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THE USE OF BLOCKCHAIN TECHNOLOGY FOR THE DEVELOPMENT OF ELECTRONIC DEMOCRACY AND ELECTRONIC GOVERNANCE

Problem. We assume three main issues with regards to the blockchain (also 'block chain') technology:

- data security;
- the cost of creation and maintenance of the systems;
- the possibility of creating the widescale self-organized and non-hierarchical social structures.

One of the key issues when implementing e-governance structures is to how to ensure data security. There are two different types of risks: (i) penetration into the network (hacking) and (ii) internal interference from persons who are using the system. Yet, setting protections from external threats result in significant maintenance costs of information systems. Protection of data from falsification by officers who have access to the data management or any other the internal intervention is not yet effective.

The problem of physical intervention still remains, since the central server system can be damaged or removed. For example, in autumn 2004 during the «Orange Revolution» in Ukraine servers of the Central Election Commission of Ukraine were physically and maliciously seized by law enforcement agencies with no proper legal authority. Eventually, these problems cause distrust and

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concerns of citizens regarding the advisability of deeper implementation of public web services.

The second problem which can be solved by implementing the blockchain technology is the high cost of data centers. The blockchain is based on decentralized computing model that allows to content with relatively small data centers which significantly reduces the cost of creation and maintenance of the systems.

The third of the problems that this technology solves, as a rule do not often raised, but new technology can fundamentally change the situation. Social interaction requires making a specific hierarchical structures where people interact with each other, both in public sphere and private, including corporate. The basis of hierarchical structures is the management level (managers) and relationships of subordination. Finally, the state is a multi-hierarchical structure. This way of organizing society is usually not questioned, regardless it flaws. It has no other alternative. You can not build relationships in the group, for example, of millions or hundreds of millions of people, whatever small scope of public relations required to organize in that group. However, the new technology is a challenge to the established practice of hierarchical structures. Blockchain opens the possibility of building peer (non-hierarchical) widescale self-organized social structures.

Analysis of recent research and publications. The issue of electronic data protection and resource support of computer systems is a popular topic of publications in the field of information technology. However, the statement that blockchain technology system provides the highest degree of data protection from unauthorized interference is taking into account as the initial data. The article gives albeit a simplified technical point of view, but a detailed

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explanation. Indeed, the understanding why such the effect of reliability is reached is an essential to further understanding of the *social aspect* of this technology.

The initial papers for this article are Satoshi Nakamoto paper «Bitcoin: system Peer-to-Peer electronic cash» [1] and David Lee Kuo Chuen «Handbook of Digital Currency. Bitcoin, Innovation, Financial Instruments, and Big Data» [2].

The blockchain is not been given attention in Ukrainian science (both the technical aspects and social) at the moment of finishing the author's investigation which is presented in this paper.

Unsolved aspects of the problem is that the blockchain technology is widely used in one area of relationships – cryptocurrency turnover; other areas where it could be potentially applied are not analyzed enough. By the stage of the analysis of all aspects (social, technical and legal) should follow the modeling stage, and practical implementation. The results of operation of the new technology will be useful asset for further development of this technology as the new technology introduced new principles of social interactions that previously were not applied, or applied to a limited extent.

The purpose of this article is to expand understanding of the opportunities of the blockchain technology beyond the virtual cryptocurrency Bitcoin [3], proposing spheres of social relations where it can be used, the principles on which it can act.

The main material. New information technology creates new opportunities for the development of public relations. In particular, it opens up opportunities

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in the field of direct democracy, and establishing of a new practice of delegating of the public functions to the self-organized civil society (non-governmental) organizations.

Since 2013 the rapid development of so-called cryptocurrency «Bitcoin» and its other forks began in the world. Bitcoin is based on the blockchain technology which may be used in other areas of public relations. Changing at the same time principles of such relationships.

When the number of individuals in a group becomes large enough, the group needs a manager. If we scale this, we arrive at the multirank hierarchical structures of people in the form of a state, where public authorities play the role of manager.

Until recently, large non-hierarchical structures were not possible due to the fact that a large number of people cannot interact with each other effectively without coordinators. The appearing of public authorities at the same time creates problems of trust, the risks of violation of rules, abuse of authority and usurpation of power. Inevitably from time to time it generates conflicts of different scales.

However, today we see how the world's first self-organized non-corporate and non-governmental entirely horizontal and non-hierarchical structure operates and provides virtual currency turnover in the group, called Bitcoin [3]. This is phenomenal because this group has more than 1.2 mln of active user [4] and more than 41 mln virtual 'wallets' according to Bloomberg as of 10.02.2014 [5].

Analysis of this structure shows that it operates efficiently. This is illustrated by numerous graphs observations of different indicators (dynamics of the number of users, number of transactions, volume of transactions, etc.) [6].

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The Bitcoin phenomenon acquired great resonance in society. In the autumn of 2013 in the US Senate a hearing on this subject were held [7].

Bitcoin is a peer, anonymous a blockchain based network without a central server, without administrators, without national boundaries and even without an owner. People equally interact in the network with their PC devices. Virtual network operates according to the algorithm, which provides the turnover of the so-called Bitcoin cryptocurrency. Bitcoin itself is nothing more than a virtual entry in the registry showing that some certain amount of units belongs to some virtual account (so-called 'wallet'). Stored units can be shared and transmitted to other members of the network. Each transaction is recorded in the ledger (registry) and signed by five digital signatures randomly selected among members of the system, which provides a high level of reliability of entries made according to this protocol. Each entry is repeated in the registry of each computer of such network by method continuous chain of virtual blocks, which is called 'blockchain'. Any falsification will be revealed at a time when an attacker tries to settle false Bitcoin.

To make a definition of the blockchain technology, we took one which is given on the Bitcoin.org [3] with regards to the Bitcoin cryptocurrency and proposed a common definition.

A blockchain is a distributed data store that holds a public registry of system actions performed by users (machines) of the network which is based on the blockchain technology. This record is enforced cryptographically and hosted on machines running the blockchain based software.

Such a system also solves another problem. Because users provide their computing resources for the system, it is not necessary to organize large data centers. Computer systems that work in the mode of giving its resources to the needs of such network are called 'farms'. Successfully carrying out the work for

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the network (this process also called ‘mining’), these ‘farms’ are rewarded with new produced bitcoins. Thus, cryptocurrency cannot be taken from nowhere.

So, Bitcoin is a theory of blockchain protocol in action. It is important to understand that this technology is applicable to a fairly wide range of social relations. Bitcoin cryptocurrency is just a special case. The blockchain technology is applicable for voting, reporting of public companies or public finances reporting, maintaining of public registers (property register, land register, deals register etc.) and so on. You need just to digitize the written rules of some sphere of human activity into certain IT algorithm.

Today the world knows two examples of this technology at the state level. This is the Isle of Man where it’s going to launch an electronic register of companies working in the sphere of circulation cryptocurrency [8], and Honduras, where the work on creating electronic land registry has began [9].

Or another example, «MaidSAFE» is the company which currently is developing a social Peer-To-Peer network with blockchain technology, which will provide cloud services for remote data storage and other web services (similar to Skype, e-mail, Facebook etc.). Resources for the operation of this system will be provided by the users themselves, by those who will share a part of their computing power to the MaidSAFE network. Those people that will provide a high level of connectivity (speed of access, traffic and network uptime) will receive a reward in the form of internal MaidSAFE cryptocurrency. MaidSAFE is going to provide highly reliable services because of using digital signatures, crypto and efficient algorithms of distributed storage and data backup.

Probably, that such a self-organized social system with sufficient scaling can seriously change the software market and the Internet.

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Blockchain is a tool for self-organization of people. It is assumed that to such networks a part of social functions that in the conventional sense do states and corporations can be delegated. And due to the fact that the logic of the organization of such a network provides an unprecedented level of confidence, there is a high probability that in future public relations will develop rapidly in the paradigm of this technology.

So, the blockchain provides [3]:

1) **effective interaction**, since the blockchain insures the compliance with the rules. As long as compliance with the rules is provided by the people, there is a risk of violation of such rules or usurpation of power. At the same time when the public rules are converted into algorithms that are operated by the computer systems, this risk is greatly reduced;

2) **a high level of trust**, which is provided by recording all iterations of the system in the register with the method of a continuous chain. All transactions are public, and all users of the system have access. Iterations which are not allowed by the algorithm cannot be done;

3) **high level of reliability**, which is achieved by a decentralized organization of a network (Figure 1). All computers in the network are connected to each other directly (**Peer-To-Peer**); there is no central server; all iterations are recorded on each computer of the network. The shutting down of any computer does not lead to loss of data, while damage to the central server, as a rule, can cause serious damage to the system;

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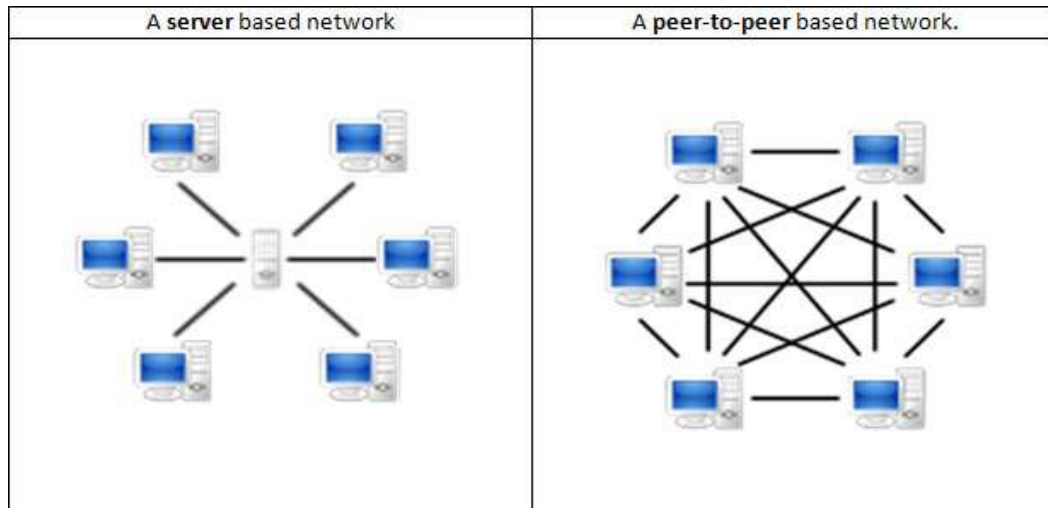
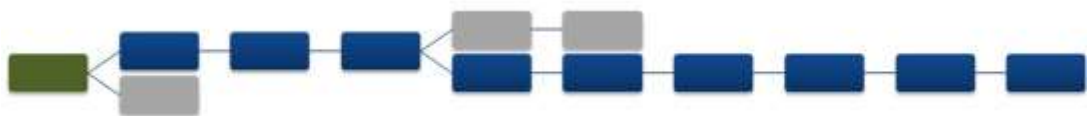


Fig. 1. Network with centralized server structure (left) and peer network (right)

4) **a high level of security**, which is achieved by the fact that there is no central server. In order to change the protocol, all computers of the network need to be hacked. In order to make a parallel chain of the protocol, it must be $50 + 1\%$ of the total capacity of the network (theoretical problem ‘ $50+1\%$ ’), see Figure 2. If the public network has hundreds of millions of computers, the problem is only at the level of theory;



5) **a high level of anonymity and identification**. The system itself is relatively anonymous, but some additional technologies such as ‘Zero-knowledge proof’ [10] provide 100% anonymity that may be necessary, for example, for voting. At the same time when open communication is required, the algorithms may require from users digital signatures to guarantee the reliable identification.

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The Blockchain technology is offered for public administration. In particular, first of all, the system is considered for the introduction of open public registers: register of legal entities and entrepreneurs, all registers of property (land cadastre, real estate, vehicles etc.), register of mortgages, charges and other encumbrances, a notary deals register, a register of court decisions, register of legal documents, registry of wills, register voters and others.

The advantage of using these registers is that they will provide the highest level of protection against unauthorized access and changes.

The blockchain technology makes impossible concealment of intervention, as the system does not allow to delete or change data, only to create new entries and an entry cannot appear from nowhere – the data of a person who made this entry is also stored.

An important area of technology can be a system of voting in elections and referendums. Operation of the system does not require centralized data center. Today there is actually ready network for voting in public places: in particular, schools with computer classrooms, public libraries, post offices and cash payments terminals, banking terminals and ATMs network and so on. To the mentioned public spots we should add personal computers or mobile devices such as smartphones or tablets. Average users, commercial or non-profit organizations can be interested in turning their PC's into the network resource for public purposes if it is proposed some motivational model that provides a particular reward, for example, mentioned cryptocurrency which can be an official cash equivalent or some internal payment instrument.

For the development of public web-services (registration, voting etc.) on a single approach it is possible to provide a reward for users of the network who provided their resources to the needs of the blockchain network (and the system itself will distribute these resources for the requirements of registration, voting

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and so on). The source of the reward is an income from fees which are received by network operators (notaries, land counselors, etc.) for the registration actions which they perform.

Let's assume a certain example of one such possible system – the system of state registration of legal entities. So we propose to base this system on distributed computing technology using blockchain. We have users who are browsing opened data. They can see data for free, but with a condition of waiting in the system (seconds or minutes) while they provide some resources of their PCs. Thus, they will pay a service by giving their computing resources. The second is the paid service when users receive data without waiting and without participation in the system. These users buy a right to receive quick service from those users who have provided their resources in the system and have received a certain number of units of internal reward system (cryptocurrency), whereby they can pass on general civil legal conditions (sale, donation, etc.). Then the next group of users – is registrar.

These registrars are not the part of centralized state service. They are self-employed professionals such as lawyers, notaries or other jurists. To ensure quality of service of state registration the person should be authorized, for example, after the online test and proof of qualification (education). To protect against abuses it is proposed an algorithm when the system will record the registration only after verification of documents by such expert-registrars who are elected by system accidentally and anonymously (it maybe a multi-stage verification by two, three or more experts). Thus, a user who wishes to make an entry (for example, the establishment of enterprise) fills in fields of registration form in proposed software program and attach documents in electronic form, and send in. The system randomly and anonymously selects a registrar who verifies documents and imposes its digital signature, thereby making the record

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in the system and receives a payment. The system of state administrative service centers can thus perform paid service of certification paper data that will be printed from the system.

It is known that the State Registration Service of Ukraine was eliminated in 2015 primarily due to significant corrupt situation and the large number of violations and abuses that occur in the system. The proposed system minimizes this risk and make the service system is completely self-sustaining for the society.

Conclusions

So, the new technology leads to the possibility of developing of new public self-organized systems.

The legal basis for the social interaction model of self-organized system at the stage cryptocurrency appearance caused a number of questions. For example, what should bitcoin be considered? This is not a currency, as it does not have a number of required properties (not fiat, no mobility etc.). Can this be considered as a financial asset? If so, it must have a nominated value and certify someone's commitment. But it does not. Bitcoin does not guarantee by itself to its owner the opportunity to exchange it for money. This is just an entry in the electronic protocol.

What is the legal nature of the relationships of people who have united together in such a network? Obvious is the fact that these relations currently have an **agreement nature**. What law should regulate such relationships? And whether it needs any kind of law to settle such relationships at all?

The topic of a *social contract* is also very relevant. In fact, until now it was only a theory, which by the way, some scientists criticized as it attributes a social phenomenon those properties which do not actually exist. At the same

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time self-organized social systems on the basis of the agreement in practice literally confirms this theory.

New technology creates new opportunities for the development of democratic relations.

Since the times when first democratic institutions appeared in the USA, this process has not changed. A representative democracy remains to this day as a basic form of democracy. Procedures of direct democracy remained until today and are expensive. New technology makes it possible to develop such institutions as *a referendum* on a new level. It is likely that along with this technology we may witness an appearing of new public institutes and further developing of existing ones. For example, *vote of censure* in a form of *public impeachment* can be applied not only to electoral officials, but to every official. Perhaps changes will attend justice and an institute of jurors.

Branches of government are limited by the law, thereby ensuring the balance of power. Many constitutions of the world suggest that people are the source of power and have full power. The new tool allows a self-organized society to make not just *any* public decisions, but to take the functions of public authorities and perform them more efficiently.

References

1. The Cryptography Mailing list at metzdowd.com (2008), «A Peer-to-Peer Electronic Cash System», Nakamoto S., available at: <http://www.mail-archive.com/cryptography%40metzdowd.com/msg09959.html> (Accessed 31 May 2015).
2. Lee Kuo Chuen D. (2015), Handbook of Digital Currency. Bitcoin, Innovation, Financial Instruments, and Big Data, Academic Press, New York, USA.

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3. Bitcoin Project (2009), «How does Bitcoin work?», available at: <https://bitcoin.org/en/how-it-works> (Accessed 31 May 2015).
4. Bitscan (2014), «How many people really own bitcoins – and why does it matter?», Hurst B., available at: <https://bitscan.com/bitnews/item/how-many-people-really-own-bitcoins-and-why-does-it-matter> (Accessed 31 May 2015).
5. Bloomberg (2014), «Bitcoin Economy Widens as Parents Pay Digital Allowance», Kharif O., available at: <http://www.bloomberg.com/news/articles/2014-09-25/bitcoin-economy-widens-as-parents-pay-digital-allowance> (Accessed 31 May 2015).
6. Blockchain Ltd. (2015), «Currency Stats», available at: <https://blockchain.info/ru/stats> (Accessed 24 May 2015).
7. The Verge (2013), «Bitcoin hits \$700 during surprisingly friendly Senate hearing on the virtual currency», Jeffries A., available at: <http://www.theverge.com/2013/11/18/5119062/senate-committee-hearing-on-bitcoin> (Accessed 31 May 2015).
8. Coindesk (2015), «Isle of Man Trials First Government-Run Blockchain Project», Caffyn G., available at: <http://www.coindesk.com/isle-of-man-trials-first-government-run-blockchain-project/> (Accessed 31 May 2015).
9. Reuters (2015), «Honduras to build land title registry using bitcoin technology», Chavez-Dreyfuss G., available at: <https://uk.news.yahoo.com/honduras-build-land-title-registry-using-bitcoin-technology-162701917.html#rJ041PN> (Accessed 31 May 2015).
10. Goldwasser, S. Micali, S., Rackoff C. (1989), «The knowledge complexity of interactive proof systems», SIAM J. COMPUT. Society for Industrial and Applied Mathematics, vol.18, pp. 186-208.

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Використання Blockchain технології для розвитку електронної демократії та електронного урядування

У статті аналізується нова інформаційна технологія, яка отримала назву «блокчейн» (від англійського «blockchain») та можливості, які відкриваються при застосуванні цієї технології в електронному урядуванні та електронній демократії. Запропоновано, в яких сферах може бути застосована ця технологія і які саме переваги вона надасть, та як саме підвищить ефективність управління публічними справами.

Ключові слова: blockchain, block chain, bitcoin, блокчейн, електронне урядування, е-урядування, електронна демократія, е-демократія, цифрова демократія, публічні фінанси, захист електронних даних, безпека електронних даних, суспільні відносини, самоорганізація людей, модель децентралізованих розподілених обчислень, державні реєстри, бази даних, веб-сервіси, Peer-To-Peer.

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Использование Blockchain технологии для развития электронной демократии и электронного управления

В статье анализируется новая информационная технология, которая получила название «блокчейн» (от английского «blockchain») и возможности, которые открываются при применении этой технологии в электронном управлении и электронной демократии. Предлагается в каких сферах может быть применена эта технология и какие именно преимущества она даст, и как повысит эффективность управления публичными делами.

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Ключевые слова: blockchain, block chain, bitcoin, блокчейн, электронное управления, е-управления, электронная демократия; е-демократия цифровая демократия публичные финансы, защита электронных данных, безопасность электронных данных, общественные отношения, самоорганизация людям, модель децентрализованных распределенных вычислений, государственные реестры, базы данных, веб-сервисы, Peer-To-Peer.

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The Use of Blockchain Technology for the Development of Electronic Democracy and Electronic Governance

The article deals with the new information technology, known as «blockchain» and the opportunities which gives the use of this technology in e-governance and e-democracy. It is hypothesized in which areas this technology can be applied and what benefits it will provide and improve the efficiency of public affairs management.

Key words: blockchain, bitcoin, electronic government, e-democracy, digital democracy, public finances, electronic data protection, electronic data security, social relations, self-organization of people, decentralized computing model, public registries, databases, web-services, Peer-To-Peer.

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