Analecta Technica Szegedinensia
Vol. 17, No. 3 ISSN 2064-7964 2023

MERGE IN THE ETHEREUM BLOCKCHAIN – TECHNOLOGY DEVELOPMENT IN A NEW AND INNOVATIVE INDUSTRY

[1] András Bertalan, [2]Balazs Gyenge, [3]Károly Kacz

[1]Széchenyi István University, Vár 2., 9200, Mosonmagyaróvár, Hungary, e-mail: bertalan.andras@sze.hu
[2]Hungarian University of Agriculture and Life Sciences, Páter Károly 1., 2100 Gödöllő, Hungary, e-mail: gyenge.balazs@uni-mate.hu
Széchenyi István University, Vár 2., 9200, Mosonmagyaróvár, Hungary, e-mail: kacz.karoly@sze.hu

Received: 03rd April; Accepted: 05th June

ABSTRACT

The food industry has been at the forefront of rapid implementation for several technological innovations. One of the main reasons for this is that food security has been of paramount importance in supplying a growing population, taking into account both quantitative and qualitative requirements. And the necessary development could only be ensured by incorporating the latest developments.
Blockchain technology is also a tool to consider in terms of how it can help track food chains. Its widespread application is only a decade old, but in some areas, for example, the operation of cryptocurrencies has already accumulated enough experience to see if it really lives up to the hopes attached to it, and what problems still stand in the way of further spread. With this material, our primary goal is to present a significant technological change that aims to solve one of the main problems of blockchain-based data management. It will be presented how the technology works (with a specific focus on the proof of work mechanism) and the transition to a truly significant platform, the proof of stake mechanism at Ethereum. This gives us an idea of how much a relatively new technology can undergo changes, and at what rate a seemingly significant problem (in this case, e.g. environmental impact) can decrease. This potential for development provides the basis for counting blockchains as a technology that can be applied in other areas, such as the food industry. In addition to scientific treatises, we often rely on Internet sources in the material, since the change occurred so quickly that publications in scientific journals could not yet track it or only in a narrower circle.

Keywords: blockchain, environmental impact.

1. INTRODUCTION

Blockchain technology has been widely used in the case of cryptocurrencies, with Bitcoin developers being the first to use it to keep the ledger of digital currency. However, its development can be dated to earlier [1]. University of Berkeley (California) doctoral student David Chaum outlined a blockchain database in his dissertation "Computer Systems Established, Maintained, and Trusted by Mutually Suspicious Groups" [2]. Decentralized databases existed before, but he is considered the inventor. Chaum also wanted to use the technology for business, for which he founded a business called DigiCash in 1989. He also created his own cryptocurrency called eCash, however, the business could not be commercially successful, so he later ceased to exist [3].
Blockchain is actually a database, which differs from traditional solutions in that information is stored not on a server (i.e. a centralized network), but on a distributed network [4].
In the case of centralized networks, such as banks or agencies, our data is managed centrally, which requires a strong level of trust in their direction. This is necessary because the data handled in this way is exposed to serious dangers, since if there is a problem with the central storage, either due to intentional damage or failure, the entire database can be compromised. The source of such a problem can be a hacker attack, a natural disaster, the abuse of the registry keeper, etc. In the case of a decentralized network, these problems do not arise, since information is available in several places and its modification is possible only at the cost of extremely great efforts, which in practice means the impossible.
The best example of decentralized networks is the Internet itself. When we connect to the ISP with our phone, tablet or computer to reach a larger provider, we are practically using a decentralized network.

DOI: https://doi.org/10.14232/analecta.2023.3.19-25

In the case of blockchain, information is downloaded to computers operating on nodes of distributed networks. Its operation is provided by pre-written software that is immutable and tamper-proof. If there is a database change, such as a transfer, it is checked by software running on all computers on the network, and then its database is updated.
As previously mentioned, the use of blockchain technology in the case of cryptocurrencies has become widespread. This is because, even in the case of traditional national currencies, serious confidence is required to operate the system. It is necessary to trust the Central Bank that it will not degrade the value of the currency, which has already happened in history for most currencies. It is necessary to trust commercial banks to store, manage and carry out transactions of funds deposited with them. However, this process is also known to not operate one hundred percent, since bank failures have already occurred, suffice it to think of the bankruptcy of Lehmann Brothers in 2008.
From the foregoing, it is clear that the blockchain architecture, due to its operation, is suitable for being used to track various supply chains. So is, it meets the requirement of reliability, since the information recorded during the process cannot be modified, and even if an error occurs during the recording, the correction is also carried out only with a new block, that is, the data originally recorded can also be seen. This data is accessible to all actors in the food chain, so all participants can be accountable and their activities can be monitored in the process. As a result, the journey of food from farm to fork can be tracked in real time [5]. The latter fact gives the other great advantage, since if there is a problem with the product, it is possible to very quickly delimit the range of products and trace the source.

2. PROOF OF WORK ALGORITHMS

The proof of work algorithm is presented through the solution used for the Bitcoin cryptocurrency, since the mechanism of operation is the same, so an implemented example can be suitable for real illustration.
In the process, the players in the Bitcoin payment network, the so-called mining computers, have to perform a mathematical calculation, which requires significant computing power. So, there is a cost to perform the calculation (computational capacity), so not everyone is able to produce data. At the same time, if the result of the mathematical operation has already been calculated, then the rest of the network can quickly and easily verify that the result is real. In the case of Bitcoin, mathematical operations are designed in such a way that on average there is a result every 10 minutes, such this way, a block can be created every 10 minutes, which is connected to the last block of the blockchain network (Fig. 1).

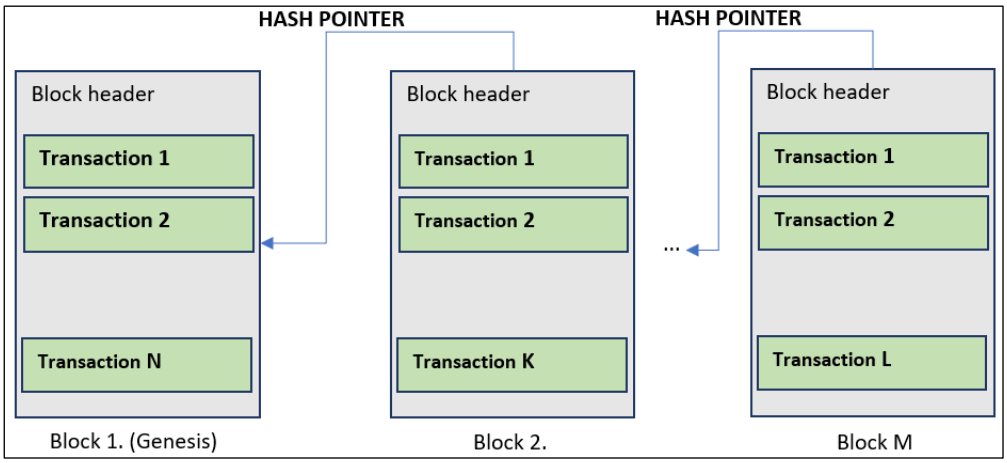

Figure 1: ***Decentralized ledger***

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And blockchain is the complete ledger which contains all transactions so far, all Bitcoin payments can be found in it. The essence of the proof of work algorithm is that only the user can create the commit block can authenticates the transfers, who has sufficient computing power. It is important that the more miners, the greater the competition, the more the difficulty level increases. This also means that as competition intensifies, more and more powerful devices are needed, so the electricity consumption of the Bitcoin payment network is increasing. The proof of work algorithm thus guarantees the security of the Bitcoin network, but at the same time its price is high electricity consumption, i.e. an increased ecological footprint [6]. The current energy demand of the system can also be tracked via a link: https://digiconomist.net/bitcoin-energy-consumption. It follows that with the spread of the system, the rate of electricity consumption must be solved, since it is not only Bitcoin that uses this algorithm, which can thus rival the energy consumption of the largest countries over time. In addition, due to the serious need for computing, video cards specially designed for this purpose are already being made, with high-performance chips, a process that increases the price level in the computing market, reinforces the already present chip shortage. Thus, a change in technology can also dampen this price increase.

3. PROOF OF STAKE ALGORITHM AND ITS APPLICATION

The application of the proof of work algorithm represents a step forward in the management of transactions in cryptocurrencies, ensuring that they are secure. However, due to the disadvantages mentioned above, a technological shift is required.

A solution to this can be the proof of stake algorithm, which significantly reduces power consumption. Its essence is that with its use the mining activity ceases, mining computers do not need to perform complex mathematical operations. Instead, among the miners, the system randomly selects which one can make the new block. Fraud solved with a security deposit, i.e. miners must make a deposit, and in the event of fraud, they will lose it [7].

Staking also has its drawbacks from the point of view of users. One of the biggest drawbacks of these is that the cryptocurrencies used for staking are locked for a while. Similarly to bank deposits, which cannot be accessed for a certain period of time. This may not be a problem if the value of the crypto currency rises, but there can be a serious loss if it is not possible to liquidate the stock in the event of a negative trend due to the lockdown.

In the field of cryptocurrencies, proof of stake algorithm have been used in the past, however, their capitalization is low compared to market leaders. As a novelty, in the second half of 2,022, the cryptocurrency with the second largest market capitalization, Ether (Ethereum's cryptocurrency), also switched to the system. Thus, we will present this shift below.

3.1 Ethereum

Ethereum is an open-source, public, social, blockchain-based cryptocurrency and computing platform based on distributed computing. The latter sets it apart from most cryptocurrencies, as it is also a platform that allows for solutions such as smart contract management. And with it, various applications can be built on the blockchain. The system provides a decentralized virtual computer, the Ethereum Virtual Machine (EVM), in which computational operations are performed by an international network of public nodes. The code run by the Ethereum Virtual Machine is written in the Solidity programming language. Ethereum also provides a cryptocurrency called Ether. Solidity is an object-oriented programming language that supports the development of smart contracts. The language includes the solc (Solidity Compiler) compiler, which is compatible with the Ethereum Virtual Machine and generates solidity code.

Ether is one of the most popular cryptocurrencies after the Bitcoin, which is currently the most well-known cryptocurrency. Ether Capital ranks second in the ranking of cryptocurrencies based on capitalization (Fig. 2).

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#	Name	Price	Changes 24H	Changes 7D	Changes 30D	Market Cap	Volume 24H	Available Supply
☆ 1	(BTC) BITCOIN	$16,726.29	↑ 0.76%	↓ -0.69%	↓ -2.10%	$321.99 B	$12.48 B	19.25 M BTC
☆ 2	(ETH) ETHEREUM	$1,218.31	↑ 1.37%	↓ -0.08%	↓ -5.85%	$146.83 B	$3.65 B	120.53 M ETH
☆ 3	(USDT) TETHER	$1.000	↓ -0.01%	↓ -0.08%	↓ -0.05%	$66.26 B	$16.85 B	66.26 B USDT
☆ 4	(USDC) USD COIN	$1.000	↓ -0.01%	↓ -0.10%	↓ -0.10%	$44.71 B	$1.55 B	44.70 B USDC
☆ 5	(BNB) BNB	$247.07	↑ 0.72%	↑ 1.53%	↓ -15.61%	$40.35 B	$398.40 M	163.28 M BNB

Figure 2: ***Order of cryptocurrencies by market capitalization (02/01/2023 www.criptofalka.hu)***

The creation of Ethereum was proposed in late 2013 by Vitalik Buterin, one of the researchers of crypto currencies. They wanted to create an altcoin that would solve the problems with Bitcoin (such as long calculated transaction times or the 51% hash rate possession problem for centralized, "miners"). The word "Altcoin" stands for "alternative coins", but it can be translated more as "alternatives to Bitcoin". All digital currencies (cryptocurrencies) built using blockchain technology are included in Bitcoin outside.
However, there is one exception in the approach of many sources: Ethereum (ETH) was the first alternative cryptocurrency to set itself a completely new goal, and to this end, its construction was very different from that of Bitcoin.

3.2 Ethereum merge

Since its launch in 2015, Ethereum has used the proof-of-work algorithm to securely add new transaction information. Mining is safe but also energy-intensive [8]. The Ethereum network as a whole, in addition to proof-of-work operation, consumes the same amount of energy per year as a smaller country, eg. Austria.
Proof-of-stake is an algorithm that consumes much less electricity. Whereas in the past, miners use high-energy computing devices, after merge, users who want to participate in the authentication of transactions put their own cryptocurrency at risk in a process called staking [9]. These approvers — also known as validators — are randomly selected to verify new information to be added to the block. They will receive an Ether reward if they participate in the validation of information. If they act unfairly, they will lose the Ether deposited. A network using a proof-of-stake mechanism works on the same principle.
Ethereum's developers expected the transition to reduce electricity consumption by as much as 0.01 TWH/yr by replacing the proof-of-work mechanism in favor of proof-of-stake corresponds to annual consumption.
There were two milestones in the preparation of the merge: the first was the creation of the Beacon Chain in December 2020 (Fig. 3). The Beacon Chain acted as a proof-of-stake network running parallel to Ethereum, where users could stake Ether. The earlier launch of the Beacon Chain was intended to have enough Ether on the network by the time of the changeover.

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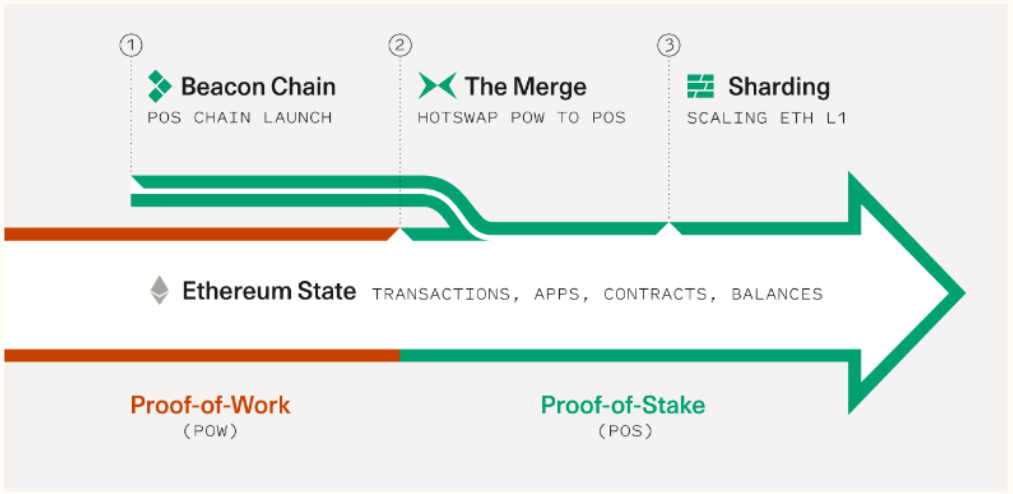

Figure 3: Ethereum Merge scheduling [10]

The Beacon Chain allowed the proof-of-stake consensus to be tested live for an extended period of time without affecting ethereum's core network, which is home to billions of dollars' worth of capital.

As a test of Merge, Ethereum's developers performed several checks on test networks – clones of the Ethereum blockchain used for experimental purposes – during 2022.

4. RESULT

The most important result of Merge is clearly that Ethereum has become a much more environmentally friendly, secure, and future-proof platform than it has been so far (Fig. 4). This is mainly due to a drastic reduction in energy use [11]. Thanks to this, it is no longer necessary to waste significant amounts of money on electricity for mining, so fewer Ether will have to be created as a reward, such this way, the cryptocurrency can be more valuable than before.

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Figure 4. Annual energy consumption (June 2022 Ethereum Foundation/ Digiconomist www.independent.co.uk/tech/ethereum-merge-crypto-energy-environment)

5. CONCLUSION

The development of Ethereum has proven how much development potential there is in blockchain technology. Its application - other than cryptocurrencies - is mostly experimental in other areas, although even the largest technology companies (e.g. IBM, Microsoft) are devoting considerable resources to the development. However, technological level jumps like merge can give a significant boost to the spread. Such developments allow other industries to access and use the technology. In the case of food chains, these advantages are also reflected, e.g. reliable data, traceable process, but several challenges still need to be solved for widespread application (e.g. return on financial investment or the attitude of the actors).
And if the databases are reliable, they can be more easily integrated into a system covering the entire process. For example, in real time, harvesters recording data during harvesting use 5G to transmit the data to a blockchain database, which is then processed by artificial intelligence. And the AI - based on the data - makes recommendations for further farming, e.g. fertilizer use, water management, etc. Thus, even the producers become interested in the use of new technologies.

6. SOURCES

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