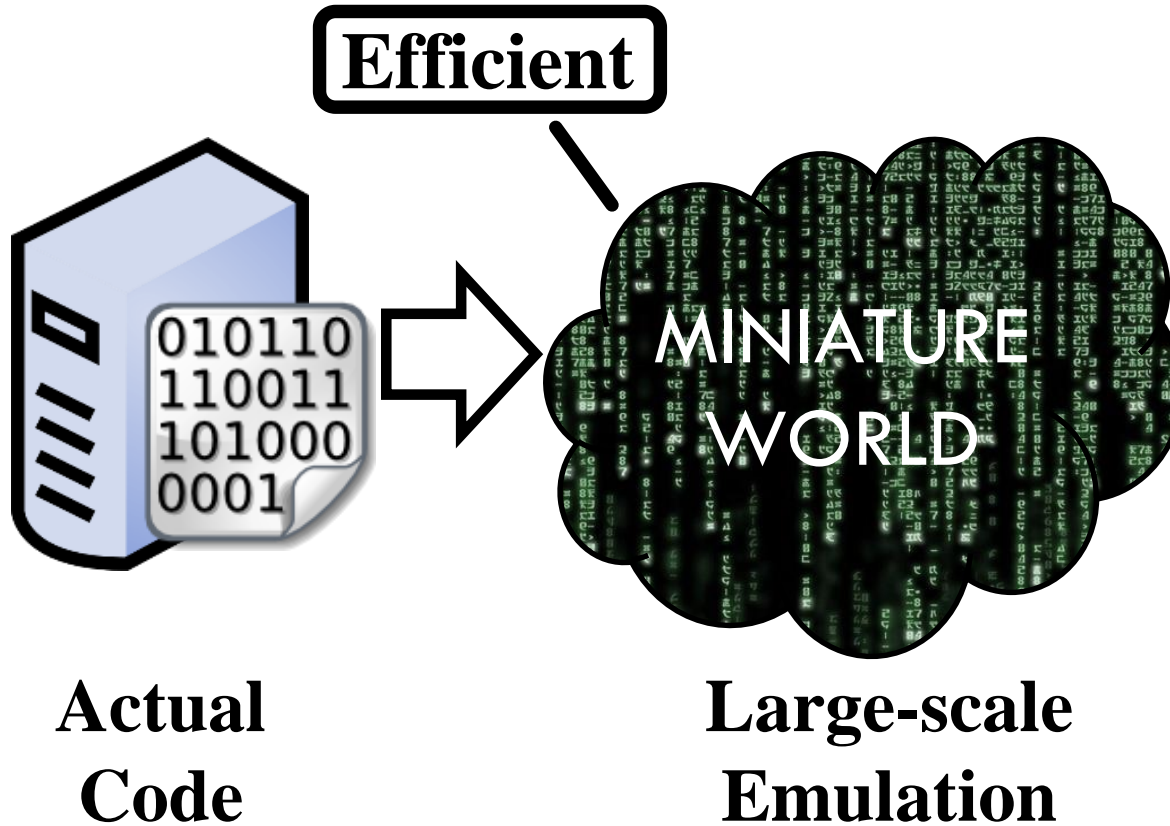
# Miniature World

8



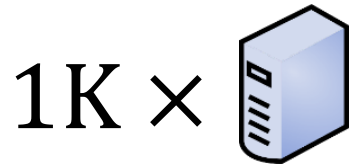
# Miniature World

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# Experience with Bitcoin-NG

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: 15% the size of the Bitcoin system



: Latency data from measurements



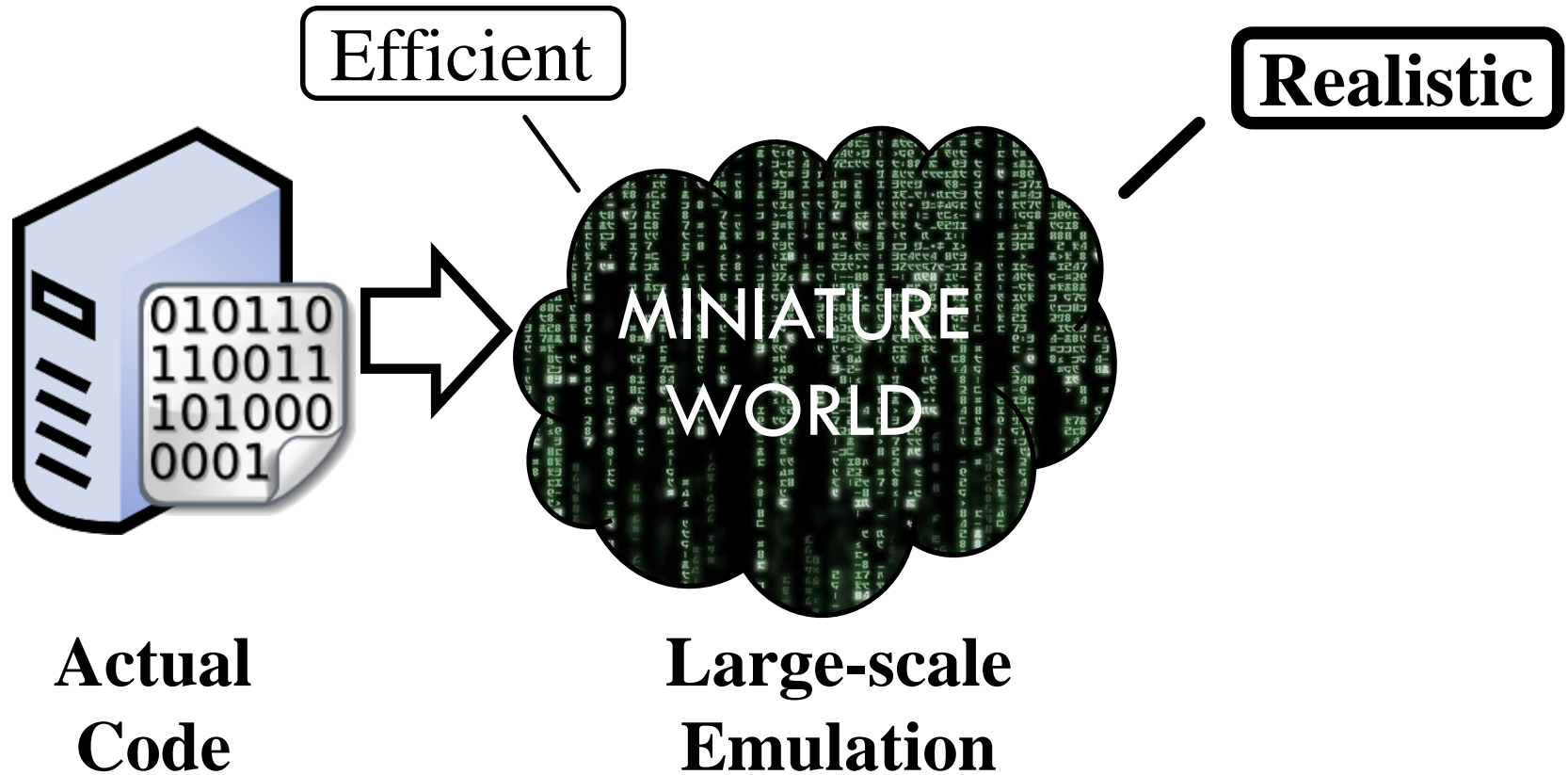
: Verification\* of characteristics

\* Decker and Wattenhofer '13



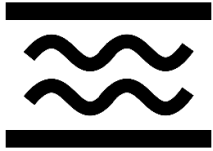
# Miniature World

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# Measurement and Characterization of Bitcoin Network

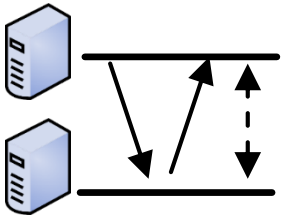
11



: Bandwidth



: P2P Latency



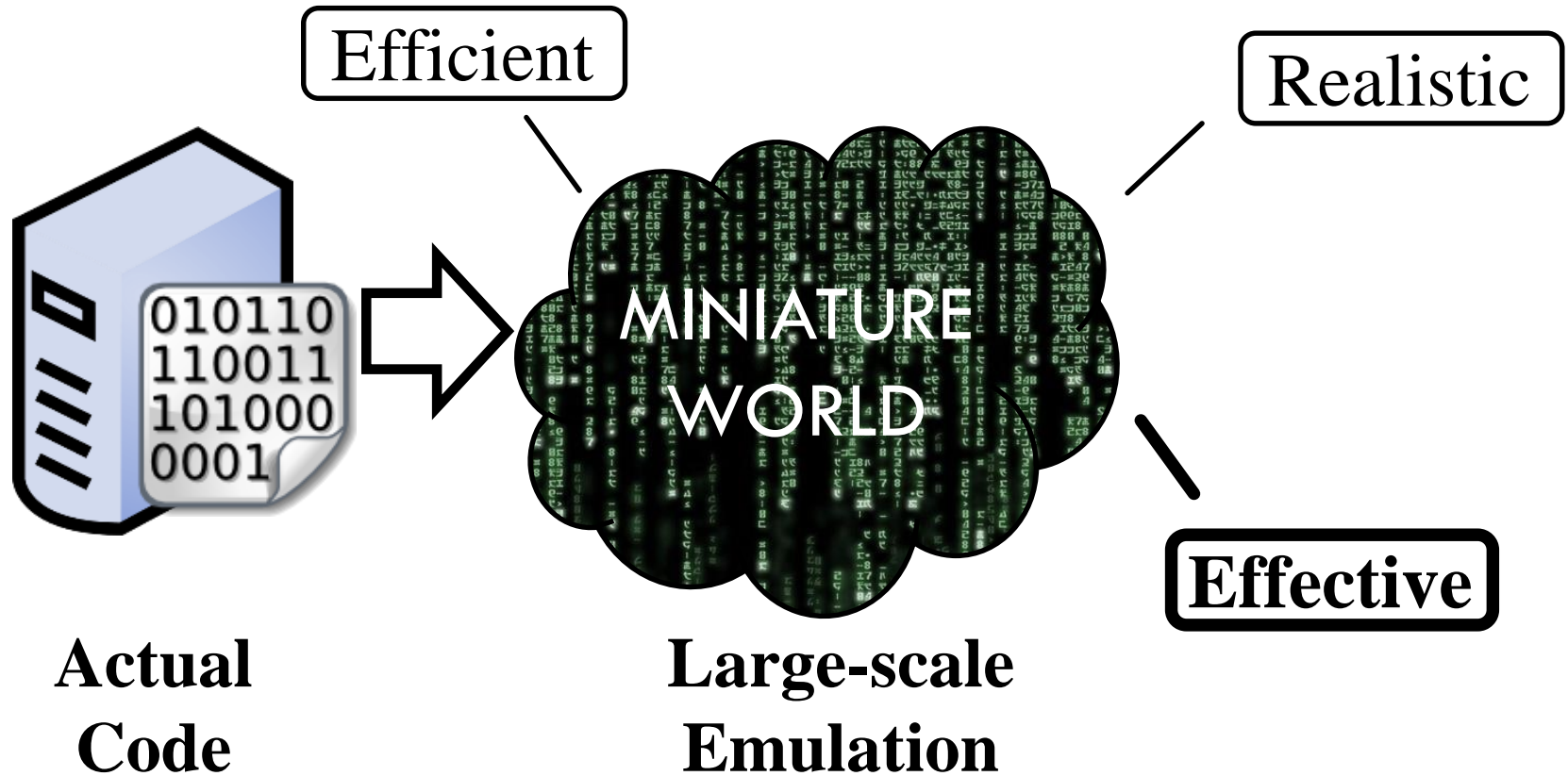
: Protocol-level traffic



: Temporal and event-driven variations

# Miniature World

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# Metrics for Blockchain Protocols

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Mining Power  
Utilization



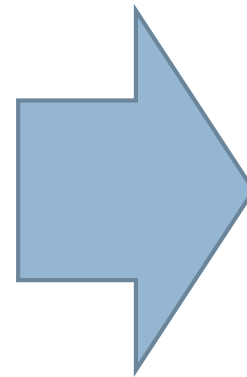
Fairness



Consensus Delay



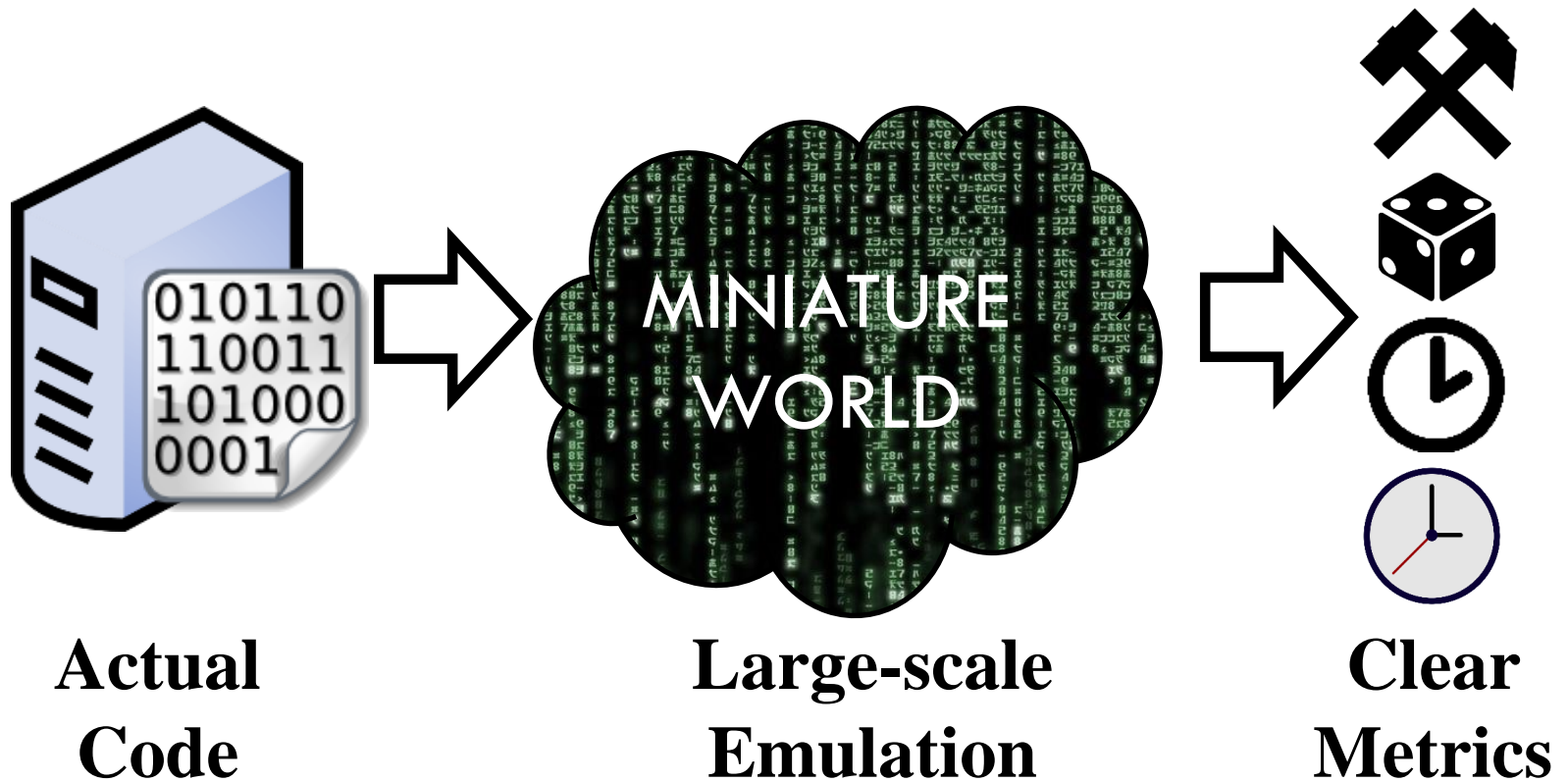
Time to Win &  
Time to Prune



{ Security  
Efficiency

# Miniature World

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# Conclusion

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## A principled way of evaluating proposals



Full control over: latency, bandwidth, traffic



Large-scale setup based on measurement and characterization of existing network



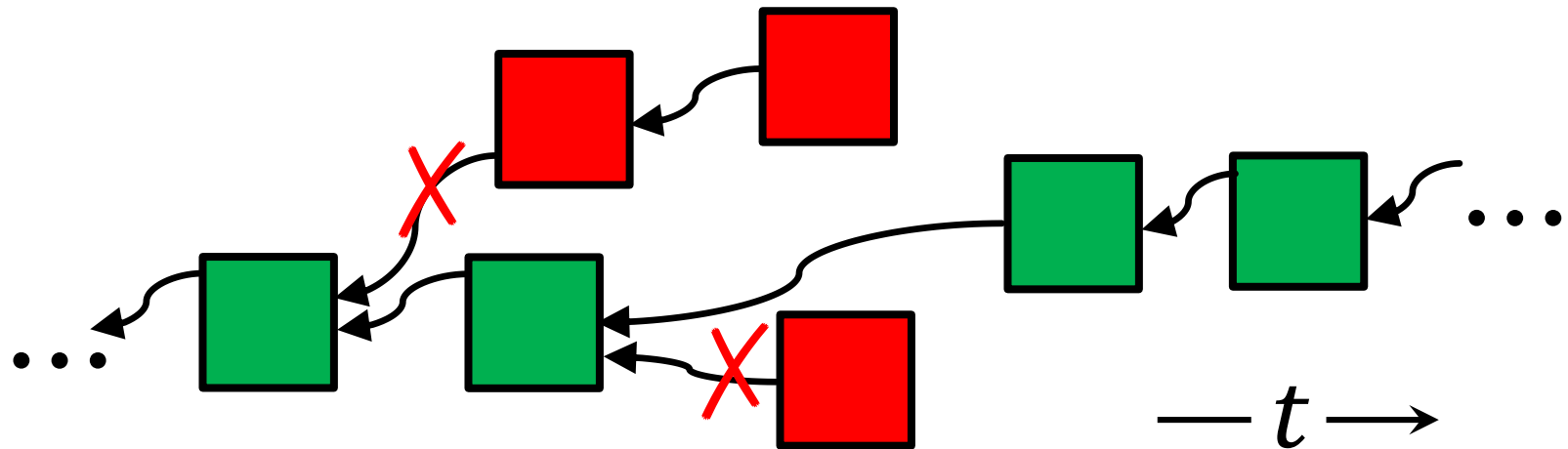
Custom metrics for blockchain protocols





# Mining Power Utilization










Measure of robustness against rollback



$$\frac{\sum \text{Green Block}}{\sum (\text{Green Block} + \text{Red Block})}$$

# Fairness

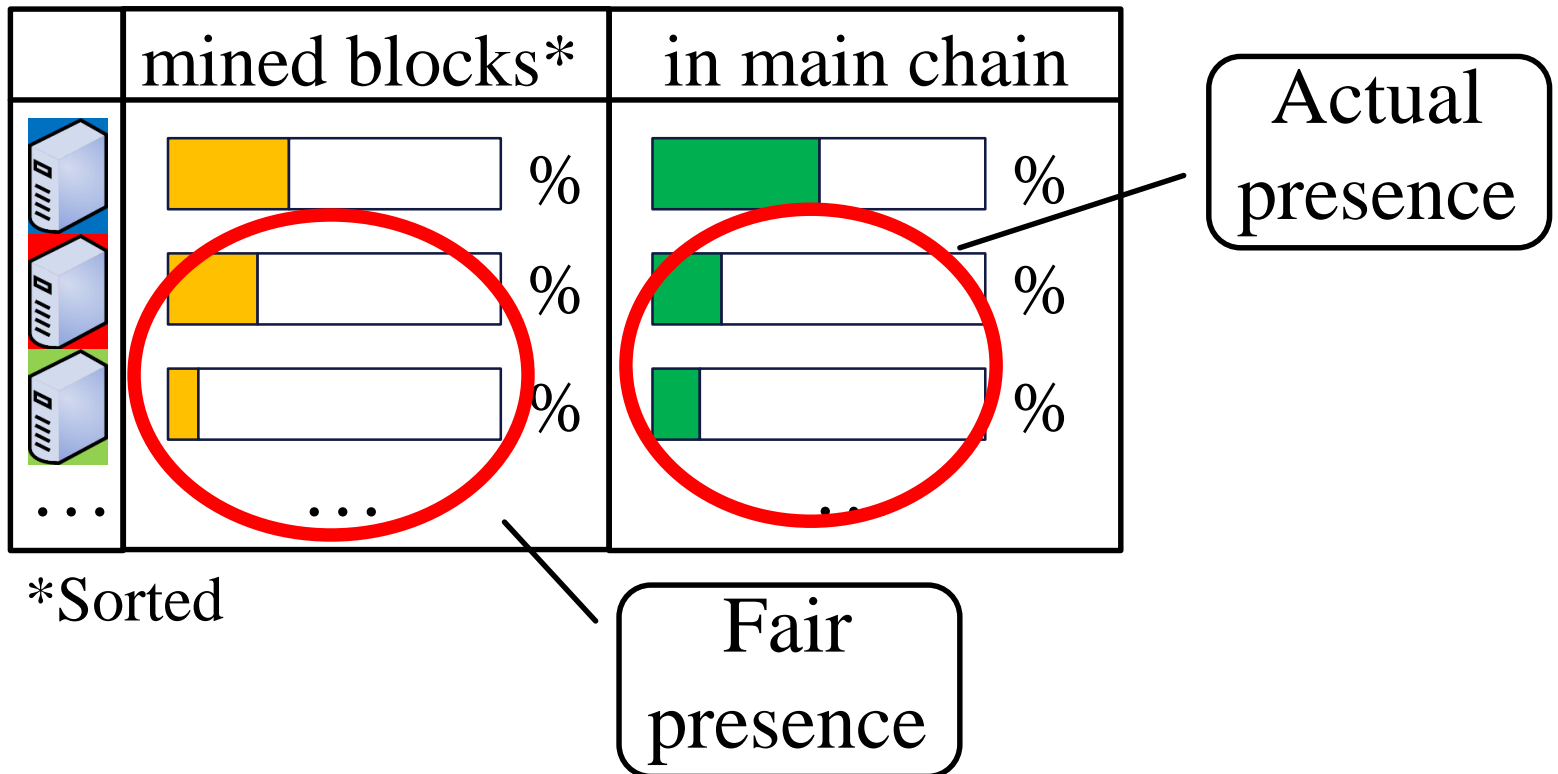
Measure of robustness against centralization

	mined blocks*	in main chain
	 %	 %
	 %	 %
	 %	 %
...	...	...

\*Sorted

# Fairness

Measure of robustness against centralization



# Fairness

Measure of robustness against centralization

$$\frac{\textit{Actual presence}}{\textit{Fair presence}}$$