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DEVELOPMENT OF FORM OF INTERACTION OF PARTICIPANTS OF NON-CASH PAYMENTS IN CONDITIONS OF ECONOMY DIGITALIZATION

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New high-tech methods for making non-cash payments have appeared in the conditions of digitalization of economy (in systems of electronic payment and crypto currency, including the possibility of signing smart contracts). These methods satisfy the requirements of the Internet community: safety of storage and information processing in payment and settlement systems, low cost and high speed of transactions, simplicity and usability, possibility of carrying out payments for small sums in virtual space and others. Despite the absence of legal regulation of the circulation of new hi-tech payment tools, the number of transactions with their participation and the volume of the performed operations increases annually. At the same time, we can note that the traditional ways of non-cash payments fulfillment are still equally popular in the financial and economic sphere (by means of financial instruments in material form, at an office of the money transfer operator, in the system of remote bank service). We have considered the types of payment and settlement systems (traditional electronic and innovative digital). The result of comparative analysis of advantages and disadvantages of each type of systems is presented. We have characterized the forms of interaction of participants of non-cash payments with different methods of initiation of payment operations. On the basis of the obtained results, we have proved that introducing scientific and technical progress into all spheres of public life has promoted change of forms of interaction of participants of non-cash payments from personal contact to digital due to automation of financial processes. However, in the future, in the conditions of globalization of economy, decreased reliability of a world currency system, high level of cyber threats in the financial and economic sphere, intense geopolitical situation in the world, integrated use of traditional and innovative technologies in the sphere of payments and settlements both at the national level, and on the international scene is advisable for increasing reliability and efficiency of non-cash payments, counteracting money laundering, ensuring national and economic security of the country.

Keywords: non-cash payments, technology of distributed registers, interaction form, digital system, electronic system

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РАЗВИТИЕ ФОРМЫ ВЗАИМОДЕЙСТВИЯ УЧАСТНИКОВ БЕЗНАЛИЧНЫХ РАСЧЕТОВ В УСЛОВИЯХ ЦИФРОВИЗАЦИИ ЭКОНОМИКИ

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В условиях цифровизации экономики появились новые высокотехнологичные способы совершения безналичных расчетов и платежей (в системе электронных денег и в криптовалютной системе, в том числе с возможностью заключения смарт-контрактов), удовлетворя-

ющие потребности интернет-сообщества: безопасность хранения и обработки информации в расчетно-платежных системах, низкая стоимость и высокая скорость транзакций, простота и удобство использования, возможность проведения расчетов на небольшие суммы в виртуальном пространстве и др. Несмотря на отсутствие (наличие слабого) нормативно-правового регулирования обращения новых высокотехнологичных финансово-расчетных инструментов, ежегодно возрастают количество транзакций с их участием и объем совершаемых операций. При этом наравне с ними в финансово-экономической сфере не менее популярными остаются традиционные способы совершения безналичных расчетов (финансовыми инструментами, имеющими материально-вещественную форму, в офисе оператора по переводу денежных средств, в системе дистанционного банковского обслуживания). Выделены типы расчетно-платежных систем (традиционные электронные и инновационные цифровые) и представлен результат сравнительного анализа, на основании которого определены достоинства и недостатки каждого типа систем, а также охарактеризованы формы взаимодействия участников безналичных расчетов при разных способах инициации расчетных операций. На основе полученных результатов доказано, что внедрение научно-технического прогресса во все сферы общественной жизни способствовало изменению форм взаимодействия участников безналичных расчетов от личного контакта до цифрового за счет автоматизации финансовых процессов. Однако в будущем в условиях глобализации экономики, снижения надежности мировой валютной системы, высокого уровня киберугроз в финансово-экономической сфере, напряженной геополитической обстановки в мире для повышения надежности и эффективности безналичных расчетов, противодействия легализации преступных доходов, обеспечения национальной и экономической безопасности страны целесообразно интегрированное применение традиционных и инновационных технологий в сфере расчетов и платежей как на национальном уровне, так и на международной арене.

Ключевые слова: безналичные расчеты, технология распределенных реестров, форма взаимодействия, цифровая система, электронная система

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Introduction. In the conditions of digitalization of economy, improving, developing and promoting non-cash payments is directly related to computational and information technologies. Advances of scientific and technological progress introduced in the financial sector, resulting in new ways of non-cash payments, have accelerated cash flows, reduced the impact of territorial restrictions, reduced the time, financial and labor costs of storing, processing and transmitting information, as well as provided a higher security level of payments. At the same time, we note that using innovative technologies for organizing payment and settlement systems contributed to changing the forms of interaction between participants in payment and settlement operations.

Ever since network technologies have been introduced for accessing information systems, financial organizations have been constantly

threatened by intruders. Successful attacks on traditional electronic systems not only lead to substantial financial and reputation losses for the affected organizations, but also destabilize the economy as a whole. Therefore, recently, special attention of scientists and researchers has been directed to studying the essence of high-tech payment and settlement instruments, their role in life and economy, developing proposals for improving traditional electronic systems, as well as the possibility of using innovative technologies in the field of payment and settlement that can reduce (eliminate) the disadvantages of traditional systems, including those concerning information security (Geva [1], Chiu [2], Robbek [3], Atey [5], Andryushin [6], Ason [7], Babkin [9], Baldina [10], Vavrenyuk [13], Genkin [14], Dostov [15], Dubyansky [16], Kashirina [18], Kosten [8], Kochergin [19], Lukasevich. [21], Obaeva [11],

Popikov [22], Revenkov [23], Simanovsky [24], Stolbov [25], Trofimov [26], Fedorova [27]).

The goal of the study is to determine the form of interaction of participants in non-cash payments when they use different technologies to perform payment operations.

Research methodology. The methodological basis of the study consisted of a set of dialectical principles that made it possible to identify the essential characteristics of the studied processes and the forms of their manifestation. We have used the techniques of formal logic, a systematic approach and the method of comparative analysis.

We have carried out comparative analysis of electronic and digital payment and settlement systems;

identified the advantages and disadvantages of each type of digital economic systems; given the forms of interaction of participants of non-cash payments considering the technologies they use for performing settlement operations; proved the feasibility of integrated application of traditional and innovative technologies in the field of payment and settlement.

Results. High-tech innovations in payment and settlement play a key role in increasing the efficiency and competitiveness of payment systems [20]. Today there are two types of payment and settlement systems, depending on the technology that underlies them: traditional electronic and innovative digital systems, whose comparative characteristics are presented in Table.

Comparative characteristics of traditional electronic and innovative digital payment and settlement systems

Parameters	Traditional electronic systems	Innovative digital systems
Information processing device	Dedicated server (server group)	Distributed network of servers
Data storage	Database	Distributed databases
Format of records on accounting units in system	Numeric entries on user accounts	Transaction records in the form of blocks signed by user's private key
Transaction view format	Record for operation of transfer of funds between accounts	Script in a cryptosystem programming language (additional conditions)
Application architecture	Traditional client-server solution	Distributed registry technology
Network architecture	Network with dedicated servers	Peer-to-peer network
Public key equivalent	Account number	e-Wallet number
Private key equivalent	Password	Unique server ID
Access to financial account or user account in system can be restored	+	–
Transaction conditions	Uninterrupted operation of at least one server, incl. subscriber devices, communication channels and software	Uninterrupted operation of most servers and communication channels in network, subscriber devices, and software
Smart contracts can be signed	–	+
Issue of accounting unit in system	Centralized	Decentralized
Limited number of issued accounting units can be established in system	–	+
Maximum divisibility of accounting unit	10^{-2}	10^{-8}
Transaction data sharing	–	+
Anonymity	+/- (depending on amount of transfer)	Not guaranteed
Exchange rate of accounting unit system for legal tender	+ (electronic money) / not required (non-cash system)	+ (secured units of account) / – (varies depending on demand on unsecured basis)

End Table

Parameters	Traditional electronic systems	Innovative digital systems
Exchange rate volatility	Low	Low (secured units of legal tender) / Medium (secured units of precious metals and natural resources) / High (unsecured units of account)
Availability of accounting unit	+	+/- (unsecured cryptocurrency, social trust)
Form of security	Law, legal tender	Legal tender, precious metals, natural resources
Participation of user devices in system	-	+
Form (type) of accounting unit in the system	National currency / Private	Private
Operator responsible for system's operation	+	+/-
State control and regulation	+/- (depending on the amount of transfer)	-
Private control	+	+
Private regulation (by the operator)	+	-
Amount of commission for conducting operations in system	Average	Low
Level of reliability of financial information in system	Low	High
Impact level of operational risks	High	Low
Temporary restrictions on operations in system	+ (office) / - (remote maintenance in system)	-
Territorial restrictions on operations in system	+ (office) / - (remote maintenance in system)	-
Number of parties involved in payment and settlement transactions in system	= 3 (sender, recipient, system operator)	≥ 2 (sender, recipient, if necessary, third party in case of smart contracts signing, or intermediaries involved in order to conduct anonymous calculations to «blur» transferred amount)
Mechanism (processing) of payments and settlements	Complicated	Simple

A centralized approach is used for organizing traditional electronic payment and settlement systems, which involves storing information in a single database and processing operations on a dedicated server that has a unified «interface» for interacting with the user. The user's device is not involved in this process.

When organizing an innovative digital payment and settlement system, a decentralized approach is used with cryptographic methods for protecting information, which does not include a unified interface, and all the servers in the decentralized system are equal. The digital system is based on distributed registry technology [4, 12]. A transaction

is typically processed in such a system by several computing servers at the same time, simultaneously performing an operation, confirming or rejecting it. One of the main advantages of an innovative digital system is its substantial territorial distribution, which makes it immune to loss of individual servers. Note that the innovative technology not only provides secure storage of user data and financial information, but also provides a guarantee of reliability of these data [17].

Based on the structured information presented in the table, it is possible to highlight the advantages and disadvantages of traditional electronic and innovative digital payment and settlement systems.

The main advantages of existing traditional electronic systems are:

- protection of personal data of users;
- security for units of account in the system (non-cash funds (law) and electronic money (legal tender or precious metals));
- strict exchange rate of electronic and legal money;
- official representative of the system responsible for its functioning and regulation, for resolving disputable issues and considering claims, providing advice on working in the system;
- third parties are capable of influencing the operations carried out in the system: blocking accounts, suspending or refusing to conduct suspicious transfers;
- access can be restored to financial account or user account in the system, etc.

Typical disadvantages of traditional electronic systems are:

- complex mechanism for payments and settlements;
- centralized nature of system management and information storage, with risks of different types of attacks, such as «denial of service», phishing attack, MIM, and others;
- low level of transparency of system management, which consists in the lack of access to statistical data, difficulty of verifying the provided information;
- operative control over the activities of money transfer operators (electronic money transfer operators) is impossible to exercise;
- third parties can access funds without knowledge and coordination of the account holders for the purpose of unlawful actions;
- high level of operational risk;
- unsecured emission of funds in the system, etc.

The main advantages of innovative digital payment and settlement systems operating today are:

- simple mechanism for payments and settlements, requiring special knowledge in the field of information technology;
- immunity to attacks peculiar to traditional electronic systems;
- system performance is maintained in case of failure of no more than half of the total number of servers;
- transparency of all financial transactions;
- low level of commission;
- software source code available to its users for system modification and auditing;

– high level of cryptographic security, sufficient for safe storage of personal data and financial information;

– transferred amounts are immediately visible in electronic wallets of the sender and the recipient, confirming the transaction takes some time, after which the recipient can freely manage the amount, etc.

The following disadvantages of modern innovative digital systems should be considered:

- no official representative of the public system responsible for its functioning (for example, Bitcoin);
- it is impossible to resolve disputes and consider claims due to lack of technological capabilities in the system (in the case without smart contracts signing);
- no collateral guarantee of the accounting unit in the system (if it is not provided for), or no option for the system operator to conduct online checks on collateral guarantee of the accounting units;
- high volatility of an unsecured cryptosystem accounting unit, depending on its demand level;
- risk of «51%», «dust», Sibyl attacks;
- no option to block accounts and refuse to make suspicious transfers, i.e., influence the account status and transfer process;
- no option to correct operations in the system in the event of an error, restore the e-wallet's private key and cancel the transfer;
- irretrievable loss of funds in the electronic wallet to which access is lost;
- private key to the electronic wallet cannot be changed (it is dangerous to store cryptocurrency in a compromised electronic wallet);
- low transaction confirmation speed, etc.

The large-scale implementation of scientific and technological innovations in all spheres of public life contributed to different methods emerging for initiating non-cash payments (office, ATM, remote banking services, electronic money, cryptocurrency), which, in turn, improved the procedures and transformed the form of interaction between non-cash payments entities from personal contact to digital. The forms of interaction between the sender and the recipient of funds when performing payment operations initiated in different ways are presented below, based on the assumption that the payment operation (the amounts payable by one party to another are calculated exclusively by means of

mentally represented money, making sense only when completed with payments, i.e., transfer of legal tender) consists of four procedures:

- 1) ensuring the availability of funds for transfer or delivery to the recipient (to the account/e-wallet);
- 2) providing the order initiating the payment operation (movement of funds);
- 3) implementing non-cash payment (transfer of funds);
- 4) confirming the execution of non-cash payments.

Historically, the first form of interaction between economic entities when performing payment operations was personal contact between the sender and the recipient of funds in real world using financial instruments (the sender transfers the funds to the recipient «from hand to hand»: checks, bill of exchange or receipt with a tangible form) (Fig. 1).

According to Fig. 1, such a scheme of interaction of economic entities corresponds to the following procedures of non-cash payments:

- procedure 1 «ensuring the availability of funds for transfer to the recipient (to the account /e-wallet)» corresponds to personal contact between the sender and the issuer of the financial instrument in order to deposit funds and receive the payment tool;
- procedure 2 «providing the order initiating a payment operation» is absent, since the payment

tool, which is received personally from the issuer and has a material form, is at the same time confirmation of the recipient’s right to receive funds and the sender’s acceptance of payment;

- procedure 3 «implementing non-cash payment» corresponds to transfer of the payment tool by the sender of funds to the recipient «from hand to hand»;
- procedure 4 «confirming the execution of non-cash payments» corresponds to the sender receiving the confirmation personally upon settlement of the payment tool.

Over time, at a certain stage of social development, payment and settlement operations began to serve not only cash, but also non-cash money. As a result, a new form of interaction between the sender and the recipient of funds emerged for performing payment and settlement transactions: **indirect interaction**, suggesting indirect contact in real world (Fig. 2). In this case, the sender and the recipient of funds do not contact directly with each other in the process of making a payment operation; the representative of the money transfer operator acts as a link between the two, serving the sender personally at their location (in the office), while the sender’s functions include carrying out procedures for transfer of funds from the time of entering the details provided by the sender of the funds to confirming the payment.

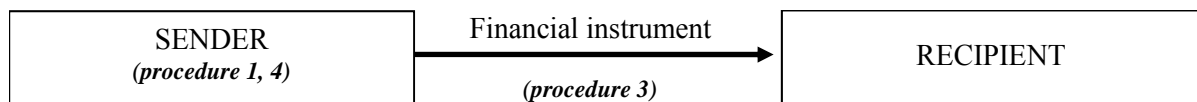


Fig. 1. Personal contact between sender and recipient in payment operation

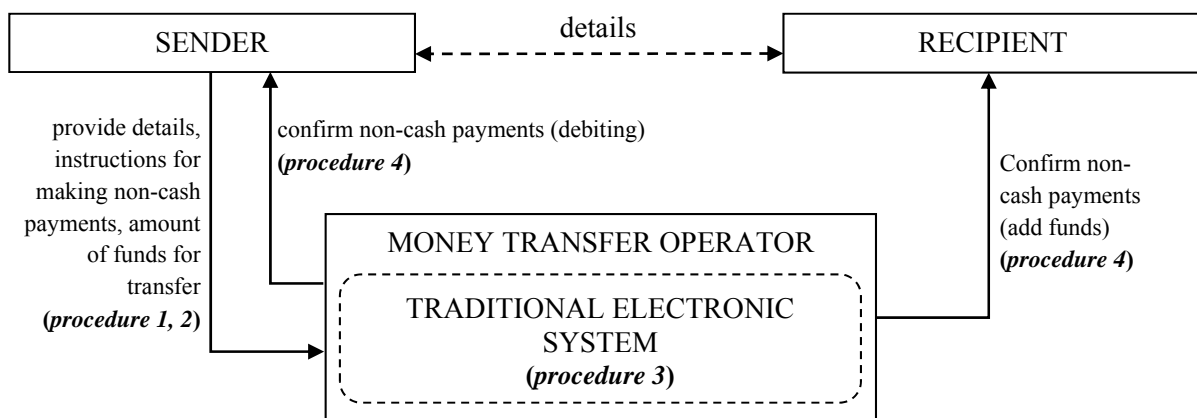


Fig. 2. Indirect interaction of sender with recipient in real world during non-cash payments

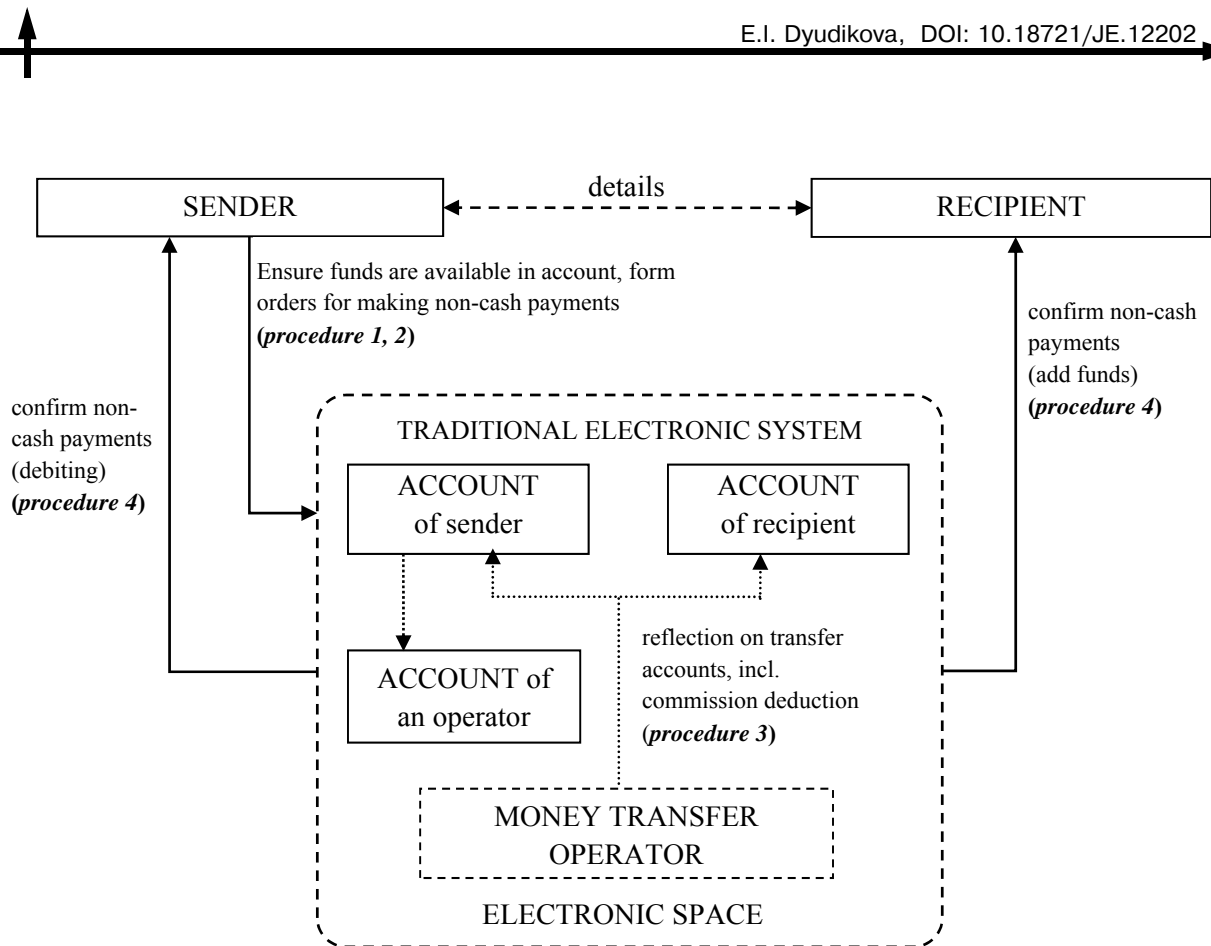


Fig. 3. Electronic interaction between sender and recipient when making non-cash payments

Fig. 2 visually presents non-cash payment procedures for indirect contact:

- procedure 1 «ensuring the availability of funds for transfer to the recipient (to the account)»: replenishing the bank account with cash or non-cash money in case of personal contact between the sender and a representative of the money transfer operator in the office in case of shortage of funds for non-cash payments;
- procedure 2 «providing the order initiating a payment operation»: the sender transfers the recipient's details and personal confirmation of the transfer in the office to the representative of the money transfer operator;
- procedure 3 «making non-cash payments»: the transfer is made by the money transfer operator without the participation of the sender;
- procedure 4 «confirming non-cash payments»: the representative of the money transfer operator either sends a confirmation of the non-cash transaction by personal contact with the sender (recipient), or sends a notice via communication channels (SMS message, e-mail, letter, etc.)

The next stage of transformation of the form of interaction between economic entities in the area of payments and settlements is related to the advent of ATMs, remote banking systems and electronic money systems, i.e., **electronic interaction** involving indirect contact in electronic space (Fig. 3).

Electronic interaction means that the sender and the recipient of funds do not contact each other directly in the process of non-cash payments, the money transfer operator acts as a link between them, providing an opportunity to perform payment operations without a personal visit to the office through the traditional electronic payment and settlement system, while initiating the transfer is fully performed by the sender who enters details of the recipient of funds, generates and sends an order on the movement of funds. Thus, electronic interaction of non-cash payments is carried out in the traditional electronic payment and settlement system, in which a third party can influence the course of payment operations, the status and state of accounts, including without the consent and knowledge of the account holder.

Electronic interaction between the sender and the recipient of funds in each procedure of non-cash payments presented in Fig. 3 has the following form:

- procedure 1 «ensuring the availability of funds for transfer to the recipient (to the account)»: replenishing the account with cash or non-cash money in case of personal contact of the sender with a representative of the transfer operator at the cash desk or through an ATM, terminal, payment aggregators, exchange services with no need for personal contact with a representative of the operator, etc.;
- procedure 2 «providing the order initiating a payment transaction»: the sender independently enters the details of the recipient of funds within the traditional electronic payment and settlement system and confirms the transfer without the participation of third parties;
- procedure 3 «making non-cash payments»: this procedure is performed by the operator without the participation of the sender of funds (in automated or manual mode);
- procedure 4 «confirming non-cash payments»: confirmation is carried out in the personal account of the traditional electronic payment and settlement system (electronic form).

Organization of innovative digital systems based on the technology of distributed registries encouraged the emergence of a new form of interaction between non-cash payment participants: **digital interaction** (Fig. 4), involving direct contact in the digital space without intermediaries and without personal contact through a decentralized cryptosystem, where the sender needs only to enter the recipient's electronic wallet number to transfer funds. Electronic interaction of non-cash payments is carried out in an innovative digital system whose technology (distributed registry technology) eliminates the influence of a third party on the transfer of funds, the status and state of electronic wallets, and the information in the system is non-repudiable and genuine.

The form of interaction between the sender and the recipient of funds during each payment procedure in virtual space is shown in Fig. 4:

- procedure 1 «ensuring the availability of funds in the sender's electronic wallet for transfer to the recipient»: the replenishment operation is carried out only remotely by mining or purchasing (buying) cryptocurrency units (transfer from an electronic wallet to an electronic wallet);

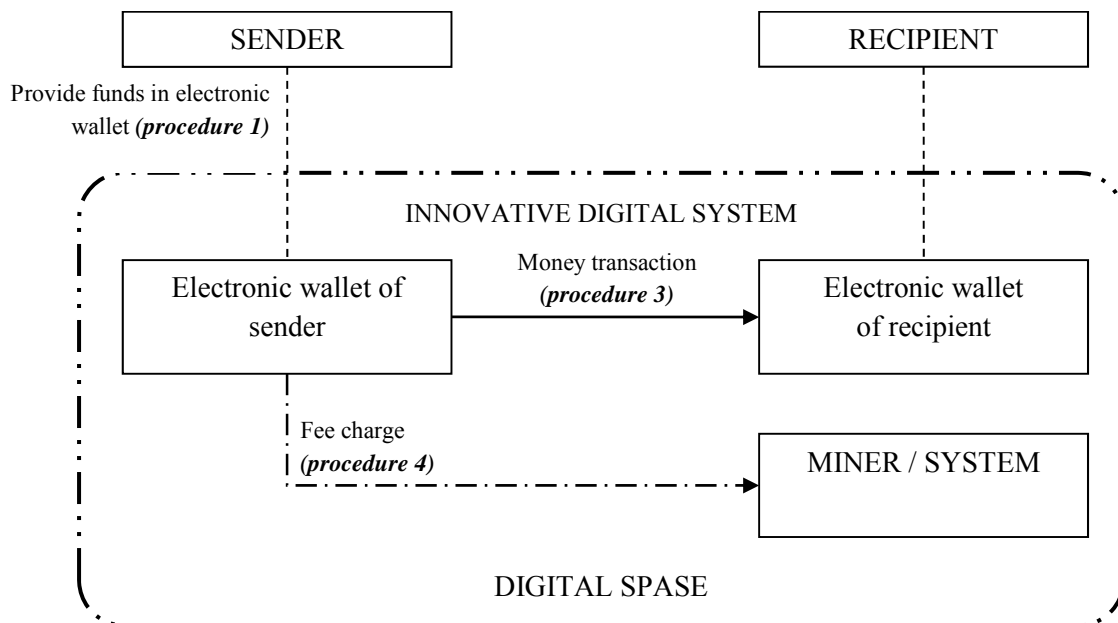


Fig. 4. Digital interaction of sender with recipient when making non-cash payments

– procedure 2 «providing the order initiating a payment operation» is absent, since functioning innovative digital systems based on distributed registry technology have no option for the operator (if it exists) to regulate and influence e-wallets, the system does not provide instructions or confirmation of the sender;

– procedure 3 «making non-cash payment»: in the innovative digital system, the sender transfers funds directly to the recipient without the participation of third parties by entering only the electronic wallet number;

– procedure 4 «confirming non-cash payments»: this procedure consists in entering the operation into the block of transactions of the cryptosystem (commission collected).

Thus, as a result of the study, we have obtained the following results:

– it was established that traditional electronic and innovative digital payment and settlement systems form the basis of the digital economy; each of the systems has its advantages and disadvantages; a regulatory framework governing the sphere of circulation of digital financial assets of the new generation has to be developed, with integrated functioning of traditional and innovative technologies in the area of payments and settlements;

– the modern forms of interaction of participants in non-cash payments when they use different technologies to perform payment operations have been identified; that confirms the importance of each method for initiating payment operations in the conditions of digitalization of economy.

Findings. Technological and communication progress contributed to transformation of the form of interaction of participants carrying out non-cash payments, providing the opportunity for the sender to transfer funds in the virtual space to the recipient directly without personal interaction and participation of intermediaries. Each new stage of technological development significantly accelerated, simplified and cheapened the payment operation by automating financial processes. By applying new methods of initiating non-cash payments, the senders of funds no longer need personal interaction and intermediaries; the level of operational and technological risks, as well as the influence of the «human factor» on the procedures for payments and settlements, is reduced. At the same time, each type of payment and settlement system (traditional electronic and innovative digital) has its advantages and disadvantages; therefore, in the future, it is advisable not to categorically reject the use of one technology, but to integrate them, which will provide a qualitatively new level of organization of payment and settlement systems, increase security, reduce costs and raise the speed of payment operations.

The directions of further research are seen in defining the financial essence of digital financial assets of the new generation and offering practical recommendations for developing a mechanism for their circulation, based on the technology of distributed registries through integration into international payments.

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