TECHNICAL SCIENCES

INTEGRATION OF BLOCKCHAIN TECHNOLOGY AND THE INTERNET OF THINGS

Nurullayev J.
Faculty of Business Administration, ADA University, Baku, Azerbaijan
Babayev H.
Faculty of MBA, UNEC, Baku, Azerbaijan
Bunyatzada A.
Faculty of International Trade and Logistics, Azerbaijan Technical University, Baku, Azerbaijan
https://doi.org/10.5281/zenodo.6778546

Abstract

The article analyzes the results of the use of digital technologies in international trade. At the heart of the new technological revolution are digital technologies, especially the Internet of Things and blockchain. The Internet of Things (IoT) is a revolutionary networking technology of people, devices, physical and virtual objects, processes, and systems that can communicate with each other through data transmission. The Internet of Things allows these objects to communicate, exchange data, and analyze information about the world around them through networks and cloud software platforms. This technology helps solve many productions and household problems, gives control over the supply chain, prevents equipment failures, and opens up opportunities to sell new digital products and services. Under the influence of digitalization, international trade has become more fluid, global chains have become more flexible, delivery times for goods have been reduced, smart contracts have become widely used, and credit has become more accessible as a means of financing trade. With the advent of digital technologies and the transformation of the Internet into an important operational tool, the global economy is undergoing major changes. New technologies have changed consumer habits and also made life easier for suppliers. There are new online markets, new products, and new business models based on these technologies. E-commerce has rapidly outgrown thanks to the widespread use of the Internet and connected devices, which have provided direct access to online marketplaces for suppliers and buyers. This allowed them to manufacture, sell and distribute their products at low prices, making it easier to enter the market and diversify production. As a result, more and more goods and services are delivered remotely, often from overseas.

Keywords: digital technologies, IoT, EDGE, internet of things, blockchain, smart contracts, retailers, integrated systems.

Introduction. International trade is a very important part of the development of any country and the world as a whole because, in the context of globalization, no state can develop without creating an effective system of economic relations. Digitalization has changed the structure of the world economy, making digital technologies a leader in the economic sphere and public life. The concept of the digital economy, which is currently evolving with the development of digital technologies, includes doing business, maintaining connections, and providing services in all sectors. The critical factor in the digitalization of the economy is the use of robotics and artificial intelligence. Harnessing the power of the global network through its abstract, machine-coded structure and software has simplified value creation, transactions, and cross-border interactions [1].

One of the technologies that were discussed as a breakthrough at the recent International Economic Forum in Davos, dedicated to the fourth industrial revolution, the application of modern technologies and their impact on changing the economic, social, and cultural landscape of contemporary society, was the concept of the Internet of Things (IoT). The concept of the Internet of Things has led to the modernization of individual management tools and methods and contributed to a radical restructuring of management processes and ways of organizing activities in modern companies. The experience of global companies already using IoT technologies has helped to increase efficiency, significantly reduce the costs of logistics, marketing, and administrative processes, and also created a new type of business. However, the implementation of these technological solutions requires fundamentally new solutions in the field of human-machine interaction, new skills from employees, and, most importantly, new methods of public administration.

Tools for identifying things not connected to the Internet include RFID tags, OIDs such as barcodes, QR codes, Data Matrix, infrared tags, and real-time location tools. The means of identifying objects connected to the Internet include the MAC address of the network adapter, which allows you to identify the device at the link level. The means of measuring the parameters of objects include sensors, smart meters, and integrated systems. The means of data transmission include wireless and wired networks. Data processing tools - specialized applications, information, and computing systems [2].

Not only do IoT devices generate huge amounts of data, which presents many business opportunities, but also the equally huge challenges of managing, analyzing, and storing this data. Typically, these processes were handled in a private cloud or company data center. Analyzing the data where it's coming from and sending only the information that matters to effective raw

stream decision making provides a wide range of cost and efficiency benefits. Edge computing (peripheral or edge computing) helps maintain security in an organization. Edge technology (Edge is a digital wireless data transmission technology for mobile communications) refers to remote monitoring and data processing directly on IoT devices. Edge computing solves the latency problem in the cloud, allowing organizations of all sizes to benefit from the latest advances in IoT. The Internet of Things and the worldwide network of sensors are gradually increasing the amount of data that the regular cloud has to process. With Edge IoT and new sensor tokens in the field of freight transport, it is possible to track and control a container on a cargo ship in the middle of the ocean, or in an airplane right in the middle of a flight, and with the advent of 5G, explosive changes will be inevitable. Tracking the location and status of cargo through the Internet of Things has provided a new level of cargo transportation and transport security. Multiple sensors in smart containers, connected to the Edge data communication architecture, allow you to instantly know the status of the cargo. All this becomes possible only with the use of blockchain technologies.

Blockchain is a system for recording information that makes it impossible to cheat, change or hack and is a distributed registry technology (Distributed Ledger Technology (DLT), where transactions are recorded with an unchanged cryptographic signature called a Hash. In other words, it is a technology for storing data in a chain of sequentially connected blocks on computers where storage media are not connected to each other using a single server. Once an entry has been added to the chain, it cannot be changed.

Features of DLT technology:

Programmable - DLT is programmable;

Secure – all records are encrypted;

Distributed - DLT is distributed, that is, for complete transparency, network participants have a copy of the registry;

Immutable - checked entries are irreversible and cannot be changed;

Time-Stamped - the time of the transaction is recorded in the block;

Anonymous - the identity of the participants is not revealed;

Unanimous - Network members agree on the validity of each entry.

DLT can completely change how financial markets work by eliminating intermediaries. When goods move from one part of the world to another, supply chains contain a huge amount of information and it is impossible to trace the source of problems using standard data storage methods. Therefore, storing information on the blockchain makes it easier to monitor the supply chain. Due to the huge number of devices and limited resources, deploying blockchain in IoT is a particularly challenging task. The optimal blockchain architecture should scale to many IoT devices and should handle high throughput transactions.

Currently, in blockchain-based CP-ABE data exchange schemes, data is encrypted and stored in the cloud. If users need to process the data, they must decrypt the ciphertext, and after processing the data, encrypt it again and upload the text to the cloud. Blockchain-based identity and access control systems, using encryption, have the potential to solve important security problems for the Internet of Things, in particular, to prevent IP address spoofing.

The system consists of a cloud server, an attribute authority (AA), a blockchain, an IoT device, edge servers, and users.

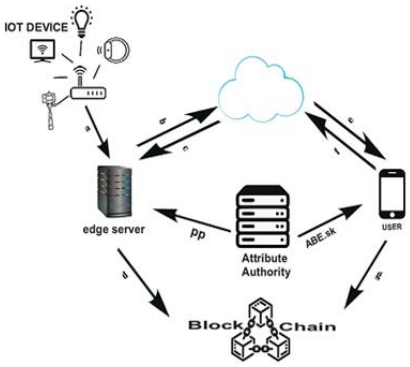
✓ Cloud server stores encrypted IoT data and calculates ciphertexts for users.

✓ AA is responsible for generating decryption keys as well as evaluating keys for users and generates a public key for each IoT device.

✓ Blockchain records data hash, cloud server signatures and data access policy.

✓ IoT devices are data collectors that define the data access policy.

✓ Edge Servers are responsible for encrypting IoT data and sending encrypted text to the cloud. In addition, the edge servers check the accuracy of the ciphertext stored on the cloud server. All edge servers jointly maintain the blockchain and also run smart contacts to write the actual information about the IoT data to the blockchain.



✓ Users are individuals who request data and calculations.

Let's show the architecture of the system:

a. IoT devices send the collected data to the nearest edge server over a secure channel.

b. The edge server encrypts the IoT data and sends the encrypted texts to the cloud server.

c. The cloud server signs the ciphertext hash using the traditional and homomorphic signature algorithm, and then returns the signatures to the edge server.

d. The edge server verifies signatures and records valid signatures, data hashes, and data access policies on the blockchain.

e. The user submits an access request or compute request to the cloud.

f. The cloud server extracts the ciphertext, then sends the result of the ciphertext calculation to the user.

g. The user decrypts the ciphertext and downloads the data from the blockchain, verifying the validity of the data using the data hash.

The entire IoT system is distributed and scalable, however, if it is not possible to transfer data from the end device to the cloud or vice versa, retries are made. For the exchange of signals between the components of a distributed system, special solutions are used - mes-

sage brokers, which guarantee the delivery of the necessary data to one or more recipients through a managed queue. The main advantage of the Internet of Things in commerce lies in the potential sensors and mechanisms for contextual, personalized, real-time interactive communication with consumers and buyers. At the same time, IoT can lead to the implementation of logistics and outcomes for better retail business management [4].

Conclusion. Much can be achieved today thanks to digital technologies, but for their successful functioning, physical transformations are required, which are also driven by digital technologies. Blockchain-based applications have the potential to improve the supply chains that today's trade and manufacturing are built on by providing the infrastructure for registration, certification and traceability of low-cost goods that are transferred between often distant parties that are connected through the supply chain but do not necessarily trust each other. . Blockchain-based systems can improve the efficiency of procurement, logistics, and payment processes, reduce paperwork, ensure compliance and delivery of goods, and prevent wastage, all of which reduce costs and minimize fraud. Blockchain-based solutions are created that are implemented in conjunction with the Internet of Things, Big Data technology, artificial intelligence, etc. A unique aspect of IoT, compared to other network systems, is the presence of many physical things and devices other than computing and data processing devices.

Thus, IoT and blockchain open up truly wide opportunities, both for automating household and everyday tasks, and for decision support systems and robotization of high-tech industries.

This work was supported by the Science Development Foundation under the President of the Republic of Azerbaijan – **Grant № EİF-GAT-6-2021-2(39)-13/02/1-M-02**

References:

1. Nurullayev J., Babayev H., İmpact of digital transformation on the labor market: a review, Journal of Global Economics, Management and Business Research , 13(4): 92-96, 2021, ISSN: 2454-2504

2. Довгаль В.А., Довгаль Д.В. Интернет Вещей: концепция, приложения и задачи, ISSN 2410-3225 Ежеквартальный рецензируемый, реферируемый научный журнал «Вестник АГУ». Выпуск 1 (216) 2018

3. Sun, S.; Du, R.; Chen, S. A Secure and Computable Blockchain- Based Data Sharing Scheme in IoT System. Information 2021, 12, 47. https://doi.org/10.3390/info12020047

4. Kasznik, E. 5 ways the 'Internet of Things' transformed the vending machine [Electronic resource] / E. Kasznik // Bizjournals. – URL: http://www.bizjournals. com/bizjournals/how-to/technology/2015/ 04/the-internet-of-things-is-transformingvending.html

5. Namiot D. et al. Blockchain applications for transport industry

6. //International Journal of Open Information Technologies. – 2017. – Т. 5. – №. 12. – С. 130-134.