

Exploiting Ethereum after “The Merge”: The Interplay between PoS and MEV Strategies

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Ethereum is a decentralized, open-source blockchain with smart contract functionality [3]. Initially based on a *Proof-of-Work* (PoW) consensus mechanism, on September 15, 2022, it has transitioned to *Proof-of-Stake* (PoS), after merging with a separate blockchain called *Beacon Chain*. This update, known as “The Merge” [4], gives the opportunity to analyze in detail the actual activity of validators in the blockchain after this consensus mechanism change.

So far, the scientific literature has investigated the behavior of the Ethereum blockchain before “The Merge”, addressing several issues about mining power [8] and wealth distribution [7]. However, after the major update of September 15, 2022, numerous online newspapers and magazines in the crypto community pinpointed how a very limited amount of token holders validated more than 40% percent of the first 1,000 blocks. This raises concerns about the decentralization of the Ethereum network [1, 2]. Moreover, since the PoS consensus protocol entails that the user in charge to propose the next block is known epochs in advance with respect to the epoch in which the block will be eventually added, there are some potential risks related to the proliferation of actors in the blockchain implementing *Maximal Extractable Value* (MEV) strategies, i.e., acting on including, excluding or, rearranging transactions to obtain additional value in terms of cryptocurrency. To mitigate the potential negative impact of private MEV strategies on the Ethereum blockchain (e.g., increased centralization) a research and development organization known as *Flashbots* has recently started a set of initiatives with the main goal of enabling a permissionless, transparent, and fair ecosystem for MEV extraction [6].

Indeed, in recent times, MEV has become an important topic for the Ethereum community. As a result, several initiatives have been developed to mitigate the negative impact of MEV (e.g., centralization) on the network. Among them, Flashbots’ MEV-Boost is a noteworthy proposal that aims to create a more equitable distribution of value. In addition, this solution creates an active off-chain ecosystem that includes searchers, builders, relays, and validators. Searchers identify MEV opportunities, and builders aggregate the MEV transactions identified by searchers and the transactions in the mempool and optimize the ordering of them in a block template to maximize profits. Once a builder has created a block, it must bid for validator block spaces, and relays and MEV-Boost come into play. The relays verify the validity of the blocks sent by the builders and select the valid blocks that offer the highest bid to the validator. Finally, MEV-Boost selects the block that offers the best reward to the validator among all connected relays.

In light of these issues, since (to the best of our knowledge) no in-depth scientific analysis of the economic and decentralized effects of “The Merge” and the introduction of these new MEV-related players in the Ethereum ecosystem has been published in the literature, in our oral communication we will report an analysis of the current situation of the network and whether the proposed solutions are actually working to not favor the few at the expense of the many.

In our study, we conducted an analysis of the validated blocks after Ethereum’s update to PoS, known as “The Merge”, showing how the scenario has changed in recent months. 936,869 blocks were downloaded over a period of 131 days, from September 15, 2022 (date of “The Merge”) to January 24, 2023. We compared the first 1,000 blocks after the PoS transition to the next 936,869 blocks to identify the fee recipients that received priority fees (transaction fees paid by users to incentivize validators to prioritize their transactions) as a reward for validating the block. Our analysis of the initial 1,000 blocks following “The Merge” confirmed allegations that a few entities were validating 40% of the blocks. We investigated the addresses of fee recipients who received priority fees and discovered that the top two recipients were featured in 43% of the blocks. Upon observing the complete dataset of 936,869 blocks, we noticed that the top three fee recipients were different from those of the first 1,000 blocks. The top three recipients are now addresses corresponding to builders employing the Flashbots relay, with a total percentage of 47.3%. The situation seems to have completely reversed in favor of these three builders compared to the first 1,000 blocks. However, analyzing only the fee recipient addresses is not sufficient to understand who really performs the activity of validation and receives rewards for their efforts. In fact, it is necessary to recall that Flashbots builders have a specific standard to reward actual validators. The builder is indeed the fee recipient, but it includes a transaction (the last in the block) that pays Ether tokens to the block-proposer validator [5]. Hence, we extracted the addresses of these rewarded validators within the Flashbots relay data, in order to investigate who was in charge of validation. As a result, we noticed that the top three validator addresses are the same as those in the first 1,000 blocks.

From our preliminary analysis, it seems to remain confirmed what was observed in [1, 2] with respect to the first 1,000 blocks, because most share of the validation activity continues to reside in the hands very few validators, the same who were already dominating this role. In the future we would like to extract data from more relays belonging to the Ethereum ecosystem to obtain complete data on the rewards received by the validator for the task performed.

References

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