Ethereum's Uncle Rates

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Uncle Blocks

- The concept of "uncle" blocks in Ethereum are analogous to the concept of *orphan* blocks in the Bitcoin blockchain.
- In Bitcoin,
  - the mining window is set to 10 minutes
  - If a certain miner is able to create a Block A, it propagates this information throughout the network.
  - However, propagations can sometimes be slow, and if another miner solves a Block B before receiving information about Block A, a fork is created in the network
  - The main chain is then decided on the basis of number of confirmations
    - Whichever miner's block receives higher number of confirmations first, that block is considered to be part of the main chain
    - The other block is now stale, and computation power has been wasted
  - Due to higher difficulty, Bitcoin network has low orphan creations

Uncle Blocks

- Ethereum has a lower mining time, ~13 seconds.

- This leads to increased chances of "orphans" (Bitcoin parlance), or "uncles" (Ethereum parlance) being created

- More number of stale blocks (those that don't get counted in the main chain) reduce incentives to perform confirmations, as it is considered a waste of computational resources.
    - Lesser confirmations = low security = low network integrity

Uncle Blocks

- Ethereum is able to keep its low block mining time AND keep incentivise block mining by implementing a modified GHOST protocol
- By this, uncle blocks are not "stale" blocks anymore
- Uncle blocks are made part of the blockchain.
- This is done by providing more incentives in the coinbase of each new block:
  - The miner that created the main block (that's considered part of the main chain) is given the full new-block reward
  - The miner that created the uncle block is given a mining reward too
  - Subsequent children (upto the 7th generation) that include the uncle block in their chain are rewarded

Gas limits

- In Ethereum, gas limits per block limit the number of transactions and transaction data that can be added per block to the chain
- Higher gas limits means there is an opportunity to add more transactions to a single block thereby reducing the network congestion, and getting more gas fees per block
- However, increasing the gas limits gets more expensive and resource-consuming, as more data needs to be handled and validated, which not many nodes/miners might be able to afford
- Thus, an increase in gas limits usually is followed by a decrease in number of nodes in the network validating transactions

Gas limits

- Reduced number of nodes in the network is bad for two reasons:
  - Lesser nodes validating/confirmation blocks means lesser integrity and security of a chain or confirmed block
  - **Slower propagation times** of information across the entire network

- **A fast propagation time is very important to reduce uncle creation!**

How is the Uncle Rate in Ethereum Low?

- The uncle rate in Ethereum is kept low and balanced by carefully choosing the gas limit per block.

- Higher gas limit → more transactions/block → more resource-heavy → lesser nodes → higher propagation time → more uncles

- Lower gas limit → less transactions/block → less resource-heavy → more nodes → lower propagation time → less uncles

- Both, larger number of transactions per block AND lesser uncles, are two ideals the network strives for, and these two factors are somewhat inversely related

- Appropriately setting and modifying the gas limits helps keep this balanced, and the Ethereum network is able to maintain low uncle rates.

References

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