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THE MAIN FEATURES OF BLOCKCHAIN TECHNOLOGIES CLASSIFICATION

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Abstract: This article discusses the main features of the classifications of blockchain technologies. Ten years after the first blockchain appeared, this technology is still largely experimental. It is difficult to predict the future of the blockchain industry and the technology itself with confidence, but its certain outlines are already emerging. The purpose of the study is to consider the classification of blockchain technologies and analyze the problems that arise when using these technologies. When writing the article, the authors used methods of collecting and studying individual facts, generalization, scientific abstraction, cognition of laws, as well as the methods of objectivity, concreteness, and pluralism. It has been proved that the legal regulation of blockchain technologies should be carried out through the development of uniform world standards and that prohibitions and restrictions on certain types of activities should be systematized and regulated at the international level. The study has concluded that three types of blockchain are used: public blockchains with open access (public blockchains), private blockchains with open access (consortium blockchains), and private blockchains with closed access (fully private blockchains). Following this typology, the authors have highlighted the main features of each blockchain category.

Keywords:blockchain; bitcoin; classification; digital technologies; closed access; open access.

I. INTRODUCTION

Along with Big Data, machine learning, and artificial intelligence, blockchain is one of the most promising technological industries, comparable in scale, degree of influence, and distribution in the future with the effect that the Internet had in the 2000s [1].

Blockchain is a continuous sequential chain (linked list) of blocks containing information built according to certain rules. The term first appeared as the name of a fully replicated distributed database implemented in the Bitcoin system [2], which is why the blockchain is often referred to as the basic cryptocurrency technology. However, the blockchain system can be extended to any interconnected information blocks and used in a wide variety of sectors, such as supply management, logistics, and secure document flow.

Lower costs, improved security, and higher transaction transparency are the three main strengths of blockchain. In connection with the need of banks, businesses, and society in these three aspects, any theoretical work or development in this area becomes relevant.

Global investments related to blockchain technologies may reach 9.7 billion US dollars in 2021. The market size is calculated based on projected revenues from the implementation of blockchain solutions, as well as the provision of services based on it. At the same time, it is assumed that the average annual growth rate in the period until 2022 will be from 79.6 to 81.2%. However, some regions will increase growth rates in the blockchain industry in a priority manner: Japan by 127.3% and Latin America by 152.5%.

However, the emergence of a new technological solution that significantly affects the economic system is associated with high legal uncertainty. Suffice it to recall the problems associated with the emergence of the Internet and doubts about the validity of contracts concluded online or tax classification of activities carried out on the Internet. Similar problems are associated with block-based solutions.

The study aims to consider the classification of blockchain technologies and analyze the problems that arise when using these technologies. To reach this goal, we set the following tasks:

- to determine the types of blockchain technologies;
- to highlight the main features of each type of blockchain;
- to consider the practical aspects of using blockchain technologies and propose solutions to the problems that arise during the implementation of this technology.

II. Literature Review

The growing interest of the scientific community in the problem of innovative development contributes to the emergence of deep developments that reveal the essence of innovative phenomena and contain empirical data characterizing the development of innovative processes in changing institutional conditions. For example, Omar et al. [2] commenced considering 227 articles and subsequently filtered this list down to 87 articles. From this, a classification framework was presented that has three dimensions: blockchain-enabled financial benefits, challenges, and functionality. Nishani et al. [3] designed a blockchain architecture for organizations that facilitates effective connectivity to a blockchain while enabling auditors to leverage this technology to provide audit and assurance services. To design the architecture, we consider two broad questions: first, how do CPA firms gain access to reliable audit evidence and, second, how can client firms maintain confidentiality and security of their data given a decentralized and distributed immutable ledger (ie, a blockchain)? Warkentin and Orgeron[4] highlight the advantages of blockchain technologies with regards to non-reputability to help public managers understand how to best leverage blockchain technology to transform operations. Other experts have devoted their work to various aspects of blockchain technology as well, but in the research, not enough attention has been paid to the classification and practical application of blockchain technologies.

III. Methods

A. *General description (basic principles and methods, description and characteristics*

The object of the research is blockchain technology and features of its application in practice. For this research, we used the following methods: collection and study of individual facts; generalization; scientific abstraction; cognition of patterns. Content analysis techniques were applied to the collected qualitative data and common themes were identified using keyword and phrase analysis. Using the method of comparative analysis, we reviewed the typology of blockchain technologies and suggested an optimal classification of the used blockchain into types.

The objectivity method allowed us to consider the main legal problems of the implementation of blockchain technologies. Using the method of concreteness, we proved that the use of blockchain technologies did not need special legal regulation and that it was enough to develop uniform international standards for the use of blockchain.

B. *Algorithm*

Due to the pluralistic approach to identifying the blockchain types, we concluded the different uses of managed and decentralized blockchains. The predictive method allowed us to predict the possible use of blockchain in various industries and areas.

At the stage of collecting and studying individual facts, we used the methods of interpretation of the law, with the help of which the possibility of legal regulation of the use of blockchain technologies was clarified.

The logical-semantic analysis was also used in combination with the listed methods, which made it possible to consider in detail the main characteristics of blockchain technologies.

C. *Flow chart*

The study was conducted using certain research algorithms, due to which the results were obtained. The research algorithm is presented in Figure 1.

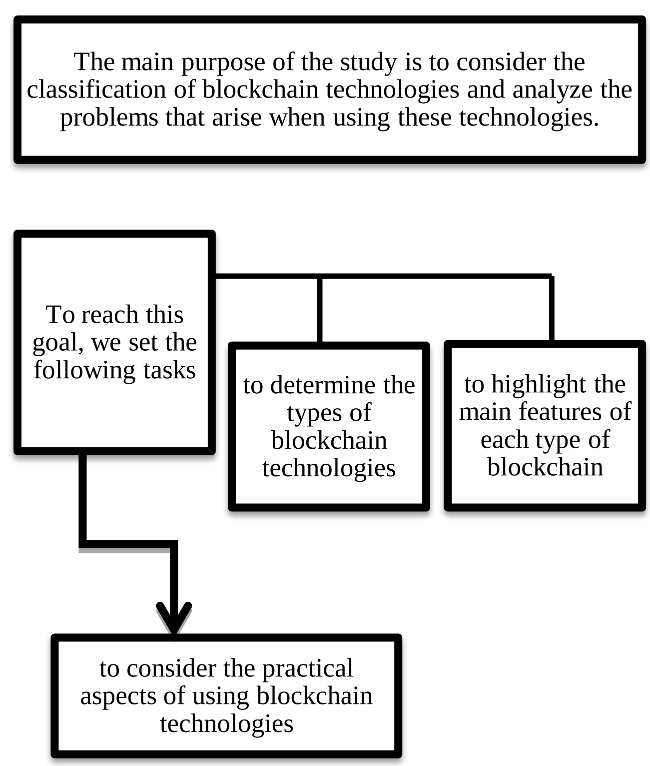

Figure 1. The research algorithm

IV. RESULTS

Various classifications of blockchain technologies have been developed. We will determine by what criterion blockchains should be classified. As a rule, changes in this technology affect only one parameter, namely, the availability of the data register for users. It is logical to divide items into classes according to this criterion. Depending on the degree of accessibility and openness of the data, two types of blockchains can be distinguished, namely open and closed blockchains [4].

An open blockchain is characterized by complete decentralization and the ability of all participants to maintain the network's performance equally. That is, if desired, each user is able to verify data and transactions by adding them to the decentralized ledger. Closed chains appeared relatively recently, more precisely, from the moment the centralized structures of the institution became interested in this technology. Conventionally, all participants in such a blockchain can be divided into two categories: users and management [5].

However, a more detailed study of the typology of the blockchain allows us to classify this technology into three different types of blockchains, which are presented in Figure 2.

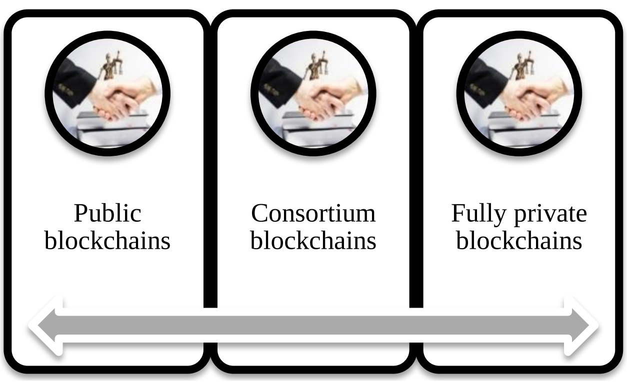

Figure 2. Blockchain types

Let us consider each type of blockchain in detail. At the present stage of development of economic relations, the most common and frequently used are public blockchains, which are used for such cryptocurrencies as Bitcoin, Ethereum, and Ripple. Public blockchains have the following main features (Figure 3).

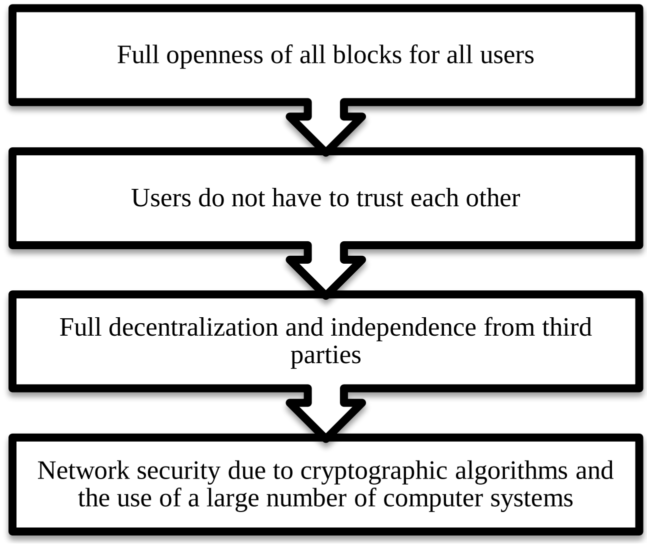

Figure 3. Main features of public blockchains

Public blockchains are widely used in the financial sector when complete independence from a third party, transparency of operations, and high system reliability are required.

When using consortium blockchains, only privileged users have to certify transactions, conduct security audits, make changes to software, and modify databases. The rest have access to read-only files. Thus, a consortium blockchain is not completely decentralized and depends on a certain circle of people. The main features of a consortium blockchain are presented in Figure 4.

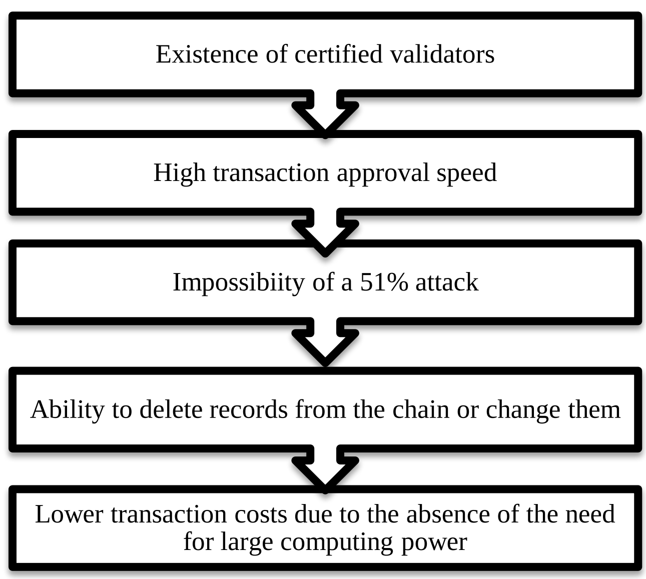

Figure 4. Main features of consortium blockchains

Consortium blockchains are used in government agencies. For example, in healthcare, when medical institutions are privileged users, they enter patient data into the chain, and patients can always use this information.

Participants can use a fully private blockchain only with the confirmation of validators, while they do not always have access to reading the chain files. Thus, this system completely ceases to be open and independent from third parties [6].

The main features of a fully private blockchain are presented in Figure 5.

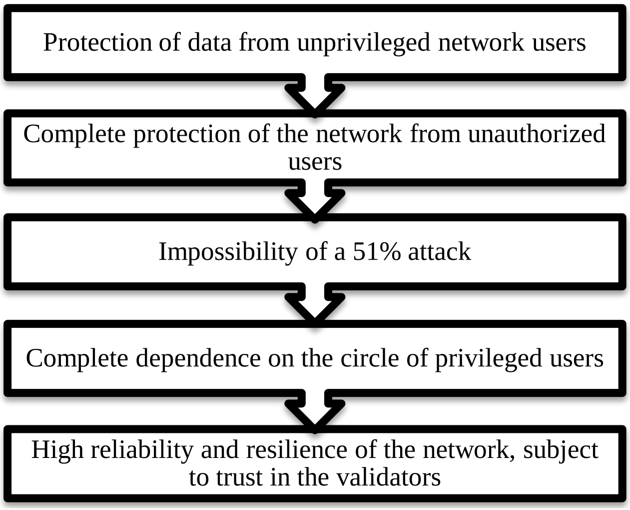

Figure 5. Main features of fully private blockchains

A private blockchain is more similar to classic centralized networks. However, having the property of maintaining a chain of interconnected blocks, it can be successfully used for internal closed private networks and secure workflow systems in enterprises or government agencies where it is necessary to store official information.

Now, two main areas are gradually defined, which will increasingly become isolated from each other: decentralized public blockchains and managed private blockchains. Since their differences are fundamental, over time, the interaction between projects of different directions will become less and less possible.

Experts point to good prospects for managed blockchains, as solutions based on Hyperledger, Corda, Exonum, and other managed blockchain projects can bring all the benefits expected of them [7]. They will reduce the costs of the approval and decision-making processes, provide a safer environment for information exchange, and increase trust between counterparties. At the same time, centralized decisions do not allow the anarchy of decentralized systems, leaving the making of key decisions not to a faceless community of anonymous people scattered around the world, but to a clearly defined group or organization that manages the blockchain.

It would be correct to call such networks not blockchains, but private distributed networks with blockchain elements. Of the three main characteristics of Bitcoin and other public blockchains (immutability, decentralization, openness), only the first is preserved in managed blockchains and even it is not fully preserved. The invariability of data in a controlled blockchain is not guaranteed for ordinary users, since if there is a single control center, such a blockchain can be stopped with a rollback to the desired block, while nodes that do not have administrative powers cannot prevent or cancel such a change. This is a partial return to the familiar client-server architecture with load balancing [8].

The notion of decentralization in a managed blockchain is ruled out at the concept level. It initially contains nodes with different levels of authority; therefore, even with distributed storage and processing of data (for which the blockchain is not required at all), it is more correct to consider its structure as hierarchical with two or more levels.

The principle of openness of a managed blockchain (that is, the ability for any network participant to see the entire transaction history of all users) can be incorporated or rejected during its creation, depending on the functional features. However, corporate networks will always be characterized by a policy of restricting access to information (both reading it and adding to the system and making changes). Full openness to government services is also contraindicated for reasons of protecting users' data.

Thus, the architectural and technical differences between public and private blockchains will intensify and lead to their completely separate development over time, even if standards are adopted to ensure interoperability. At the same time, the exchange of technologies can become one-way, meaning that all successful solutions found by developers of public blockchains can be used in private projects based on open licenses. Corporate developments will be patented, and their third-party use will become possible only upon the conclusion of licensing agreements and corresponding deductions.

V. Discussion

Blockchain is cost-effective and its motto can be reliability and transparency of transactions. However, there are some barriers to its widespread use.

Consider the problem of decentralized data storage. If a complete data register is stored in each node of the network, it will be possible to restore the network until the moment the last node of the network is destroyed, but the cost is just as great. The network is constantly growing during operation, which in the future will lead to uncontrolled amounts of data. Plus, for a new member to enter the network, they will have to synchronize a huge amount of data. To solve this problem, it is possible to propose using a standard database, which stores real data in encrypted form, and only their hash is entered into the blockchain and the old blocks are archived. Experts suggest using Big Data technology to solve these problems [9]. It is also focused on working with large amounts of data storage and processing; various architectures have already been worked out, such as Map-Reduce, Shared Memory, Shared Nothing, Shared Disk, and others. The main obstacle to integrating Big Data tools into the blockchain is the system type: the blockchain is a decentralized, distributed system, which means that calculations are distributed among several nodes and there are no nodes that control the operation of other network nodes. However, integration is also possible in the other direction. After all, technically, the blockchain is a simple database with the scalability and the absence of query languages, but decentralization, immutability, transparency, and the possibility of universal data exchange compensate for its disadvantages. Currently, BigchainDB and IPDB are under development, which could become planet-scale databases with decentralized management [10].

Another important task is to ensure trust in the blockchain system since the system must be both anonymous and transparent for its participants. Users want to see the movement of data on the network so that other users do not know what they are doing. To do this, it was decided to use asymmetric encryption algorithms. Thus, each user has a pair of keys: a private key and a public key. The private key is used to sign blocks sent by the user. The user's network address is displayed using the public key.

The blockchain can only process a limited number of transactions. The transaction speed is low. Processing a block of transactions takes a significant amount of time. For example, on the Bitcoin network, the block interval is 10 minutes; on the Ethereum network, it is about 14 seconds and during peak periods it takes even longer. For comparison, services like Square and Visa confirm transactions almost instantly [11].

Therefore, developers of public blockchains are forced to find a compromise between low network bandwidth and a high degree of centralization. As the size of the blockchain grows, so do the requirements for storage size, bandwidth, and processing power of each node in the network. There may come a time when so many resources are required to process blocks that there are too few nodes that can handle this load and then the network risks becoming centralized. Accordingly, it will be necessary to return to centralized systems that require trust in several large participants, but in practice, a system is needed that can process thousands of transactions per second and remain decentralized.

Separately, one should consider another problem of ensuring the anonymity of transactions in the blockchain. On the one hand, work is underway to increase the anonymity of transactions in public blockchains. On the other hand, attempts are being made to introduce identification mechanisms and KYC procedures in corporate versions of blockchains and other projects seeking to demonstrate to governments the ability to regulate and control transactions [12]. As a rule, the problem of identifying blockchain users is solved by external means, that is, either before creating an account on the blockchain or by analyzing the user's transactions recorded on the blockchain (for example, investigations into illegal activities are underway). If blockchains find widespread use, then the identification of user accounts at the blockchain level while maintaining full or partial anonymity of transactions will be in demand in corporate and government projects that use blockchain to one degree or another.

The problem of legal regulation of the blockchain is important if private blockchains are introduced into the legal framework and properly standardized [13], the pressure on public blockchains will increase. Point bans or restrictions on certain types of activities will be systematized and introduced at the international level. Regarding the regulation of the blockchain technology itself, there is virtually no need for it. There may be some political and financial aspects of technology that need regulation, but not the technology itself. Here the role of regulators will be played by the development of uniform world standards.

VI. Conclusion

The study examined the classification of blockchain technologies. It was concluded that three types of blockchains are used: public blockchains, consortium blockchains, and fully private blockchains. Following this typology, we highlighted the main features of each blockchain category. It was proposed to define managed blockchains as private distributed networks, since they do not have the basic characteristics of a blockchain, such as immutability, decentralization, and openness.

Among the problems of using blockchain technologies, we highlighted the most relevant issues and suggested ways of their solution. Thus, to solve the problem of decentralized storage of a large amount of data in the blockchain we suggest using a standard database in which real data is stored in encrypted form and only their hash is entered into the blockchain and old blocks are being archived.

Legal regulation of blockchain technologies should be carried out through the development of uniform world standards. Bans and restrictions on certain types of activities should be systematized and regulated at the international level. There may be some political and financial aspects of technology that need regulation, but not the technology itself.

In further research, it is necessary to develop work principles and prospects for the application of blockchain technology.

VII. ACKNOWLEDGMENT

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