Blockchain

Codification of Trust

Goal: Collaboration without a middle man (i.e. no Trusted Third Party).

Problem: Reach consensus in a peer-to-peer network (i.e. solve the Byzantine Generals Problem)

- Subproblems: authenticity, integrity, consistency

Approach:

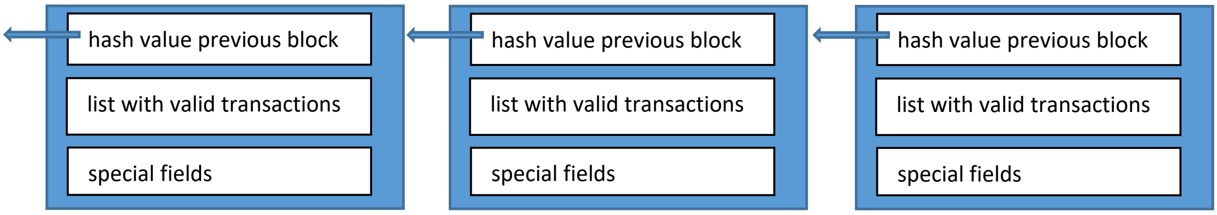
- Use public private key encryption for sender authenticity
- Use cryptographic hashing for data integrity
- Create a linked list of data blocks with cryptographic hash values as pointers, to prevent inconsistency (i.e. no double spending)

Solution:

- Transactions (data) are cryptographically signed, and then collected in new data blocks by miners
- Valid data blocks are linked into a chain: each block holds the hash value of its predecessor
- A data block is valid if:
    - All transactions (data) in the block are valid
    - The block has a certain property (consensus mechanism)
- If multiple chains exist (due to forks) the longest chain is the valid chain

Consensus mechanisms:

- Proof-of-work: the hash value of the block meets some criteria. Challenge: energy consumption
- Proof-of-stake: the block is created by a miner who meets some criteria. Challenge: nothing at stake


hash value previous block
list with valid transactions
special fields
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special fields

Special fields: used for timestamps, miner information etc. In proof-of-work also used by miners to create a block which meets the hash value criteria (simply by trying rondom values to meet the criteria).

Changing data in a block leads to a changed hash value, breaking the chain.

<u>Incentive to reach consensus</u>: the miner of a new block gets a reward (e.g. transaction fee). This reward (as all data) is clearly only usefull if the chain is valid.

Nothing at stake: if there are multiple (longest) chains then the miner can attach a new block at the end of each chain, there is no incentive to choose a single chain. This in contrast to proof-of-work, where the miner has to choose a chain where he puts his computational power in.

Research Center for Data Intelligence

Jan Beumers, Roger Bemelmans