Proposal: Exploration of Environmentally Friendly Blockchains

Huangyin Chen, Jianjia Yu, Ziming Chen

I. Background

Traditional blockchain with proof of work as the consensus algorithm requires a huge amount of computing power to work out the puzzles, which translates to enormous energy consumption. In [1], the annual energy consumption involved in mining was estimated to be over 100TWh in total by PoW Cryptocurrencies with the top 5 market capitalization. They determined electricity consumption to be between 60 and 125 TWh per year for Bitcoin. This is in the range of the annual electricity consumption of countries such as Austria (75 TWh) and Norway (125 TWh). As said in the paper, competition in the mining hardware market, resulting from the hype around cryptocurrencies, has dramatically increased the energy efficiency of mining hardware in the last decade.[1]

Building environmentally friendly blockchains is a vital problem we need to think for the sake of our environment and also for the long-term development of blockchains. In terms of measuring how environmentally friendly the blockchain is, we take into account the energy cost and the hardware cost. The consensus algorithms of blockchains determine how much computing power and what kind of hardware is needed. The first group of consensus algorithms is proof-based consensus, which requires the nodes joining the verifying network to show that they are more qualified than the others to do the appending work. The second group is voting-based consensus, which requires nodes in the network to exchange their results of verifying a new block or transaction, before making the final decision.[2]

The energy caused by different types of consensus algorithms is different. For example, in terms of energy efficiency, PoS is energy efficient while PoW and Hybrid form of PoW and PoS is not. In terms of modern hardware importance, PoW treats them as very important, Hybrid form of PoW and PoS treats them as important and PoS is in no need of them. We need to find a solution with lower energy costs and fewer hardware requirements to reach our goal of building environmentally friendly blockchains.

To build environmentally friendly blockchains is a goal, though not achieved yet, something has been done. Ethereum is trying to switch from PoW to PoS. Other cryptocurrencies, such as EOS, Tezos, and TRON – all of which feature in the Top 20 cryptocurrencies in terms of market capitalization – are already successfully using PoS.[1] Regen utilizes hybrid Proof-of-Stake and Proof-of-Authority. Proof-of-Stake entails using tokens to back the consensus process, and Proof-of-Authority relies on the reputation of validators. Neither of these methods is energy-intensive.

To further decrease the energy consumption of blockchain technology, there are some other methods we can adopt. To reduce the degree of redundancy, some concepts can be considered, such as sharding. To mitigate the redundancy in the verification of new blocks, Zero-Knowledge Proof may be taken into consideration.

II. Project Goals

Firstly, we'll give an analysis of the environmental impact of existing popular cryptocurrencies. We can analyze from several perspectives, such as the overall annual energy consumption and the transaction efficiency, e.g. electricity cost per transaction compared with traditional centralized currency systems. Second, we'll analyze the changes in cryptocurrency environmental performance brought by different consensus algorithms. Then we'll analyze the trade-offs between the blockchain system security level and the corresponding environmental performance. Finally, we'll try to deliver a new environmental-friendly blockchain system solution.

III. How to Achieve

In conclusion, we discussed and decided 4 ways to achieve our goals. First, we will grab the computing power and transaction numbers data from the blockchain browser for different mainstream cryptocurrencies. Second, we have to read a large amount of papers that focus on or relate to the environmental impact of blockchains. Third, we'll analyze the source code of different consensus algorithms to help us better understand their principles and thus the potential amount of computing resources they might occupy. Finally, we will conduct digital and graphical data analysis to better illustrate the results above.

References

[1] Sedlmeir J , Buhl H U , Fridgen G , et al. The Energy Consumption of Blockchain Technology: Beyond Myth[J]. Business Information Systems Engineering, 2020(2).

[2] Nguyen G T , Kim K . A survey about consensus algorithms used in Blockchain[J]. Journal of Information Processing Systems, 2018, 14(1):101-128.

[3] D. Mingxiao, M. Xiaofeng, Z. Zhe, W. Xiangwei and C. Qijun, "A review on consensus algorithm of blockchain," 2017 IEEE International Conference on Systems, Man, and Cybernetics (SMC), Banff, AB, 2017, pp. 2567-2572, doi: 10.1109/SMC.2017.8123011.

[4] L. M. Bach, B. Mihaljevic and M. Zagar, "Comparative analysis of blockchain consensus algorithms," 2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, 2018, pp. 1545-1550, doi: 10.23919/MIPRO.2018.8400278.