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THE BLOCKCHAIN TECHNOLOGIES IN PUBLIC ADMINISTRATION

Serhii Mynenko,
PhD Student
Sumy State University, Ukraine
Vitaliia Koibichuk,
PhD, As. Prof.
Sumy State University, Ukraine

At the present stage of development, each country is not only an area with defined borders, population and sovereignty, but with the development and complication of socio-economic relations, the number of processes that the country should perform to ensure its own functions increases. Also, the number of services provided by the state to individuals and businesses increase every year. These processes are facilitated by technological progress that should be used by the country in the management process. The technologies used by the state in the process of government are obsolete too quickly. With the changing generations, with the broadest stratum of citizens belonging to the "Generation Y (Millennials)" and the growing "Generation Z", who have a fast pace of life and feel free in the technological world of the country, it is necessary to be modern to meet the needs of the population. Today, blockchain is the most secure, persistent and transparent technology of data organization and transaction execution [1], which can solve many governmental issues, including information security issues [2]. There are three factors of technology security: the distribution registry, cryptographic encryption, and the consensus algorithm.

A fundamental and topical issue today is investigating the features and opportunities of using blockchain digital technologies in all areas of the country's economy [3], starting with financial-credit sector [4, 5] and security of online banking [6] and ending with strategically important public administration and governmental branches related to the management of e-documents by business entities, executive bodies (election campaign support), educational institutions [7-9], medicine.

The author's research provided an opportunity to generalize the scope of blockchain use within the framework of public management of worldwide organizations (table 1).

Blockchain is a special kind of database that only allows you to enter information, and removal and modification prohibit. The blockchain structure is reminiscent of a chain of blocks that is essentially a certain amount of data (physically – a separate computer) that add to the database. Each block of the system contains a Hashcash of the previous one, that is, a specific pointer to it, timestamps, and a particular set of metadata to confirm its authenticity. Here is a list of the clear

benefits of blockchain: decentralization, complete transparency, confidentiality, reliability, compromise [15-17].

Decentralization is a blockchain architecture that lacks a master data server. Each member of the system stores all records. It affects the stability of the system because if part of the blocks fails, the information will store on the remaining functioning blocks. Full transparency allows any blockchain user to track transactions that have occurred on the system. The privacy feature will enable you to save all data in encrypted form. The user can track transactions but cannot identify the sender or recipient of the information. It is only allowed to users with appropriate rights. The operation requires a unique access key. The reliability is that any attempt to make unauthorized changes will reject because of inconsistencies with the previous copies. Legally changing the data requires a special unique code, issued and validated by the system. Other participants check the data added to the system through the hash transaction listing (compromise property).

Table 1. Overview of cases which blockchain technologies used

Case	Company/Companies
Proof of ownership of modules in app development	Assembly
Proof of purchase for digital content storage and delivery	Blocktech (Alexandria), Blockparti, BlockCDN
Points based value transfer for ride sharing	Ln'Zooz
Digital security trading ownership and transfer	Symblont, Mirror, Secure Assets, Coins-e, DXMarkets, MUNA
Digitization of documents/contracts and proof of ownership for transfers	Colu (Colored Coins)
Decentralized storage using a network of computers on the blockchain	Storj
Provide digital Identity that protects consumer privacy	Sho card
Escrow/Custodian service: Gaming industry, Gaming industry and loan servicing, E-commerce	PlayCoin, Bitplay, New System Technologies, Founds.org
Decentralized patient records management	Bithealth

Note: Compiled by authors based on works [10-14]

Consider one of the everyday tasks that occur when transmitting digital information between participants in a session. Vast arrays of records transmit data in the form of blocks from one transmission node to another. The question is: how to

save and quickly find the current location (status) of a particular block. The answer is a general-purpose hash function:

$$h(k) = k \bmod n, \tag{1}$$

where n is a number of available storage places, k is a number; mod is a remainder of number division. The data transfer and the code snippet checked by the hash function is shown in Fig. 1.

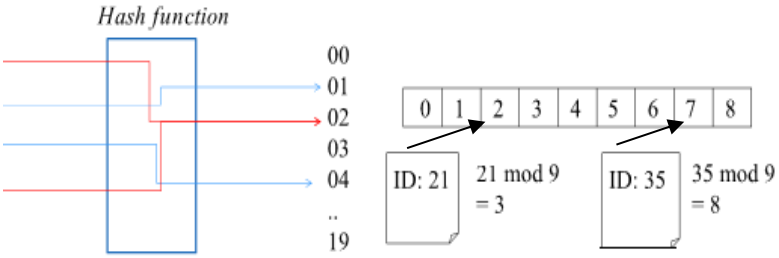

Fig. 1. Data transmission and retrieval of information in the information block based on checking the remainder correctness of the integer division

When using hash functions, a common problem is when collisions occur when two different records have the same interpretation of the save check (Fig 2).

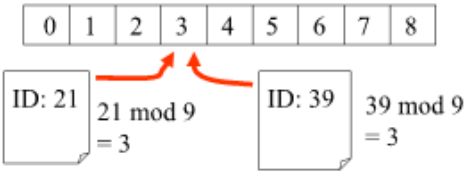

Fig 2. The result of different digital money exchange sessions has the same save address

This problem can be solved by using hash sequences that check the following available space in your computer's memory:

$$\begin{aligned} h_0(k) &= k \bmod n, \\ h_1(k) &= (k+1) \bmod n, \\ &\dots \\ h_m(k) &= (k+m) \bmod n, \end{aligned} \tag{2}$$

Modifications to the algorithms for checking the record correctness and the subsequent location of the transmitted information block are massive. However, the hash function to be considered cryptographically stable, three conditions are necessary and sufficient. They are irreversibility (stability) to the prototype restoration, resistance to collisions of the first kind or restoration of the second prototypes. This condition should be interpreted as follows: for a given message M it must be computationally impossible to select another message N for which H (N) = H (M). The collision of the hash function H is called two different input data blocks x and y such that H (x) = H (y). The third condition for cryptocurrency hash functions speaks of collision resistance of the second kind, i.e. it should be computationally impossible to pick up a pair of messages (M, M') having the same hash. These requirements are not independent.

The disadvantages of blockchain include its scalability, size and user requirements. Blockchain has limitations on its growth. In open systems, it is difficult to add new blocks. It is due to the limited technical specifications, the low number of computers with a broad data channel, the risk of constant attacks, the complexity of cryptographic tools. This drawback does not apply to private blockchains in which each block is certified. The drawback to the blockchain is that the information is overwritten on each block. It causes space to run out on this block. Certain public administration tasks implemented through blockchain can bypass this limitation. But if you need to store large amounts of data, you will need to create a hybrid blockchain. In such a blockchain, the block stores only records of transactions or transactions performed and linked to a centralized data warehouse, which of course is encrypted. The lack of system user requirements is explained as follows. Each system user should be responsible for their own information. All records are completely anonymous on the system, but some identifiers indicate a particular user. And if a person somewhere illuminates or loses that ID outside the blockchain system, then everyone on the Internet can find out about those person's transactions in the blockchain.

Blockchain networks are divided into two main classes: private and public [19, 20]. Public blockchains are a way of network construction in which all members of the network provide the control of the operation: developers, users, service providers, miners, who ensure the integrity of the network and ease of work in it. The performance of such a network is achieved by updating a protocol that prevents malicious changes. They also provide a way to protect users from developers by limiting their opportunities. The developer cannot change the code or data in public blockchain applications by himself.

Private blockchains are blockchains in which the creation of blocks is centralized, and all the rights to conduct operations belong to one organization. The public is only able to view information (if there is a key), and only trusted, certified nodes can audit, manage databases, and other applications. Private blockchains are

characterized by low transaction costs, as their validation is carried out by trusted and high-performance nodes, instead of tens of thousands of user devices. Additionally, private blockchain can be configured so that the number of transactions per second will be much higher than that of public networks. In this case, the only limitation is the throughput of the weakest node in the system. The main advantage of a private blockchain is greater control over the system by the organization. Private blockchain allows you to update functionality quickly [19]. Only a private type of blockchain is suitable for public administration because all rights to conduct transactions on the network and information belong to the state. Users, citizens or organizations, have access to the system with a key.

Now blockchain is associated with the cryptocurrency, financial and banking sectors [20-22]. But there are many areas for its use. Next, we look at the main possibilities of using blockchain technology in public administration.

Blockchain for personal identification. In this network, you can store electronic versions of documents that confirm the identity and concerns it. So, each citizen can open his documents for presentation at any time, and received documents will already have confirmation of originality, since the system units verified the request for their receipt. Besides, government organizations can receive data from the network upon request, or the user himself can send them through the blockchain.
Using blockchain technology in this way has its pros and cons. Advantages include security of information, the stability of work, convenience of electronic document flow. Disadvantages include the need to create an organization that will verify the documents and register them on the system.

Blockchain for elections. With blockchain technology, it is possible to exercise the right of citizens to elect representatives to the authorities. Moreover, this system can be done both in its pure form: voting only through blockchain and in a hybrid way when some voters come to the polling stations, and some of them vote at home.

The use of this system will solve many significant problems, such as transparency of voting results, the complexity of organizing elections for specific categories of citizens, including citizens abroad, reducing the cost of printing ballots, their delivery and the calculation of results. When using blockchain falsification of results at polling stations will not be real, if the record was added to the system, it was copied by all blocks, and it will be impossible to make changes. The disadvantages include the difficulty of implementation due to the low computer literacy of the population, especially the older generation and the additional costs of equipping polling stations.

Blockchain for tax service. With the help of blockchain technology, taxes for individuals and legal entities can be realized. Blockchains have already been implemented to financial asset flow. This system will have the only difference when

all resources flow to one holder to the country, but the fact of tax payment will be known to all participants of the blockchain.

Blockchain for medical care. The use of blockchain technology to maintain a patient's online medical record is quite promising. In this case, the blocks are medical institutions of different types. Beneficiaries are physicians who bring examination results, diagnoses, and referrals directly to the patient's profile. The use of such a system will facilitate the information exchange between laboratories and clinics. The patient will have access to a profile with complete medical history. Blockchain security will ensure stable access and reliability of the information [23].

Blockchain for notarization of documents. Blockchain technology can completely replace notaries for using it as a Smart Contract [24]. A smart contract is a system that captures the conclusion of a particular agreement between the system participants and depending on the conditions for fulfilling the deal, it gives one or another result. The guarantee of the invariance of the smart contract is recorded in the databases of all blocks. It is impossible to change the terms of the contract, except as previously determined. Even if the parties, by mutual agreement, want to change something, the smart contract will only fulfil what it has written. In such circumstances, the evidence is not given to anyone, written documents are not taken into account, and litigation is inappropriate.

Thus, the necessary actions of notaries can be implemented with the help of smart contracts: certification of contracts, other documents, issuance of certificates of ownership, other extracts from state registers.The introduction of such a system will prevent corruption and reduce the cost of supporting transactions. An interesting solution may be the use of blockchain technology by the Ministry of Education. This technology will be useful as well as for testing students to enrol in higher education. Using this system will reduce the cost of testing, prevent corruption. The users of this blockchain will be not only entrants but higher education institutions in the future to form the rating lists and entry of entrants. Also, the blockchain may store information about the educational documents of the person used in hiring. The documents received from this system will be legal for the employer.

The described blockchain technology can be implemented in public administration. The use of this technology will bring a number of advantages and transformations of the usual modern public administration. The introduction of blockchain technologies is recommended in order to increase the efficiency of functioning of organizations, enterprises and other socio-economic objects in the field of public administration, to reduce the costs of congested operations and intermediaries. The use of blockchain is also appropriate in the field of finance, medicine, education. Developments and wealth of the country depend directly on the informatization rate of all spheres of activity, quality of implementation and use of modern innovative technologies, especially blockchain technologies.

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