Directions and features of application of the blockchain technology

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Abstract. The article presents the results of the study of the blockchain technology. The main barriers of technology implementation were identified and ways for their elimination were suggested. Advantages and disadvantages of the technology were identified. It allowed for studies of feasibility of technology implementation for performing social and economic infrastructure tasks. The issue of effective application of this technology was studied. In Russia, the blockchain technology has been discussed by the Government of the Russian Federation and the State Duma. Despite some advantages, only in some countries, the blockchain technology is used in business processes. The blockchain technology can be used to solve logistics problems, data security tasks, political, economic and medical problems.

1. Introduction

Experts disagree on prospects for the development of the blockchain technology. Nevertheless, it remains an experimental technology: many problems have not been solved yet. The article is devoted to the study of implementation and application of the blockchain technology, its basic characteristics, advantages and disadvantages. The obvious advantages of this technology, compared to existing payment networks, explain the process of its integration into all economic and social spheres of human activities which confirms the relevance of the research topic. Blockchain is no longer associated with Bitcoin. It has become an independent technology that underlies new applications and systems whose possibilities are becoming much wider. One important feature of this technology is interesting for the most prominent experts: blockchain’s abilities are limited only by human imagination [1].

Blockchain does not incur transaction costs. It is a simple but original way to transfer information in a fully automated and secure way. One side of the transaction initiates the process by creating a block. This block is checked by millions of computers distributed over the network and added to the chain that is stored on the network, creating a unique record with a unique history. Falsification of one record requires falsification of the entire chain. For the first time, the blockchain concept was proposed by Satoshi Nakamoto in 2008. It was implemented in practice with the advent of Bitcoin in 2009. Due to its origin, it is referred to cryptocurrency transactions, but the scope of the technology is much wider. The system works as follows:

- A primary block in which there is no record of the previous block is created.
- Each subsequent block contains information about the “parent”, the type of transaction, its own header, used when generating the next block.
- System users see all the blocks, but have access only to their own one [2].
Prospects for the development of blockchain technologies are associated with active development of cloud services, including online banking, online catalogs, and identification systems for entering corporate websites [8].

Purpose: to identify advantages and disadvantages of the blockchain technology, find and eliminate implementation barriers, study the issue of effective application.

2. Materials and methods
Review of literary sources, comparative analysis of practices of using blockchain technologies, generalization and systematization of research results.

3. Results
Recommendations for eliminating shortcomings and barriers for implementing the blockchain technology into modern information systems. Development of the blockchain technology depends on cloud services, including online-banking, internet catalogues, system identifying logging into corporate websites [3].

Blockchain is a database in the form of a chain of blocks that represent digital information. The blocks store the following information:
- transaction information (date, time, and dollar amount of last purchases);
- information about participants in transactions, without identifying information (digital signatures or logins);
- information that is a unique code (two identical purchases will differ by their unique codes) [1].
One block can store up to 1 MB of data which allows several thousands of transactions to be placed in one block. The blockchain technology has several advantages:
- Decentralization. The blockchain has no server; all participants maintain the network. Blockchain is difficult to crack, it is not subject to censorship and centralized management.
- Transparency. The information is transparent and available to all users of the network. For example, one can track where money allocated from the state budget for specific purposes is. Each network participant can access the entire transaction history.
- The digital data stored in the registry cannot be changed (without the consent of more than half of the miners), duplication of data by network participants ensures safety and immutability of information. This information cannot be edited, changed or deleted. Consensus algorithms confirm all transactions included in the blockchain.
- There are no intermediaries. Blockchain allows strangers from different countries to build secure financial relations without the help of intermediaries and intermediary commissions.

Thanks to these advantages, the blockchain technology has been implemented and is successfully operating in economic and social spheres of some countries. The table 1 below shows some examples [4].

The table 1 reflects the fact that useful qualities of the blockchain have found their application in public administration. Blockchain ensures that falsification is unavailable, accessible and anonymous, which will allow governments to use a transparent e-voting system. The financial industry seeks to master the digital space. Most countries view the blockchain as one of the means of transition to the digital economy and seek to implement the blockchain technology into the banking sector. We gave only some examples of applications of the blockchain. The technology of the distributed registry is being implemented into public spheres. However, some experts believe that prospects for successful integration and operation of the blockchain technology are dubious; technical, economic and social barriers should be taken into account [9].

1. Due to the decentralization, system participants perform identical tasks storing and processing the same growing amount of information. The result is a number of problems:
- the more transactions in the network, the more memory they occupy. A new node requires synchronization of all previously processed data;
- the mining process consumes a large amount of electricity, and only one user is rewarded. Thus, the rest of the energy is wasted;

Table 1. Examples of the use of blockchain technology

| SCOPE OF APPLICATION | COUNTRY          | DESCRIPTION                                                                                                                                 |
|----------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Taxes, land and      | USA, Georgia     | Tax departments of some states started cooperation with the BitPay company whose goal is to collect taxes, driver's licenses, car numbers and other documents in Bitcoin and Bitcoin Cash cryptocurrencies. The National Public Registry Agency has added blockchain options that allow you to find and receive information about real estate, cooperate with Bitfury, a leading manufacturer of mining equipment for the purchase and sale of land ownership rights and notarial certification of documents. |
| documents            |                  |                                                                                                                                              |
| Elections and        | USA, Denmark     | Voting in the blockchain was used during the municipal elections in West Virginia, by the Danish Liberal Alliance party during the national voting, the libertarian party of Texas during election of candidates for internal party positions. |
| voting               |                  |                                                                                                                                              |
| Finance and business | Argentina,       | The deal that the HSBC and the Dutch ING Bank conducted to deliver cargo from Argentina to Malaysia illustrates the use of blockchain in the banking sector. Banks issued a letter of credit through the R3 Corda platform and avoided paperwork. The similar deal was made by Alfa Bank and S7. The Ripple company recognized in the blockchain industry allows its clients to transfer money through its network. M.Video, Alfa-Bank and Sberbank Factoring launched a blockchain-platform for factoring operations based on the Ethereum platform within the consortium. This platform was used to check documents keeping information about transactions confidential. Megafon issued corporate bonds using the blockchain technology. |
|                      | Malaysia, Russia |                                                                                                                                              |
| Smart contracts      | Russia           | Smart contracts provide an opportunity to exchange money, shares, property and other assets directly, without intermediaries. The Ethereum network allows users to create “smart contracts”. This can be done using any computer on which the Ethereum software has been installed. |

- there is a risk of “attack 51%”, whose implementation is possible with more than half of mining capacities;
- low bandwidth and slow transaction processing: the blockchain processes and records a limited number of transactions in a certain period. Requirements of projects may exceed performance of the blockchain which can cause interferences [1,3].

2. Social and economic adaptation is a difficult obstacle to the implementation and development of the blockchain. There are companies that perform the function of trusted storage, transmission and validation of information. They benefit from the need to trust third parties [7].

3. Problems of regulatory development of the technology and organizational barriers. The lack of awareness is one more problem, people do not understand how to implement the blockchain technology.
To eliminate the problems described, a secure blockchain device is needed. The load on each of the system nodes is limited. The solution may be the use of Payment channels outside the blockchain which will work without being added to the blockchain. Examples of these networks are already available. They are used enhance security of transactions using smart contracts and cryptographic confirmation. The blockchain handles a final transaction which allows you to save the network from the unnecessary load. The use of these channels can solve the problem of transaction speed that occur after processing the payment channel.

An approach based on directed acyclic graphs can be a solution to the problem of scaling. This allows us to have a sequence of vertices in a topological order. Directed acyclic graphs do not require proof of operations, the presence of miners and blocks, because transactions are controlled by the nodes which reduces the processing speed. Unlike the blockchain, each transaction confirms the previous ones.

The transition from Proof of Work to Proof of Stake will reduce energy costs, since there is no need for mining, increasing the capacity (there is no need to perform complex calculations), minimizing the risk of control over the entire network by hackers. In the Proof of Stake system, blocks are signed by validators; instead of remuneration, they receive a commission, and the probability of generating the block is proportional to the balance of the validator. In order to obtain the right to generate blocks, the user's balance must exceed the balance of other participants. It is unprofitable for an attacker to acquire such an amount, since the exchange rate is directly proportional to the demand. If this happens, the attack becomes inappropriate, since it puts at risk the entire system and its investment [6].

For the large-scale integration of the blockchain technology into the digital economy, it is necessary to develop a regulatory framework that describes operation rules [1,10].

4. Conclusion
The Blockchain technology has great capacities and can be used by any government agency in any country. There are discussions about disadvantages among which the issues of implementation and integration. The application of the blockchain-technology involves cooperation and costs of a large number of participants. In order to overcome the inertia of the system and implement the technology, the state can start implementing the technology in small areas which are from small beneficial.

Capacities of the blockchain technology are unlimited. One of the advantages is the fact that any initiative can be launched by a small group or even one participant, and spread to the entire market. The blockchain technology has enormous resources. It is characterized by anonymity, integrity, decentralization and transparency. The blockchain technology has many disadvantages which are being eliminated by many experts.

Due to the fact that this technology is a distributed database, i.e. is universal, it can be used by various public institutions, small businesses, government agencies. However, it is not so easy to implement the blockchain on a large scale due to a number of technical, social, economic and organizational problems.

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