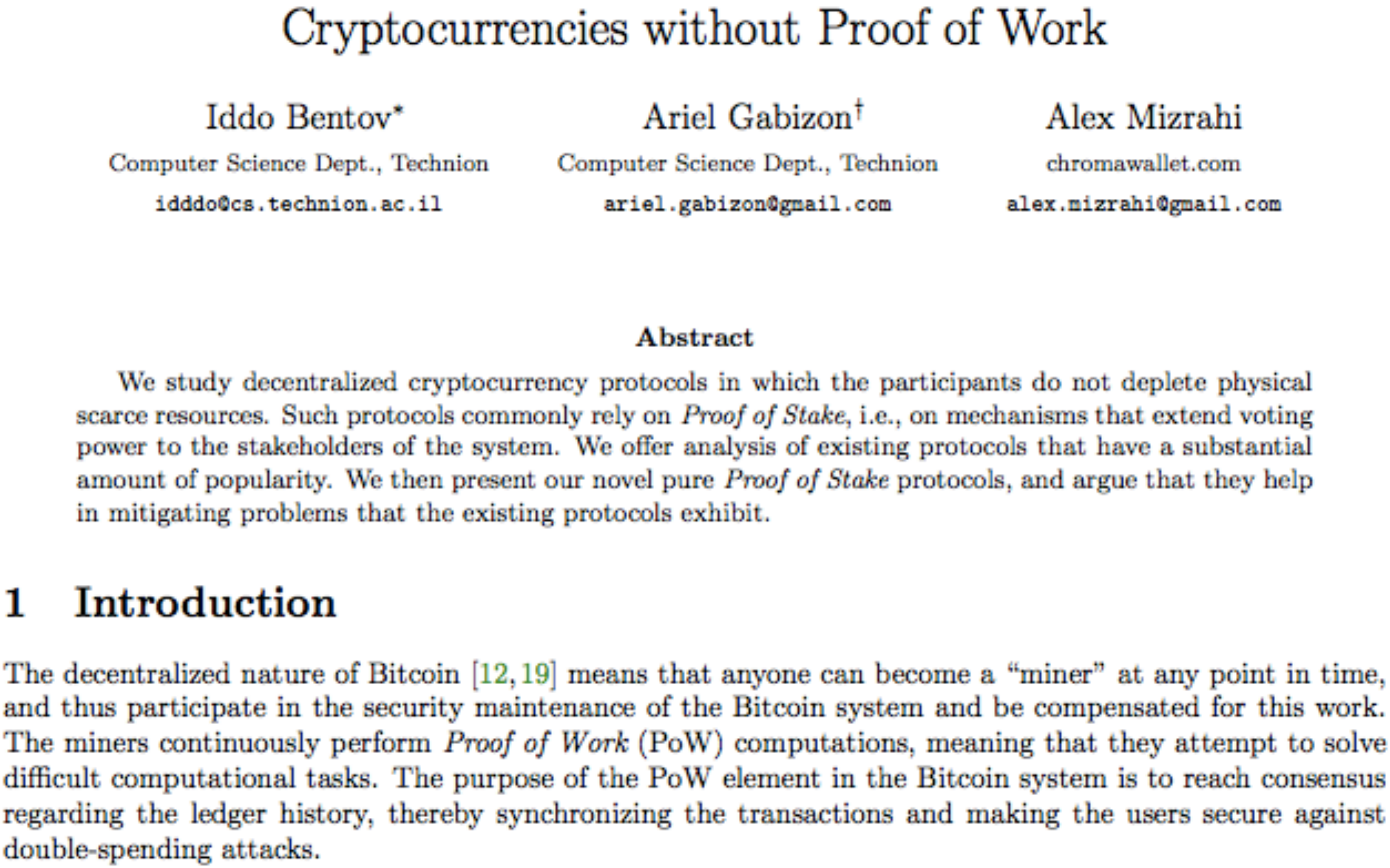
Proof of Stake 2

Murat Osmanoglu

Chains of Activity



Cryptocurrencies without Proof of Work

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Abstract

We study decentralized cryptocurrency protocols in which the participants do not deplete physical scarce resources. Such protocols commonly rely on *Proof of Stake*, i.e., on mechanisms that extend voting power to the stakeholders of the system. We offer analysis of existing protocols that have a substantial amount of popularity. We then present our novel pure *Proof of Stake* protocols, and argue that they help in mitigating problems that the existing protocols exhibit.

1 Introduction

The decentralized nature of Bitcoin [12, 19] means that anyone can become a "miner" at any point in time, and thus participate in the security maintenance of the Bitcoin system and be compensated for this work. The miners continuously perform *Proof of Work* (PoW) computations, meaning that they attempt to solve difficult computational tasks. The purpose of the PoW element in the Bitcoin system is to reach consensus regarding the ledger history, thereby synchronizing the transactions and making the users secure against double-spending attacks.

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  - Fair initial distribution of the money supply to the parties

  PoW solves this hurdle by converting physical resources into coins

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- each slot is associated with a single block that is generated by a single stakeholder

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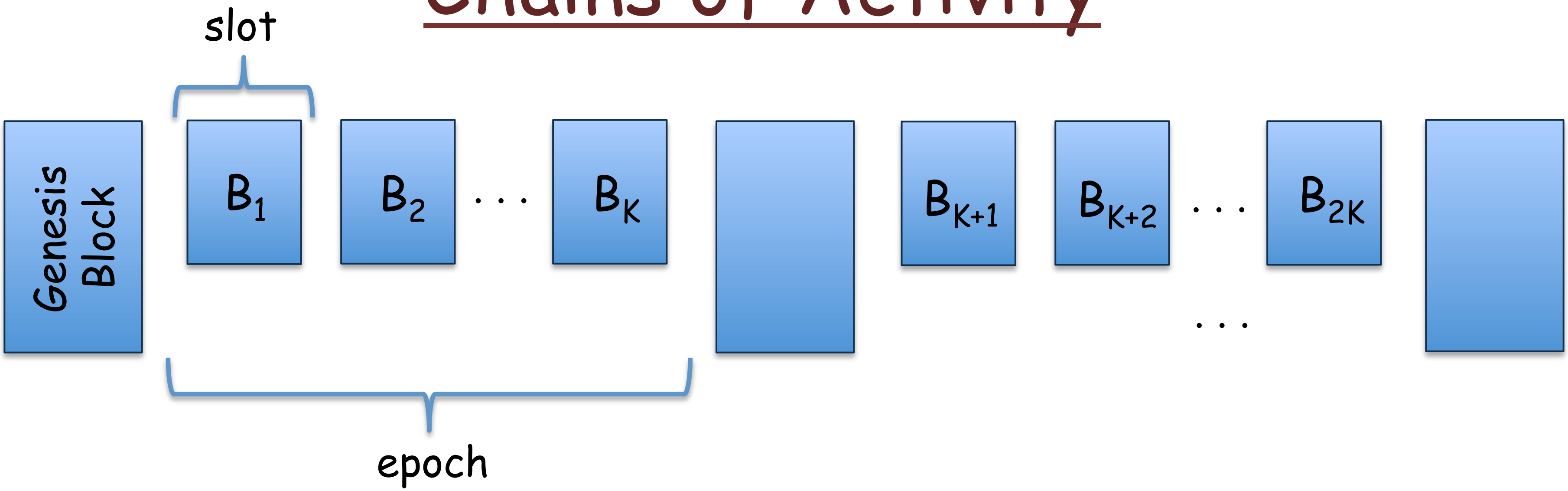
- These is then used to derive the identities of the next L stakeholders via follow-the-satoshi

Chains of Activity



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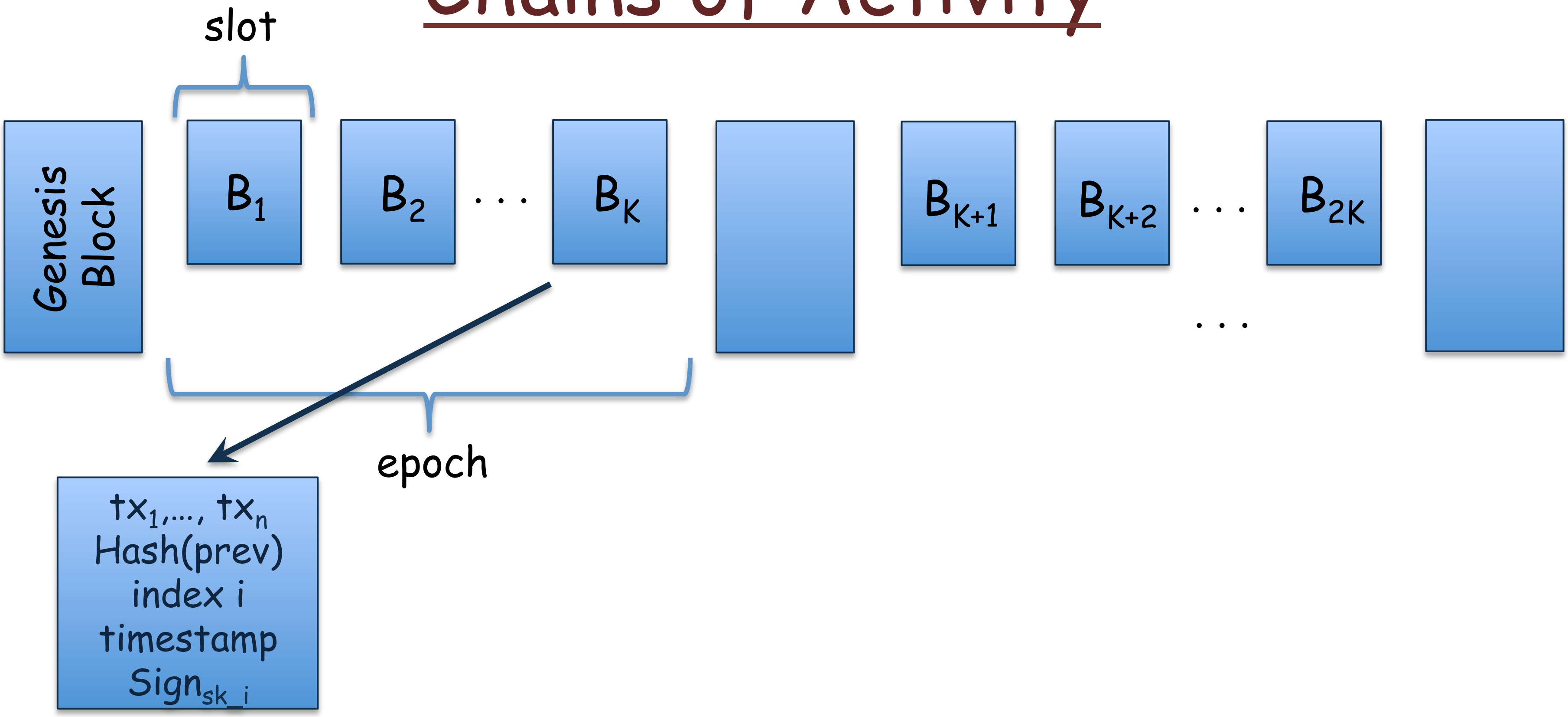

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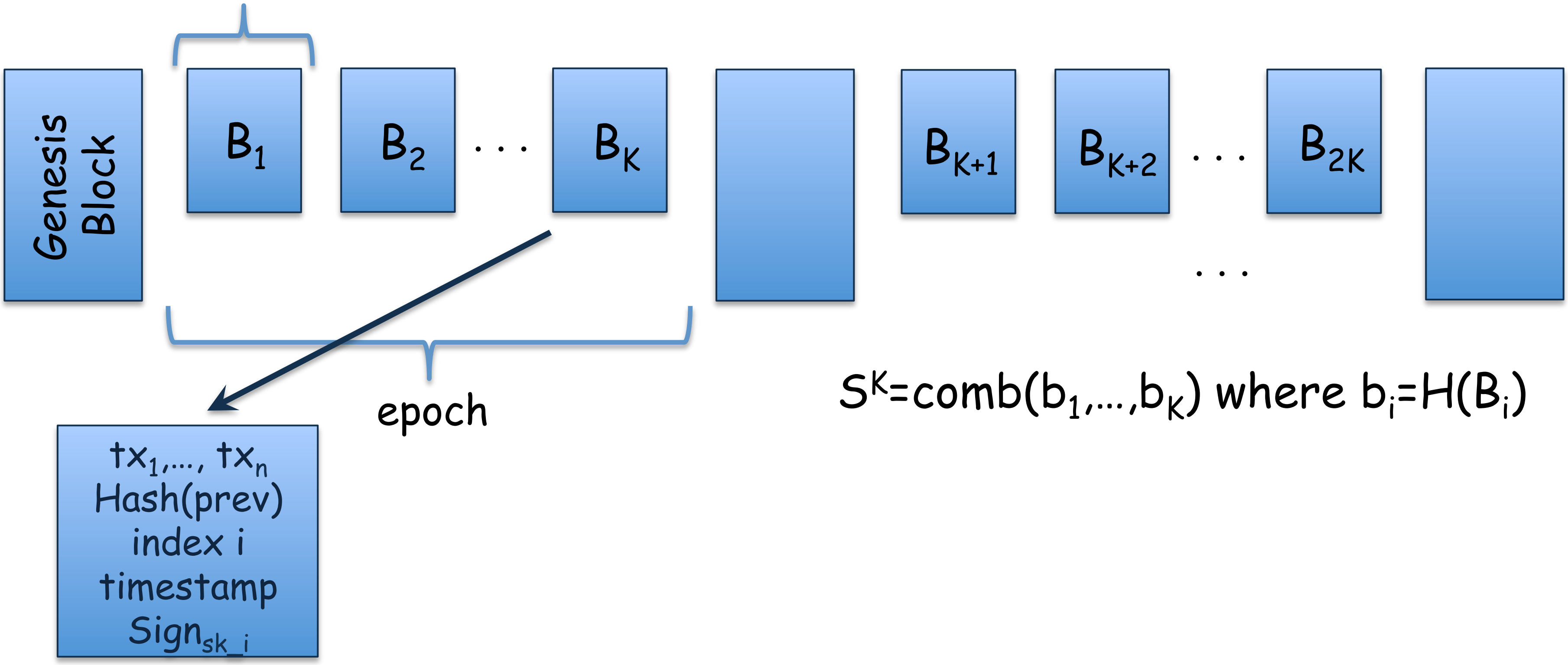

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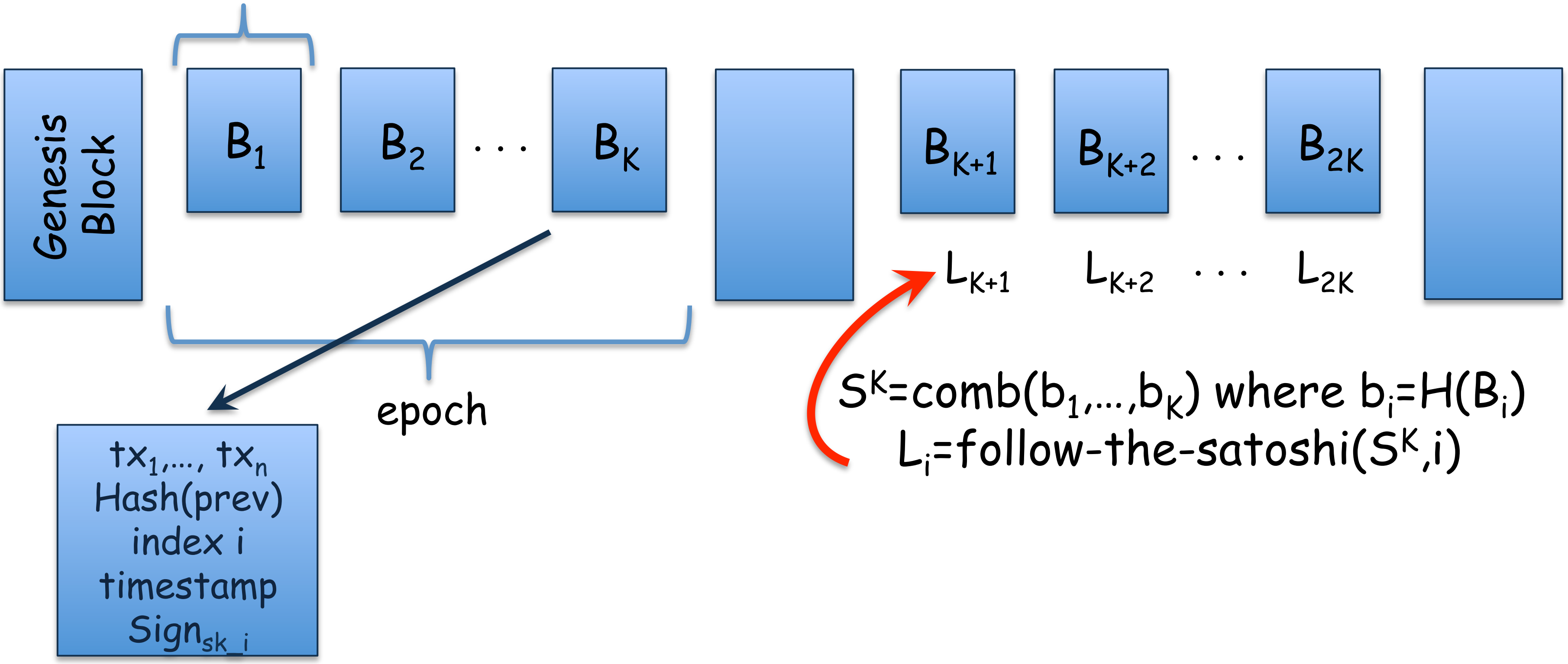

$tx_1, \ldots, tx_n$
Hash(prev)
index i
timestamp
Sign_{sk_i}

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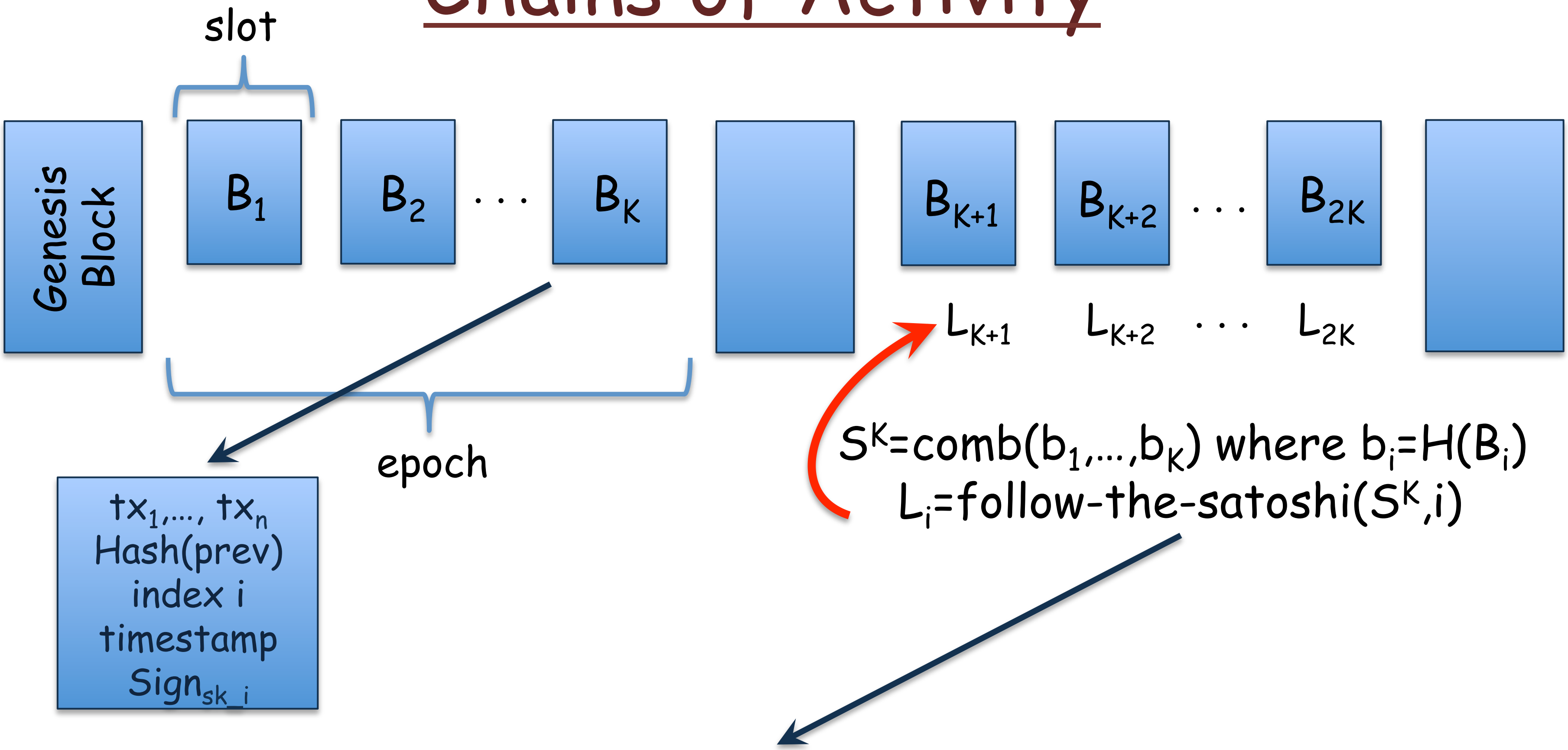

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follow-the-satoshi : it takes an index of a satoshi as input, and fetches the block of ledger data in which this satoshi minted, and tracks the transactions that moved this satoshi to subsequent addresses until the last one, and outputs this address

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- The performance of the protocol : blocks get created in intervals of less than a specific value G_0 minutes.

  Each eligible stakeholder would wish to earn fees by collecting transactions nearly until the next G_0 tick

  This value avoids the risk that the next stakeholder will extend an earlier block

  it is suggested to fix it as G_0 = 5 min

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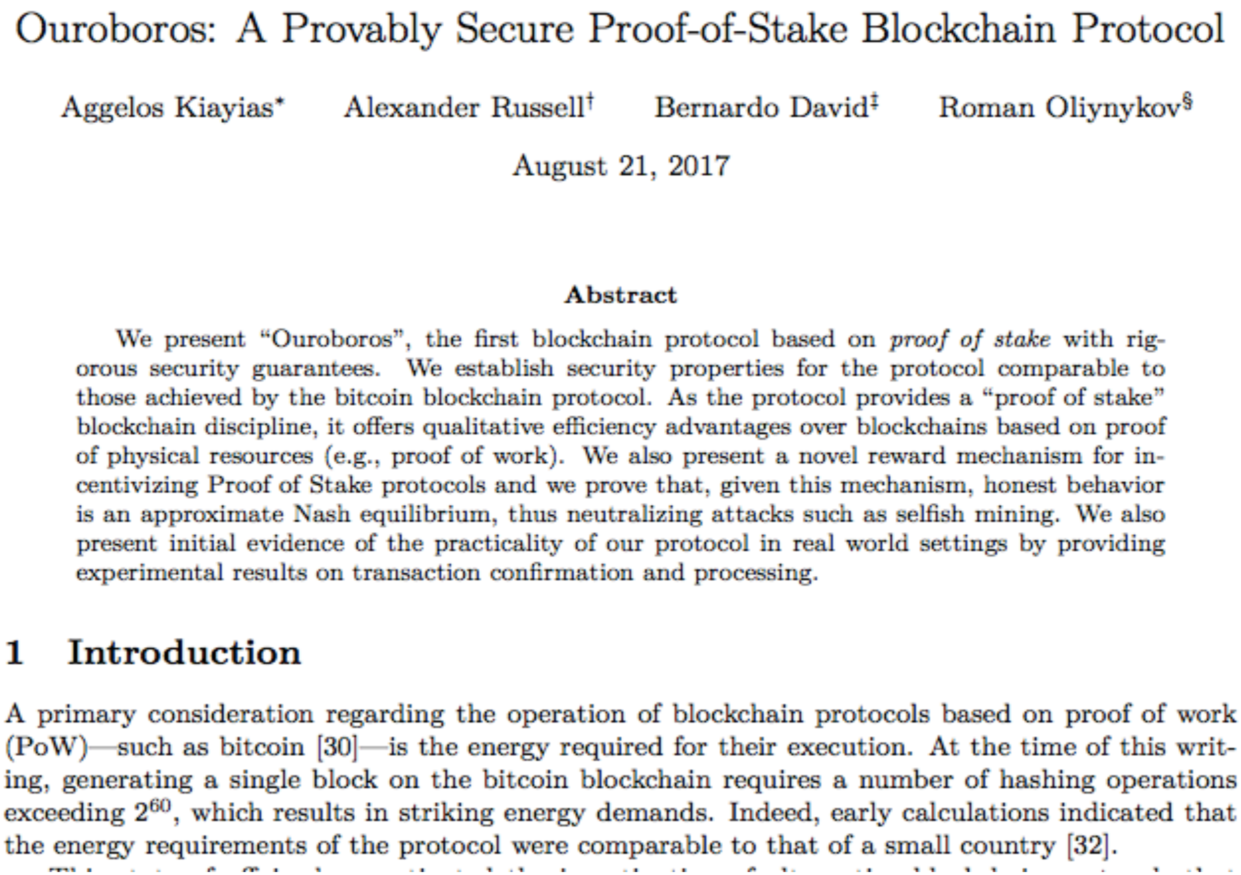
  it can be avoided by including in each transaction the index of the latest block that the user who made this transaction is aware of

Ouroboros



Ouroboros: A Provably Secure Proof-of-Stake Blockchain Protocol

Aggelos Kiayias* Alexander Russell[†] Bernardo David[‡] Roman Oliynykov[§]

August 21, 2017

Abstract

We present "Ouroboros", the first blockchain protocol based on *proof of stake* with rigorous security guarantees. We establish security properties for the protocol comparable to those achieved by the bitcoin blockchain protocol. As the protocol provides a "proof of stake" blockchain discipline, it offers qualitative efficiency advantages over blockchains based on proof of physical resources (e.g., proof of work). We also present a novel reward mechanism for incentivizing Proof of Stake protocols and we prove that, given this mechanism, honest behavior is an approximate Nash equilibrium, thus neutralizing attacks such as selfish mining. We also present initial evidence of the practicality of our protocol in real world settings by providing experimental results on transaction confirmation and processing.

1 Introduction

A primary consideration regarding the operation of blockchain protocols based on proof of work (PoW)—such as bitcoin [30]—is the energy required for their execution. At the time of this writing, generating a single block on the bitcoin blockchain requires a number of hashing operations exceeding 2^{60}, which results in striking energy demands. Indeed, early calculations indicated that the energy requirements of the protocol were comparable to that of a small country [32].

The first blockchain protocol based on Proof of Stake with rigorous security guarantees.

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- An adversary controlling a set of stakeholders may attempt to simulate the protocol execution trying different sequence of stakeholders participants so that it finds a protocol continuation that favors him

- it is called grinding vulnerability where malicious parties may use computational resources to bias the leader election

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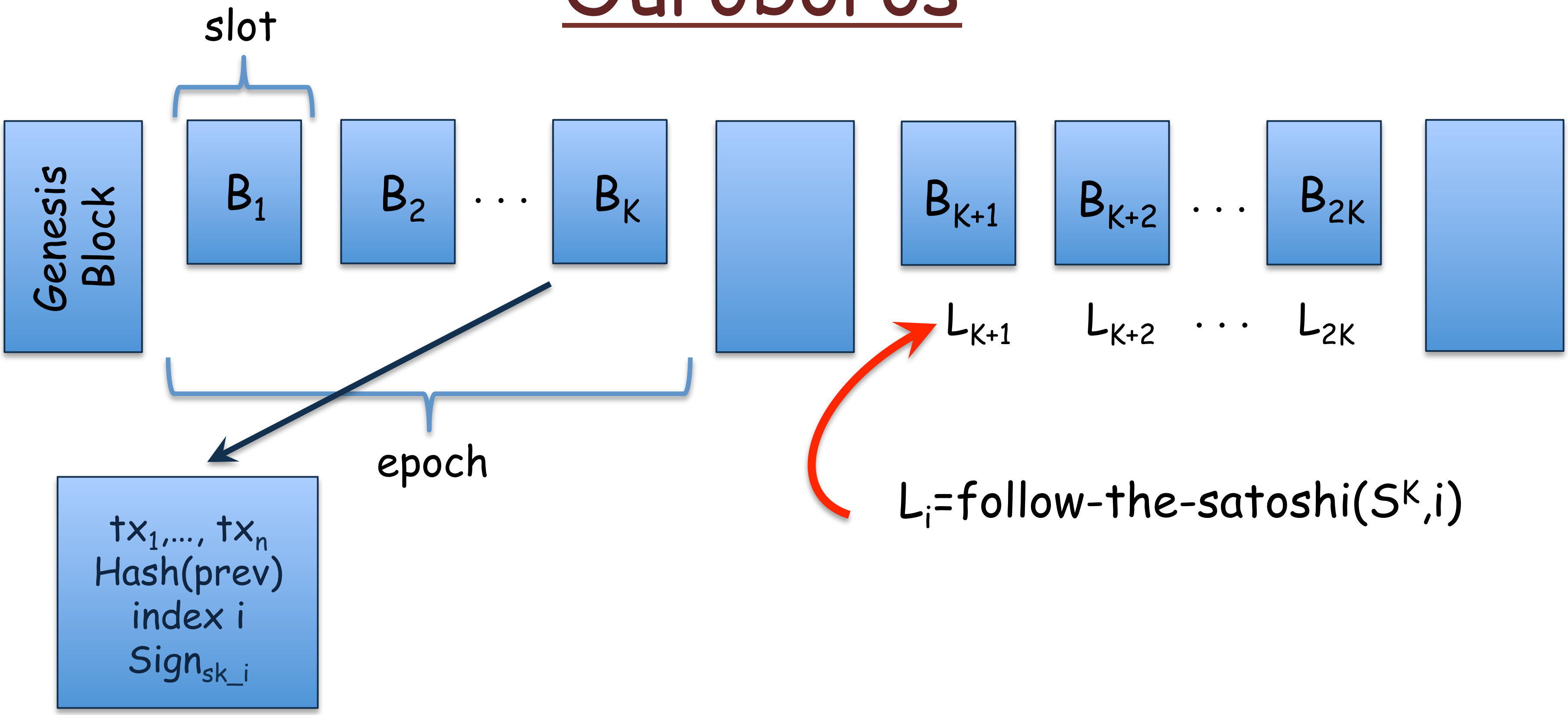

slot

Genesis Block

B_1 B_2 . . . B_K

B_{K+1} B_{K+2} . . . B_{2K}

L_{K+1} L_{K+2} . . . L_{2K}

epoch

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Hash(prev)
index i
Sign_{sk_i}

L_i=follow-the-satoshi(S^K,i)

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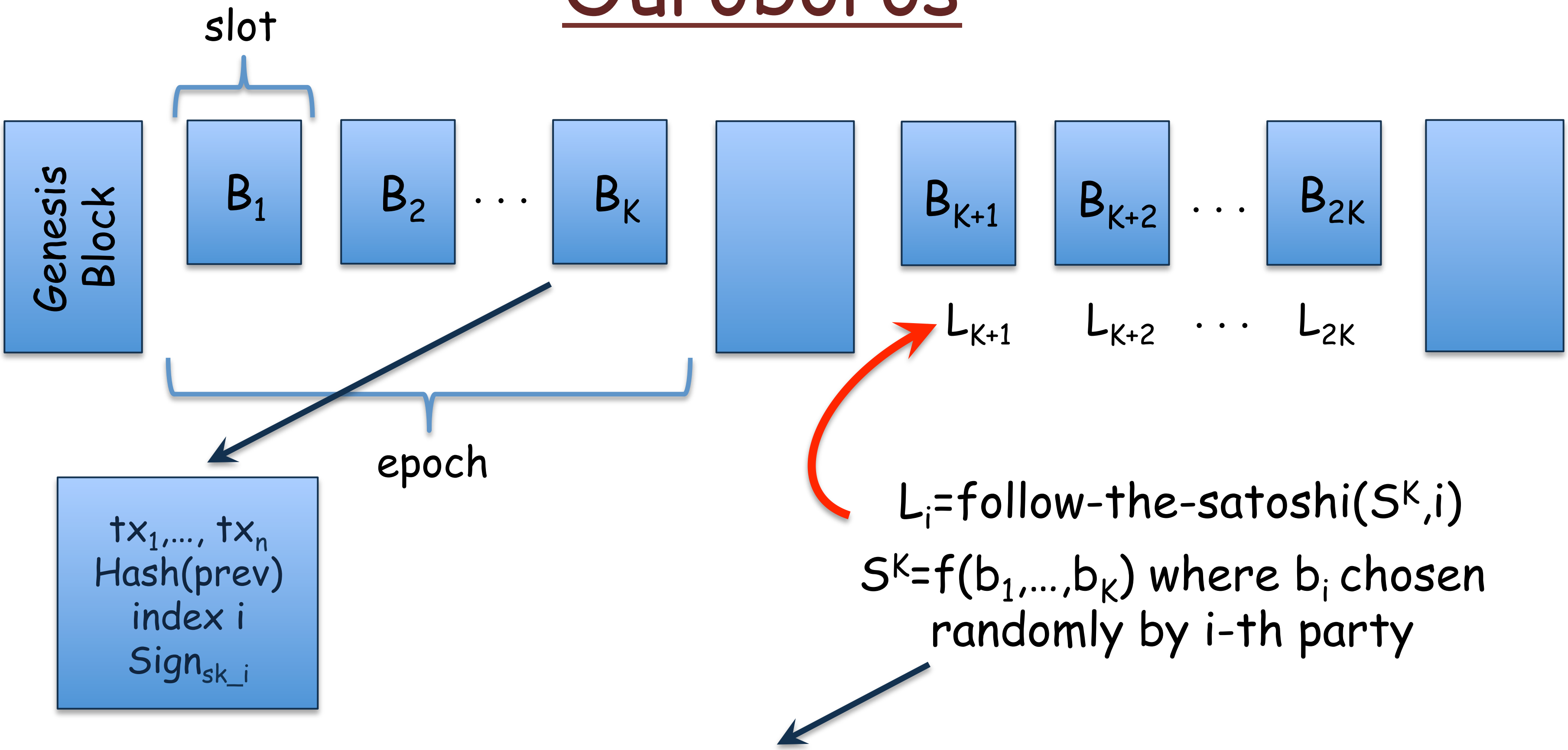

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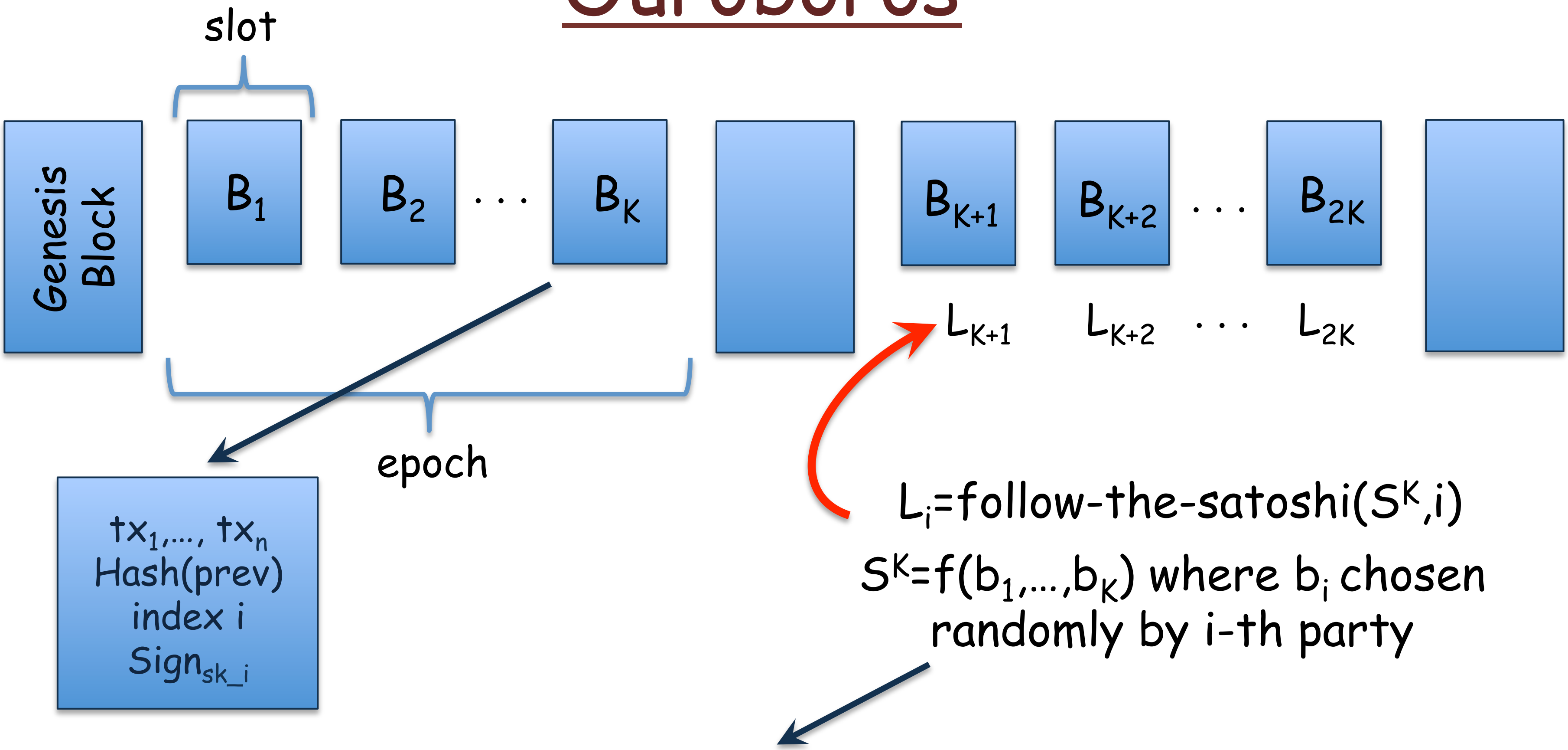

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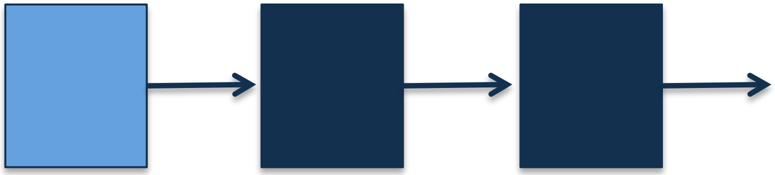
Secure Multiparty Computation: the leaders of an epoch run a secure multi-party computation to produce the randomness used to choose the leaders of the next epoch during the current epoch

PoW

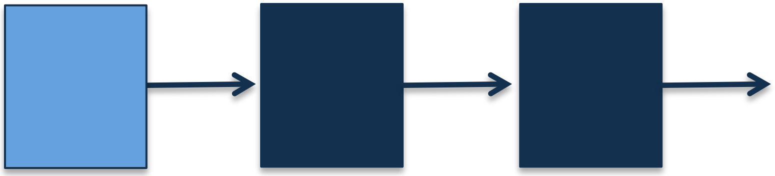
PoS

PoW



There is a genesis block which is extended by parties as they find Proof of Work

PoS



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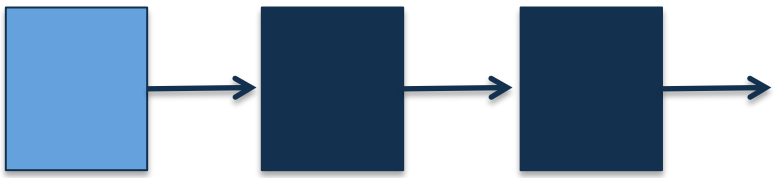
PoW



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Each block that is appended to the chain, contains transactions

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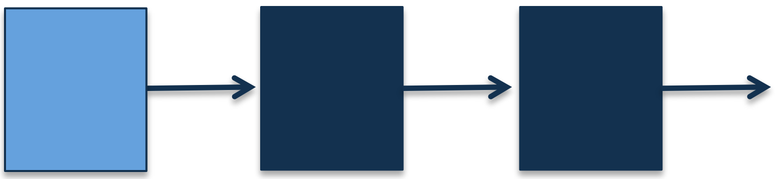

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One of the stakeholder is randomly elected to create the next block based on the stake that is recorded in the blockchain

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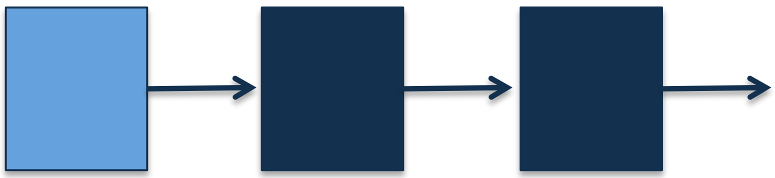

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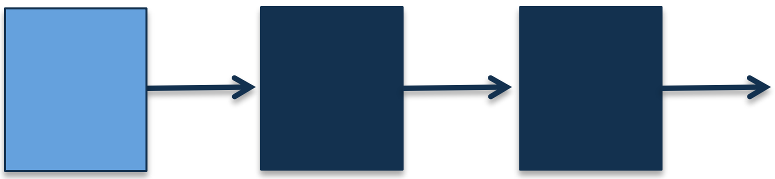

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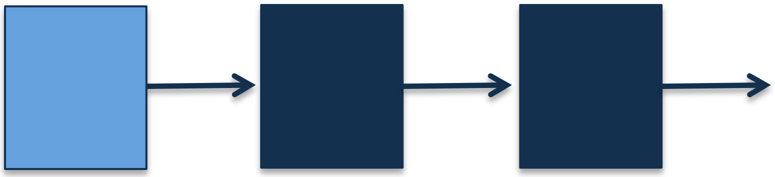

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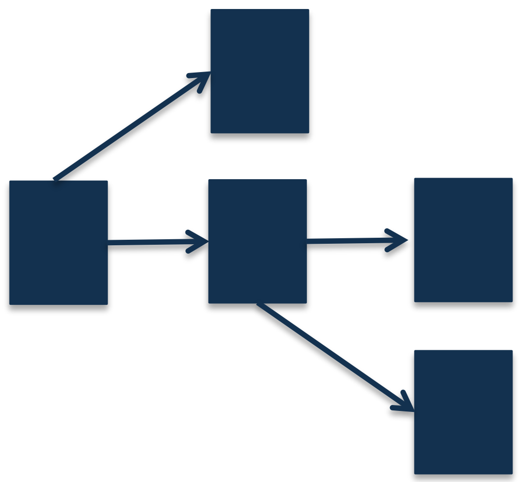

Multiple blockchains can coexist since they don't run the protocol in a coordinated way

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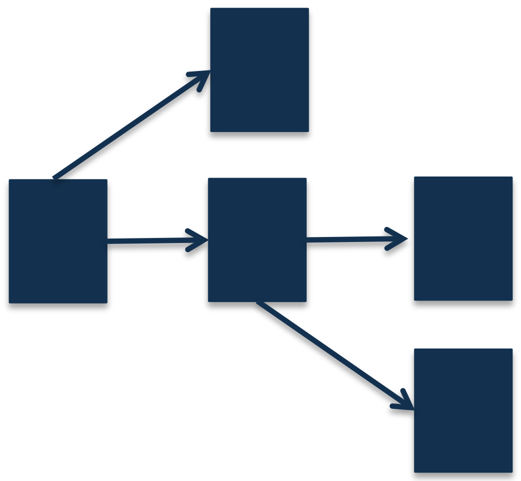

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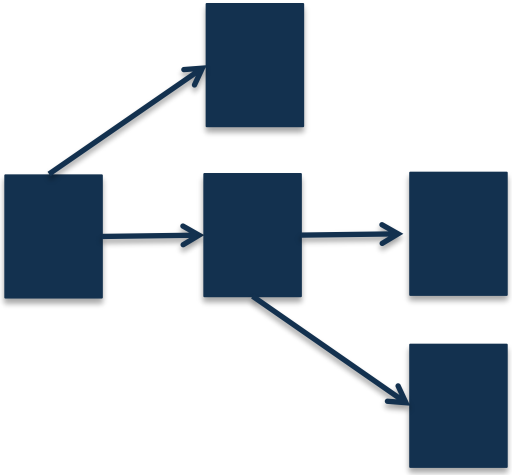

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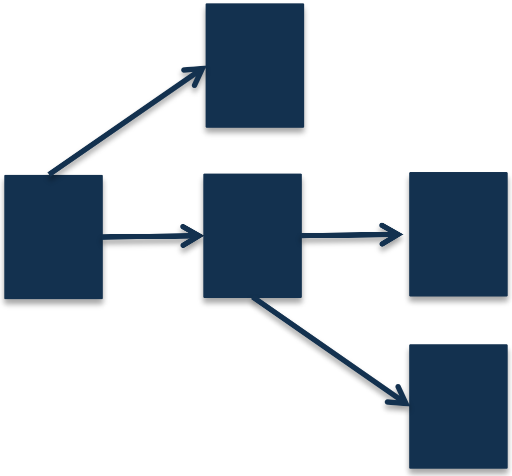

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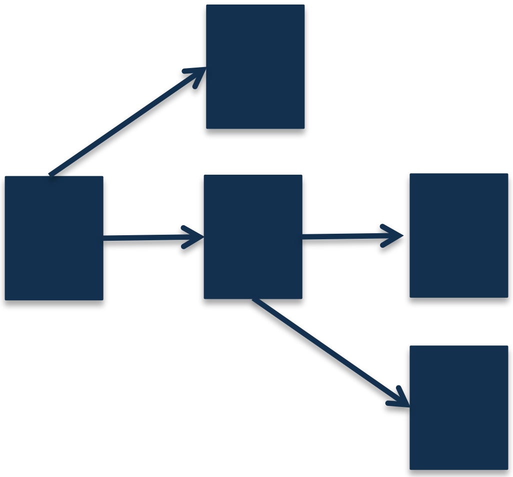

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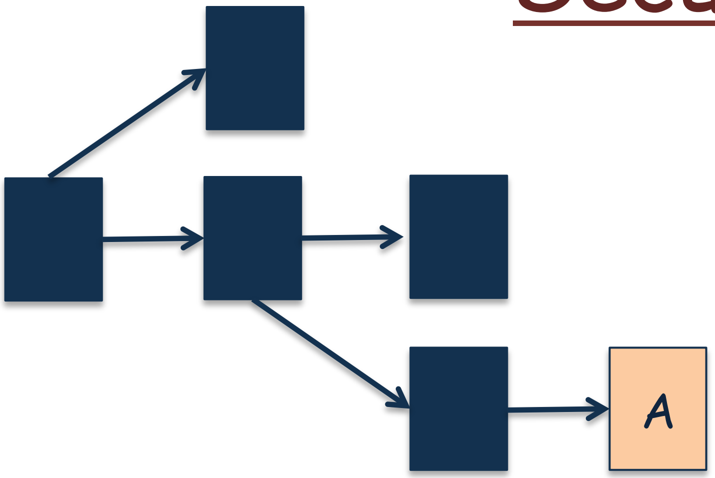

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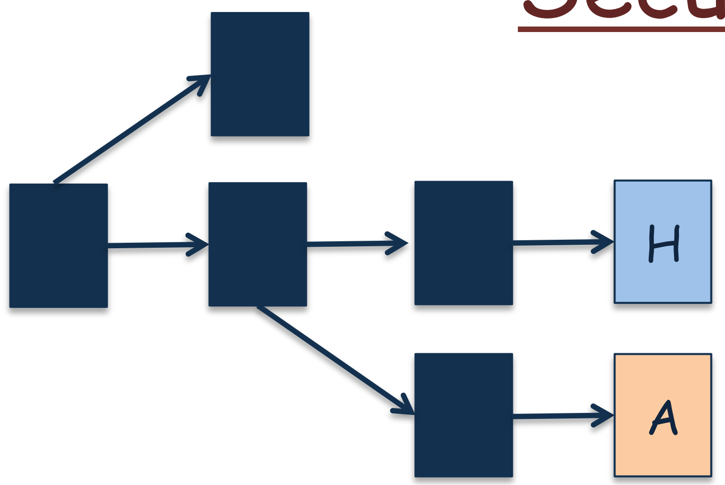

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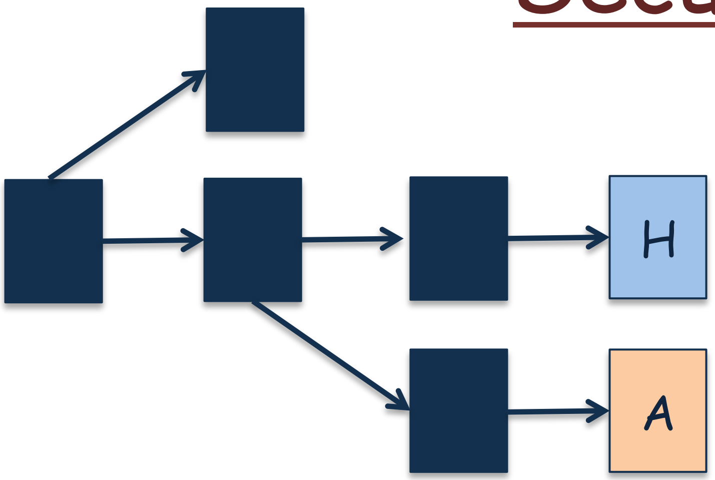

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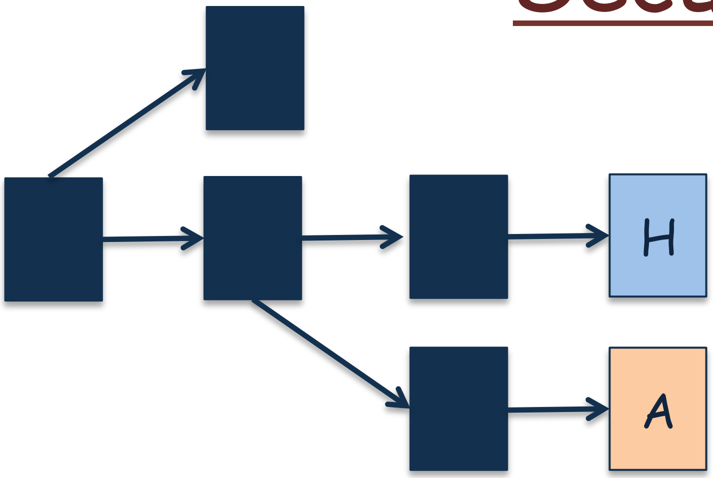

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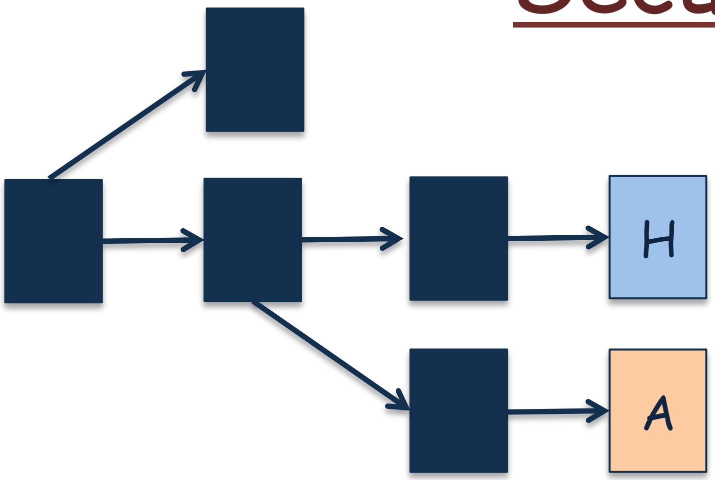
Security of PoW



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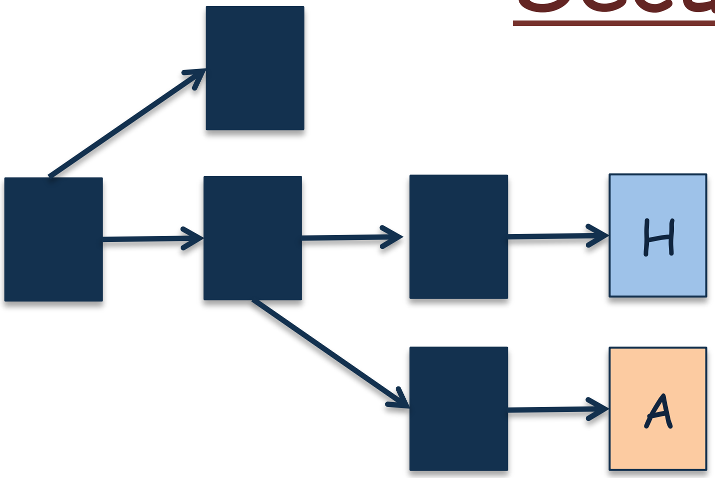

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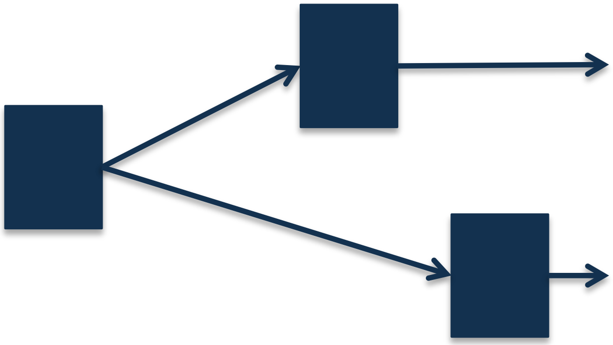
In the long term, the rate of uniquely successful round overcomes the rate of the adversarial blocks

Security of PoS



Multiple blockchains can coexist since they don't run the protocol in a coordinated way

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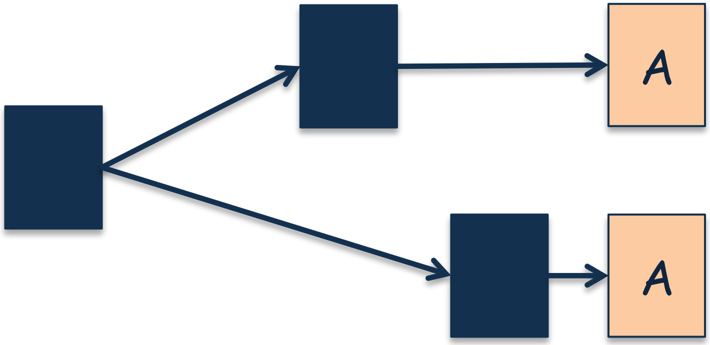
Security of PoS



Multiple blockchains can coexist since they don’t run the protocol in a coordinated way

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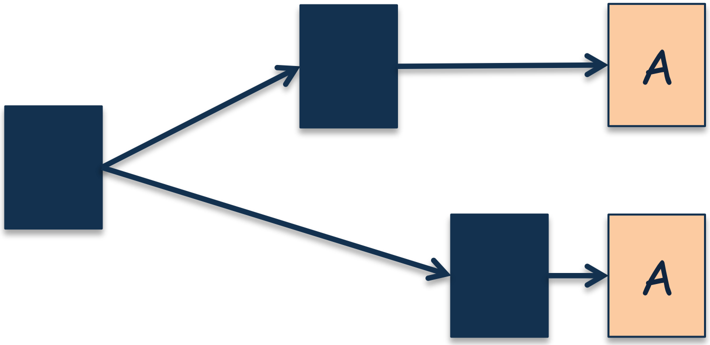

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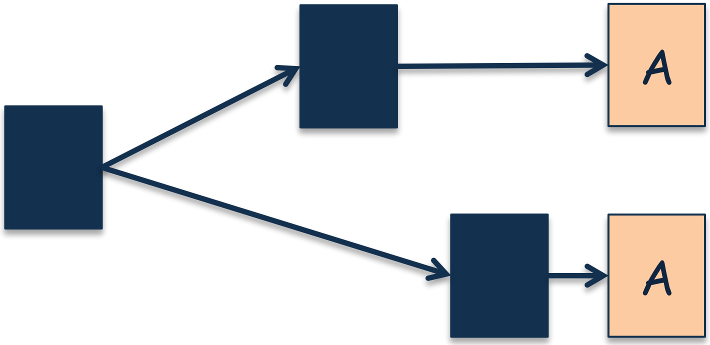

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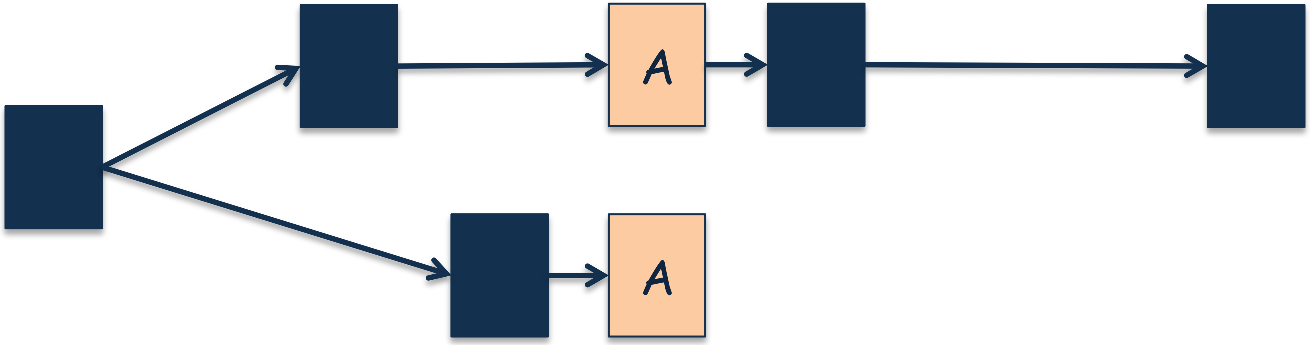

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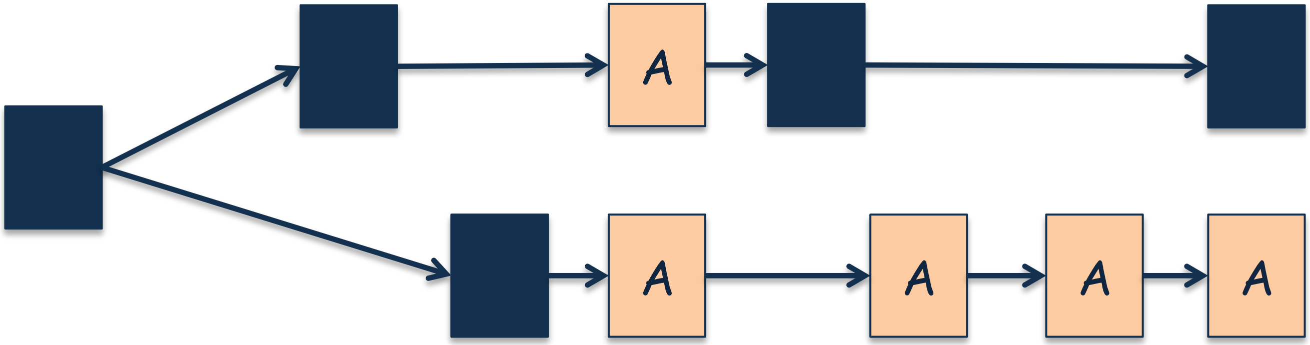

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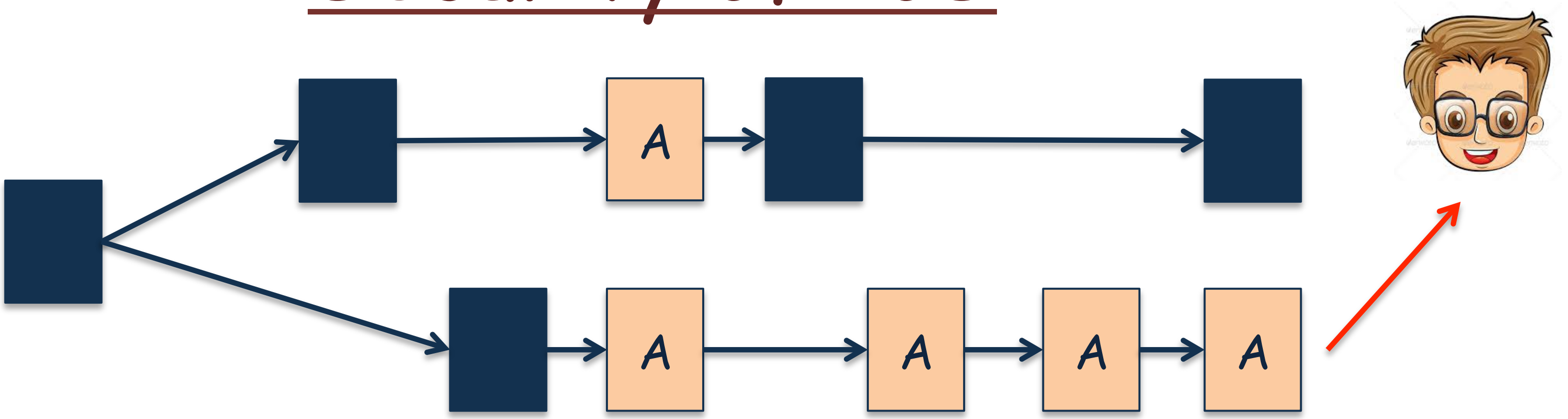

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This is a fork which undesired situation for the protocol

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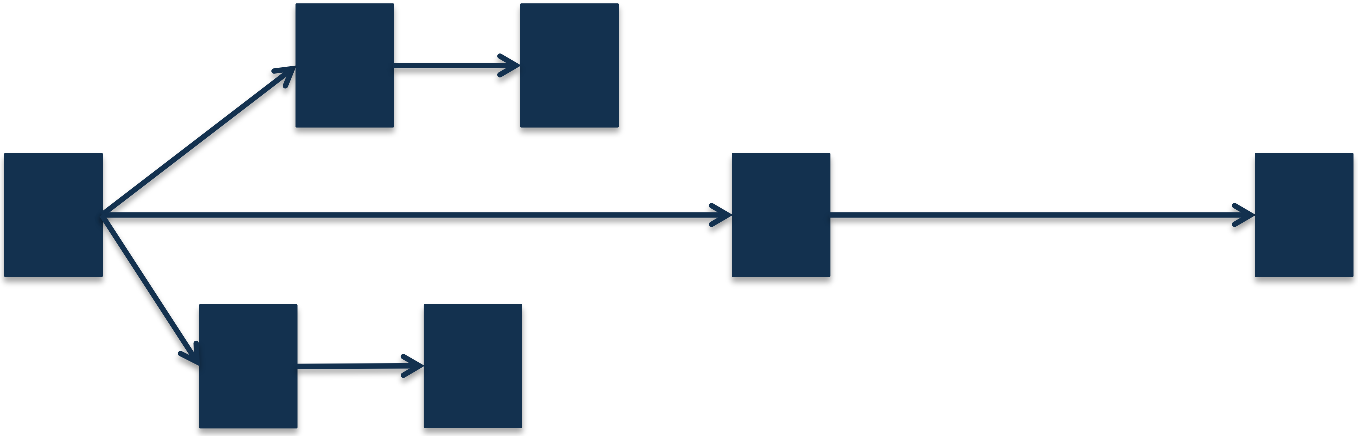

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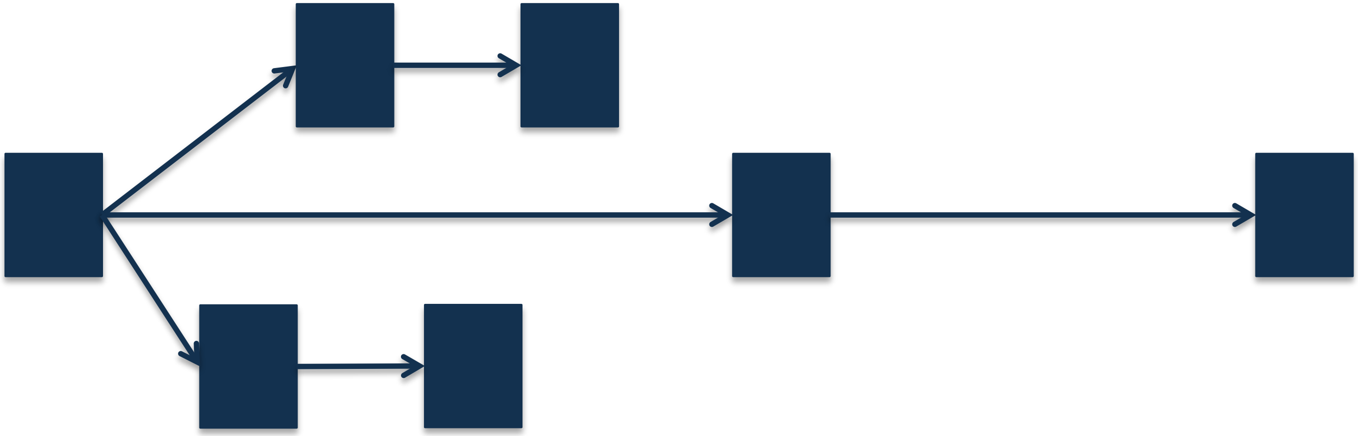

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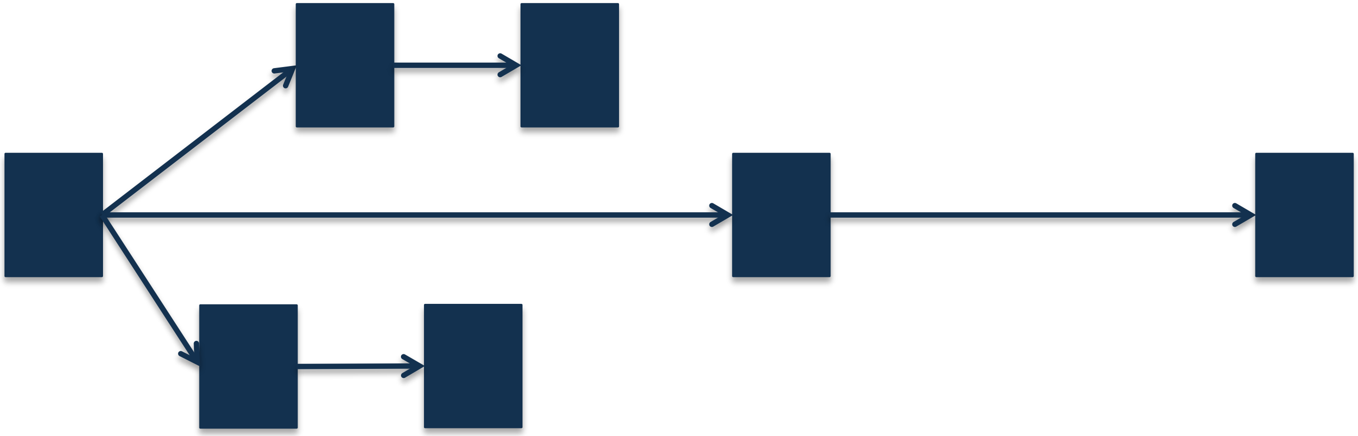

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Ouroboros proved that this happens almost all the time.