

International Journal of Advance Research in Computer Science and Management Studies

Research Article / Survey Paper / Case Study

Available online at: www.ijarcsms.com

Ethereum Merge: A Breakthrough in Blockchain or a Mistake

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Abstract: Aren't you amazed at the pace crypto is changing the dynamics? Well, crypto and change stick to each other like the toothpaste and toothbrush. One complements the other and go hand in hand. Surely, our search history today must have words like Bit coin, Ethereal, NFTs, Block chain etc. This is the proof of the changing dynamics in today's world which have pumped up our curiosity to know how crypto currency is changing the world. The most important change that crypto brings with itself is decentralization and elimination of middle-men. It prevents the need of a contractor who will make our transaction successful. Crypto is transparent and involves less human intervention which has led to more digitised and secured records. However, the staggering reality of the matter is the insane level of volatility rates. It has made our economy unstable and less credible. The fact that block chain technology is complex computational programmes that uses a lot of electricity adds to the peril of our polluted climate. Generally, crypto is run by its community independently and is not controlled by any government authority. But with lesser control comes greater responsibility with practiced freedom which requires protection from the amiss. This paper summarizes the state of knowledge in the filed and discusses about the newer version of cryptocurrency in the form of Ethereum 2.0 The intent of Ethereum is to create an alternative protocol for building decentralized applications, providing a different set of trade offs that we believe will be very useful for a large class of decentralized applications, with particular emphasis on situations where rapid development time, security for small and rarely used applications, and the ability of different applications to very efficiently interact, are important. Ethereum does this by building what is essentially the ultimate abstract foundational layer.

Keywords: Ethereum, Merge, Sharding.

Limitations of the Study: The study does not incorporate empirical based data and the research has been done in said time period, more time could have been devoted for the better interest of the scholar. There can be a conflict over Biased views and personal issues that the scholar needs to interpret so as to avoid confusion.

I. INTRODUCTION

Ethereum, the world's second most valuable crypto-currency, has completed a significant software overhaul which promises to ramp up the security of the crypto-currency while claiming to cut down on its carbon footprint nearly entirely. Ethereum is a project which attempts to build the generalised technology; technology on which all transaction based state machine concepts may be built. Moreover it aims to provide to the end-developer a tightly integrated end-to-end system for building software on a hitherto unexplored compute paradigm in the mainstream: a trustful object messaging compute framework. is a major block chain-based platform for smart contracts – Turing complete programs that are executed in a decentralized network and usually manipulate digital units of value. A peer-to-peer network of mutually distrusting nodes maintains a common view of the global state and executes code upon request. The stated is stored in a block chain secured by a

proof-of-work consensus mechanism similar to that in Bit-coin. The core value proposition of Ethereum is a full-featured programming language suitable for implementing complex business logic.

The birth of Ethereum 2.0 following the iconic 'Merge' was one of the most significant and anticipated events within the web3 ecosystem. The Merge is an upgrade to the Ethereum block chain, which powers crypto ecosystem innovations. The Ethereum Merge changed the Ethereum security mechanism from proof-of-work to proof-of-stake, which has significantly impacted the block chain's crypto economics and has many significant implications for the crypto market. The transition of Ethereum from Proof of Work to Proof of Stake demonstrates that a decentralised and permissionless network can operate in an energy-efficient manner. The merger will almost certainly spark renewed interest in Web 3 projects that aim to build a layer on top of the Ethereum network. Furthermore, the merge will improve nearly all metrics of the Ethereum block chain, paving the way for future application innovation and experimentation.

II. WHAT WAS THE MERGE

The Ethereum blockchain has merged with a separate blockchain, radically changing the way it processes transactions and how new Ether tokens are created. Merge is the combination of the original execution layer of Ethereum with a new Proof of Stake consensus layer known as 'Beacon Chain'. The merge eliminated energy-intensive mining and gave way to an environment-friendly staking system. It was successful in realising the Ethereum vision of being efficient and eco-friendly.¹

III. PROOF OF WORKS VS PROOF OF STAKE

The proof of work is an algorithm used by the miners to solve complex problems using the trial and error method. The first miner who could solve the problem gets the authority to add blocks to the blockchain and extend the chain. When the block gets successfully added to the blockchain, the miner receives a reward as compensation for validating the transaction. Proof of Work was responsible for securing Ethereum Mainnet from its genesis until the merge actually took place.² On the other hand, Proof of Stake is a consensus algorithm in which validators are responsible for validating a transaction and adding new blocks to the blockchain. In this method, there is a secured database which secures our blockchain.³

IV. WHY WAS THERE THE NEED FOR THE MERGE

A cryptocurrency can be used in the future only if proven reliable, safe, strong and efficient. These are the four most important characteristics of a promising cryptocurrency. In the case of Ethereum, it was reliable, safe and strong from the day that it was launched, but the main critique of Ethereum was that it was not efficient as a massive amount of energy was used by the miners to solve complex problems which resulted in vast emissions of greenhouse gases, thus impacting our environment. The merge was the step to take away this critique of Ethereum and make it environment-friendly by reducing carbon emissions by 99.5% and putting Ethereum on the list of ideal cryptocurrencies. This is a significant shift because one of the most common criticisms aimed at decentralised networks is that they are 'power hungry' in a world where climate change has emerged as the most pressing issue.

This is why there was a need to move from Proof of Work to Proof of Stake. Although the main aim for transitioning to Proof of Stake was to reduce carbon emissions, it also made Ethereum a stronger network due to thousands of validators. This also resulted in cost reduction for Ethereum as the network is not required to pay vast amounts of money to miners as an award for validating the transaction. Hence, Proof of Stake also made the network cheaper.

V. PROOF OF WORKS VS PROOF OF STAKE

¹ Ethereum. (n.d.). Home. ethereum.org. Retrieved October 15, 2022, from <https://ethereum.org/en/>

² Hetler, A. (2022, August 1). Proof of work vs. proof of stake: What's the difference? WhatIs.com. Retrieved October 15, 2022, from <https://www.techtarget.com/whatis/feature/Proof-of-work-vs-proof-of-stake-Whats-the-difference>

³ What Does Proof-of-Stake (PoS) Mean in Crypto? (2022, September 27). Investopedia. Retrieved October 15, 2022, from <https://www.investopedia.com/terms/p/proof-stake-pos.asp>

VI. HOW DID THE MERGE TAKE PLACE

To illustrate how this merge took place, let's imagine Ethereum as a car running on a gas engine. Now it wants to transition from a gas engine to an electric engine to reduce carbon footprints. But the real twist is that this engine needs to be transitioned without stopping this car, and this is the biggest challenge in front of them. So to achieve this, Ethereum developers develop a new electric engine and have successfully tested it for 1.5 years. After testing this engine, they decided to swap it with the old one. To do this, they put this new engine in a car and ran it parallel to the old Ethereum car at the same speed. When both the cars will come together, the developers will swap the gas engine to the electric engine, which will be known as 'the merge'.⁴ In the case of Ethereum, "stopping the car" would mean halting the block production, which would mean that no transactions could take place during the course of the merge, and this would also alter the pre-existing blocks in the blockchain. Here, the 'electric engine' symbolises the launching of 'Beacon Chain' in December 2020, which ran parallel to the original Ethereum Chain for 1.5 years. The merge took place after the successful demonstration of this Beacon Chain. So, the first step was completed when the Beacon Chain was launched. This allowed developers to create a separate network that would work on Proof of Stake to test the productivity without impacting existing Proof of Work. The second step of the merge was to merge the Beacon chain with the original Ethereum network, symbolised as the swapping of the engine in the illustration. This was the stage where the blockchain transitioned from Proof of Work to Proof of Stake.

In order to transition from Proof of Work to Proof of Stake, the execution and consensus layers were unbundled, which meant that both layers could be run separately. After the merge, there is a node which consists of a consensus node and an execution node. Also, there is an Engine API which is responsible for communication between the consensus node and the execution node. Detachment of consensus and execution level also resulted in a quicker launch of the Beacon chain as there was no worry about the execution layer.

VII. BENEFITS OF THE MERGE

The Ethereum Merge is, without a doubt, the most significant update to the cryptocurrency and blockchain ecosystems. The Merge made the whole network of Ethereum more sustainable and eco-friendlier by reducing its carbon emissions by 99.5%. According to the Ethereum Foundation, ether consumes approximately 112 Terawatt-hours of energy per year. That is roughly the same amount of energy consumed by the entire Netherlands. The merger, will eliminate the energy-intensive proof-of-work system, and replace it with a sustainable and environment-friendly system. The update would not only make Ethereum more environmentally friendly, but it would also reduce the stigma associated with cryptocurrencies. Although the Ethereum network "achieved a tremendous reduction in electricity use; the big challenge is trying to determine whether this is also reflected from a global point of view. Looking at the range of possibilities contained in different scenarios, it's clear that the Merge had a significant impact on the Ethereum network's energy use. Even when going from the total best-case scenario before the Merge—assuming all the devices on the network were running as efficiently as possible—to the worst case after, the energy reduction is still 99.84%, the paper found⁵. Meanwhile, going from the worst case to best case represents a more than 99.99% reduction. In real-world terms, that means that the Merge could possibly have reduced the Ethereum network's power use by as much as the electrical demand of the entirety of Austria⁶.

The Merge also helped the network to scale itself by taking the transaction per second from 25 Ethereum per second to 100,000 Ethereum per second. Moreover, mining a single Ethereum block takes about 13-14 seconds. The implementation of the proof-of-stake mechanism, on the other hand, reduces the validation time for a block to 12 seconds. As a result, it will be

⁴ Jakub, J. (2022, March 8). *The Ethereum Merge Explained – Finematics*. Retrieved October 15, 2022, from <https://finematics.com/the-ethereum-merge-explained/>

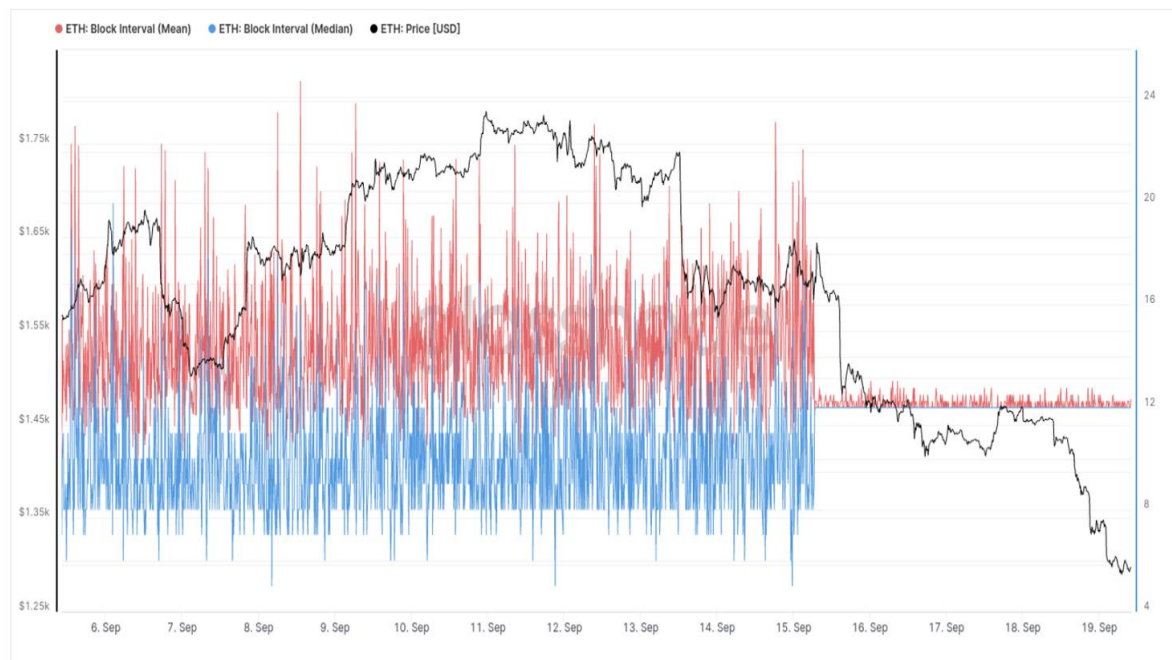
⁵ [Ethereum Merge Reduced Crypto Emissions, Research Paper Says - Coins News Magazine | Bitcoin News Today \(newsincoins.com\)](https://www.coinsnews.com/news/ethereum-merge-reduced-crypto-emissions-research-paper-says)

⁶ [Ethereum Merge Reduced Crypto Emissions, Research Paper Says - Coins News Magazine | Bitcoin News Today \(newsincoins.com\)](https://www.coinsnews.com/news/ethereum-merge-reduced-crypto-emissions-research-paper-says)

easier to use and faster because it can store more transactions in a single block. It is a common misconception to think the merge will immediately improve scalability and reduce transaction fees. The relatively minor reduction in block time may have a positive effect on throughput, but most important are the foundations that have been laid that will allow scalability improvements through future developments such as sharding. Sharding is the process of distributing the data layer to parallel systems, thus reducing network congestion and increasing throughput. ‘Shard’ is a computer science acronym for ‘System for Highly Available Replicated Data.’

The graph below shows the pre merge average block interval which was averaging around 13 seconds, and the post merge average block interval.

Ethereum: Mean and Median Block Interval



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We can see that prior to the merge, the block intervals showed substantial variation, highlighting the inherent probabilistic nature of proof-of-work consensus systems. The variation post merge significantly declined to the defined 12 second interval where the protocol selects a validator and offers a slot to be filled⁷.

The merge allows more people to participate in the network by allowing them to become validators. While mining takes a considerable amount of investment which is not possible for everyone, staking is more accessible to everyday users.⁸ Furthermore, our research shows that staking mechanisms have the potential to incentivise centralisation. Users can either run a validator on their own machines, which requires 32ETH and a 24/7 connection, or they can delegate the task to staking providers that pool together stakers and in return issue ownership tokens. Many exchanges such as Binance, Coinbase and Kraken offer these services. The first centralisation incentive is technical difficulty. The average user may not have the know-how or experience to run a validator and operate as a solo staker, nor might they be willing to stake 32ETH to do so. Secondly, it is vastly more convenient to go through a staking provider where the user receives a token in exchange for staking services. This has the added benefit of being able to use the staked ETH (eg. stETH) as collateral for other trading activities. Thirdly the

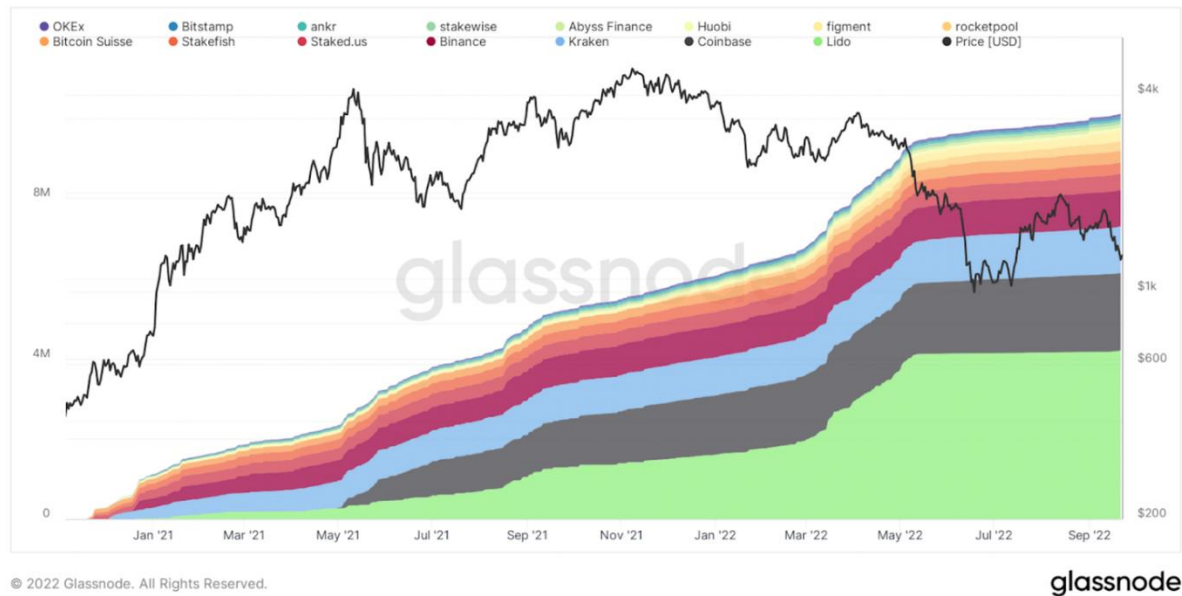
⁷ What Was the Ethereum Merge? — HAYVN | Digital Currency Reimagined (hayvnnglobal.com)@glassnode

⁸ Patel, N. M. B. (2022, September 17). *3 Must-Know Benefits of the Ethereum Merge*. The Motley Fool. Retrieved October 15, 2022, from <https://www.fool.com/investing/2022/09/17/3-must-know-benefits-of-the-ethereum-merge/>

rise of passive investing has led to the rise in demand for financialised products that offer simple exposure to markets. If this trend is to continue, we could see capital being concentrated in a few large ETF funds that socialise and centralise exposure. Finally, related to the risk of staking 32ETH, the US Treasury blacklisting Tornado Cash could prove a deterrent to users who fear their wallet could be associated with an entity coming under regulatory scrutiny. Some users reported not being able to use protocol front-ends due to their accounts being dusted (sent small amounts of currency), with ETH from Tornado Cash.

Practically, this is what we are seeing on Ethereum 2.0. The following graph from glassnode shows the amount held by large staking providers. Notably, the four biggest providers, Coinbase, Kraken, Lido and Binance, hold 60% of total staked ETH (13 million).

Ethereum: ETH 2.0 Total Value Staked by Provider [ETH]



Finally, we believe that staking introduces material economic incentives to the network that will tend toward centralisation. With the proof-of-stake network attack threshold hovering around 67%, this could pose a risk in the future. However, without significant OFAC sanctions against the major regulating exchanges and staking providers, the current level of centralisation is unlikely to be maintained. When the 2022 bear market finally exits the financial system and risk assets decouple from trading in a correlated manner, we may see these supply and demand dynamics pushing the ETH price higher. It remains to be seen whether this is at the expense of the network⁹.

VIII. DID ETHEREUM MERGE DO ANYTHING TO CRYPTO EMISSIONS?

There are a couple important caveats to consider when thinking about the potential reduction of emissions and the math involved. First off, it's not possible to know what happens to all those energy-sucking machines after the Merge—just that they're not connected to the Ethereum network any more. The fact that the network has shifted to a process that requires significantly fewer machines doesn't mean that miners who have invested money in countless machines are simply going to throw them in the trash and end their energy use.

So what are these machines being used for? Ethereum has already split off into two different forms of Ethereum-based currencies, Ethereum Classic and Ethereum POW, which, while not as profitable as Ethereum, are still proof-of-work based and could theoretically provide ways for miners to keep using their expensive equipment. Graphics cards previously used to mine Ethereum could also be used to mine smaller cryptocurrencies or be repurposed outside of crypto mining, for processes like

⁹ [What Was the Ethereum Merge? — HAYVN | Digital Currency Reimagined \(hayvn.com\)](https://hayvn.com/what-was-the-ethereum-merge/)@glassnode.

gaming or cloud computing. While these uses represent significantly less energy use than running mining equipment 24/7, they would still impact the overall global emissions reductions of the Merge.

More importantly in terms of energy use, while Ethereum miners would not be able to use their devices to mine Bitcoin—some mining machines can only be used to mine Ethereum, while others couldn't compete at a profitable level with Bitcoin—suddenly nuking a handful of machines from service frees up server space that can be taken up with other devices miners may have been keeping offline, meaning that more Bitcoin machines can get started on mining dirty crypto.

“What likely did happen is that a bunch of previously unused Bitcoin mining devices have taken the data center space Ethereum miners were previously using. “This probably explains the jump in the Bitcoin network’s computational power after the Merge too.”

Despite these caveats, it looks from this first analysis that the Merge was a success in significantly reducing the emissions associated with the Ethereum network. The real challenge will be finding other ways to encourage other cryptocurrency networks to follow suit—especially Bitcoin, which is far and away the largest source of emissions from crypto mining. As we covered when the Merge happened, there are lots of factors that are getting in the way of the Bitcoin network undergoing a similar shift to a proof-of-stake model. But that doesn't mean it's not worth it to try—particularly if governments want to step in and give regulation a shot.

IX. CONCLUSION

If the holder stakes his Ethereum on the network after the merger, it will generate an annual yield of approximately 4% to 6%. Because the proof-of-stake model rewards honest validators while disciplining dishonest validators and their delegators, Ethereum will help the network grow and become more secure. As the expected mid-September completion date of the Merge approached and the process got done, there had been significant price action in Ethereum on many exchanges, as with any major event driving the crypto narrative. Ethereum holders must understand that this is not a one-time upgrade, but rather the start of a long-term process. This merge has brought several reforms in Ethereum as well as the blockchain network as a whole. When all is said and done, the Merge is a triumph for Ethereum. It will open up a whole new world for decentralised applications and industry use cases, as well as enable new blockchain-based advancements. The most intriguing aspect is that Ethereum is now more scalable, strong, secure and efficient.

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