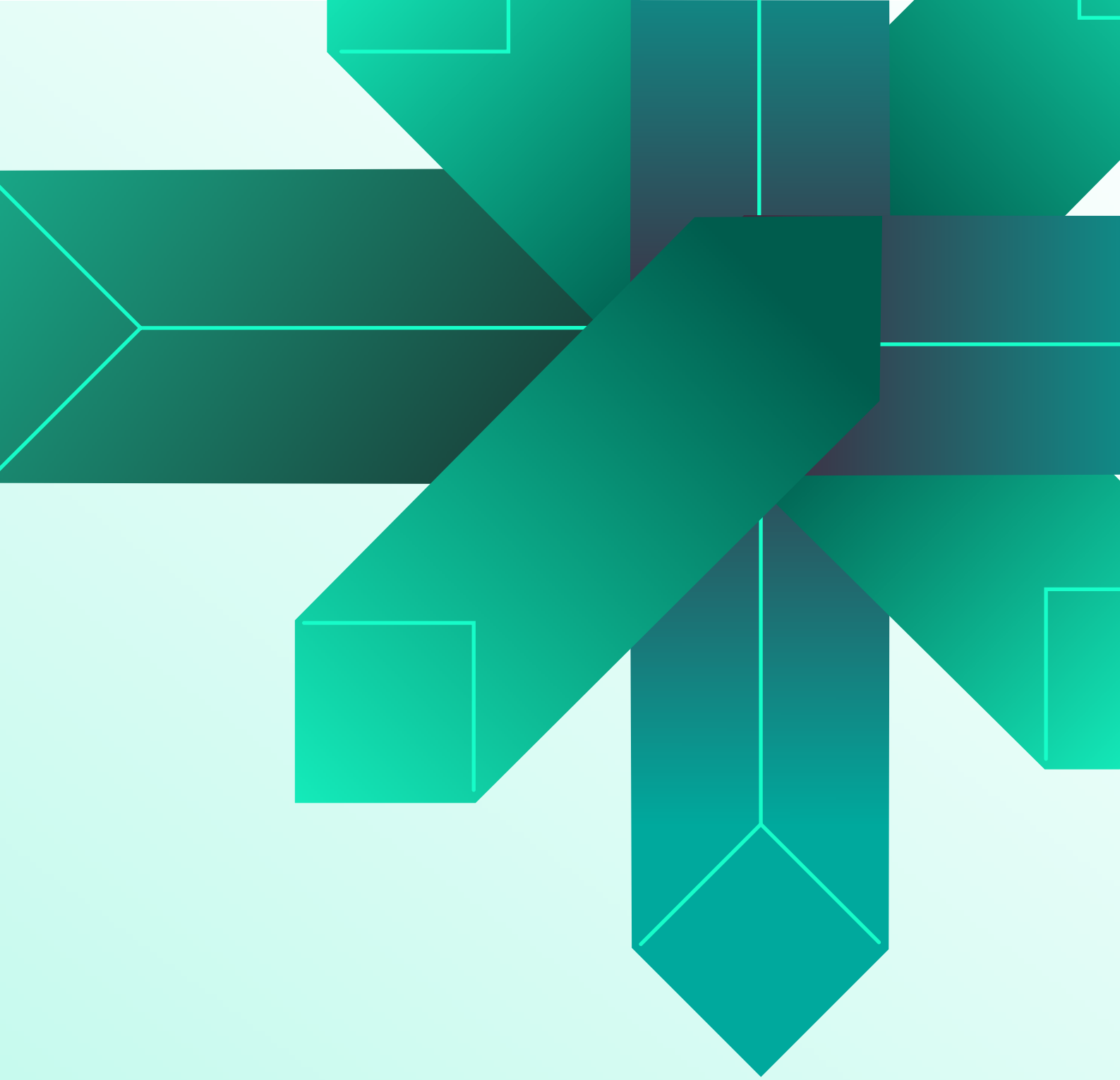


DEVELOPMENT OF THE DIGITAL TENGE: RESULTS OF THE SECOND PHASE OF THE PROJECT

Contents

Expert opinions

Cristina Doros

Senior Vice President and Regional Manager at Visa
in Ukraine, Georgia, CIS and South-East Europe.

As we begin the year 2025, we are excited to continue our collaboration with the National Payment Corporation of Kazakhstan. Their commitment to innovation and progress has been instrumental in enhancing the efficiency and security of the financial industry in the country.

Last year, we had a strong and successful partnership, culminating in the implementation of the Interbank Card Payment System in accordance with regulatory requirements. We also supported numerous initiatives, including our partnership with the Central Asia Fintech Summit, which has been instrumental in driving innovation and growth in this sector. Together with the National Bank of Kazakhstan, we have produced awhite paper to examine the evolution of digital public infrastructure (DPI) in Kazakhstan. Additionally, our joint media projects aim to foster a vibrant fintech community in the country. We are confident that our joint efforts will further enhance the digital financial landscape and create new opportunities for growth and development. We look forward to achieving even greater milestones in the coming year, driving innovation and growth in this sector.

John Velissarios

Founder of Otranto Ltd.

Over the past year, the Digital Tenge project has made significant progress in integrating the national digital currency into the real economy. As this third form of central bank money expands its scope of application, its impact is becoming evident in all areas of government and commercial activity, as well as in the daily lives of citizens. The project not only demonstrates the potential of a general-purpose digital currency, but also represents an important step towards the digitalization of Kazakhstan. The scenarios implemented to date are just the beginning, and new opportunities are constantly emerging, each bringing extremely positive results.

The Digital Tenge project is a benchmark for innovation in financial systems on a global scale. Its rapid deployment across a wide range of areas underscores the strategic vision of the project, the dedication of the team implementing it, and the collective willingness of the government and market participants to embrace transformational change. As we move along this path, new uses for the digital tenge promise to further strengthen Kazakhstan's position as a regional economic hub and a pioneer in digital transformation.

Expert opinions

Sanzhar Zhamalov

Director General at Mastercard in Kazakhstan and Central Asia

NPCK is our reliable partner, setting trends in the development of a modern, secure and innovative digital payment system in Kazakhstan.

In 2024, we successfully implemented many joint projects aimed at improving the security and convenience of financial transactions, such as the launch of the Interbank Card Payment System, the first card in the Digital Tenge of the Eurasian Bank, providing expert support for the Instant Payment System and Open Banking project, as well as participating as a general sponsor in the Central Asian Fintech Summit, a major regional fintech event that brought together over 4,000 participants.

Together with NPCK, we launched the Mastercard fintech lab at ALMA University, where we organized a series of educational events Mastercard Academy and the Girls4Tech program, and published reports on the development of fintech and digital asset markets in the region.

We are confident that our partnership will continue to bring significant benefits to the country's economy.

Anton Mussin

Managing Director of Axellect IT company

Within the framework of the Digital Tenge project, in 2024, complex integration tasks were solved, including improving the platform architecture and implementing new use cases. Axellect is a technology partner of the National Payment Corporation of the National Bank of the Republic of Kazakhstan.

We have made every effort to optimize technologies to ensure scalability, security and readiness of the digital tenge for the future challenges of the financial market of Kazakhstan.

Among the plans for the next year: developing the functionality of the digital tenge platform for cross-border payments, scaling existing and launching new scenarios with state financing and, of course, connecting new participants to the platform. We have no doubt that our joint work will ultimately help the economy of Kazakhstan not only maintain its leadership in the region, but also be at the top on the world stage!

Glossary

Abbreviations and terms

- API – application programming interface
- AML/CFT – anti-money laundering and combating the financing of terrorism
- Back-end – data management and processing of given information system
- BIS – Bank for International Settlements
- CB – central bank
- CBDC – central banks digital currency
- CBS – core banking system
- DA – digital account to conduct operations with digital tenge
- DAg – Department of Agriculture
- DevOps – Development+Operations, methodology of automation of technological processes of software assembly, customization and deployment
- DvP – delivery-versus-payment transaction
- DLT – distributed ledger technology
- DT – digital tenge
- ECCB – Eastern Caribbean Central Bank
- EDS – electronic digital signature
- EI – electronic invoice
- FC – farming company
- GA – government agency
- I – individual
- IFA – "Identification of farm animals" information system
- ISEI – information system of electronic invoices
- JSC – joint-stock company
- KYC – know your customer, customer identification procedure
- LE – legal entity
- MAg – Ministry of Agriculture
- NBK – National Bank of the Republic of Kazakhstan
- NFC – near-field communication, short-range wireless data transmission technology
- NPCK – National Payment Corporation of the National Bank of the Republic of Kazakhstan
- PBM – purpose bound money, target-driven money
- POS – point of sale, electronic software and hardware device for accepting payment cards for payment
- PSP – payment service provider
- PvP – payment-versus-payment, transaction in the "payment versus payment" mode
- QR-code – quick response code
- R&D – research and development, experimental study
- RTGS – real-time gross settlement
- SEC – socio-entrepreneurial corporation
- SRC – State Revenue Committee
- SRD – State Revenue Department (regional branch of SRC)

Glossary

- SSIS – state subsidy information system
- STB – second-tier banks
- UTXO – unspent transaction output, withdrawal of unspent transactions, i.e., the balance of cryptocurrency that the user receives from each transaction
- UI – user's interface
- VAT – value-added tax

Introduction

In 2021, the National Bank of the Republic of Kazakhstan (hereinafter – NBK) began studying the issue of the potential implementation of central bank digital currency (hereafter – CBDC). The principal result of the work of that period was the developed platform, which made it possible to confirm the possibility of technological implementation of the digital tenge (hereinafter – DT) as the third form of money in the Republic of Kazakhstan. In 2022, the NBK in cooperation with market participants, the expert community and international partners prepared a decision-making framework for the implementation of the DT, and tested the platform in an isolated environment with a limited number of participants.

Based on the results of the study, at the end of 2022, it was decided to plan the implementation of the DT in three phases until the end of 2025. The first phase of implementation was carried out in 2023, when the digital tenge was put into pilot operation by the joint–stock company (hereinafter – JSC) National Payment Corporation of the National Bank of the Republic of Kazakhstan (hereinafter – NPCK) jointly with second–tier banks (hereinafter – STB) and international payment systems.

One of the most important milestones in the development of the Digital Tenge project in 2023 was the launch of a pilot project of "digital vouchers" for free meals in schools carried out in cooperation with the Akimat of Almaty and JSC Kazpost. In addition, together with the Visa, Mastercard and 4 STBs (Halyk Bank, Altyn Bank, Bank CenterCredit, Eurasian Bank), the world's first bank cards linked to a digital account in DT were launched. In a separate experimental environment, innovative scenarios of market participants, cross-border payments, and the issuance of DT-backed stablecoins were also tested.

Obtained results demonstrated the great potential of CBDC in general and DT in particular as an innovative payment instrument with fundamentally new properties. The aspect of using DT for payments involving the state (from social assistance to public procurement) gains more interest. The activities planned for 2024 on the Digital Tenge project also includes further development of the platform's functionality through the implementation of new use cases for wholesale and retail payments, exploring potential applications of DT properties in the future, expanding the number of participants and improving the technical parameters of the platform.

This document provides information on the current status of the Digital Tenge project and the 2024 deliverables. Along with implementing several scenarios together with market participants, the NPCK also plans to continue exploring CBDC and its possible use cases in the future. In this regard, this document contains information about both the research in the field of potential development of the platform and the results of the work carried out in 2024.

About the Digital Tenge

The Digital Tenge is the third and digital form of money, which is used along with cash and non–cash funds. DT has the properties of both cash and non-cash money, while also opening up fundamentally new opportunities for all users.

DT has following properties of cash money:

- DT is an obligation of the NBK, so the DT is not burdened with the risks of financial intermediaries;
- DT has the technical capability to make payments without access to the Internet (offline), including in peer-to-peer format (from one device to another one) if there are related technological updates on the side of banking applications;
- DT has an increased level of anonymity compared to non-cash funds and is guaranteed by the state.

DT has following properties of non-cash money:

- DT can be used for payments through existing infrastructure (Internet acquiring, mobile applications of the STB, POS-terminals, QR codes, NFC, etc.);
- DT maintain the benefits of the digital format of non-cash payments: capacity for making payments without physical contact, ability to conduct transactions using a mobile phone, the ability to seamlessly embed payments in the user experience, as well as the convenience of storing and accessing funds in digital form;
- DT meets the new requirements of the digital economy for making payments that are both instant, smart, inexpensive, secure and reliable.

From a regulatory perspective, DT meets CBDC definition as **a new form of non-cash money that is issued by a government financial regulator and that is an obligation of that issuer to be used primarily as an instrument of payment.** The table below provides a more complete disclosure of the legal status of CBDC and other forms of currency transactions.

Tab. 1 - Differences between the public and private forms of money [1]

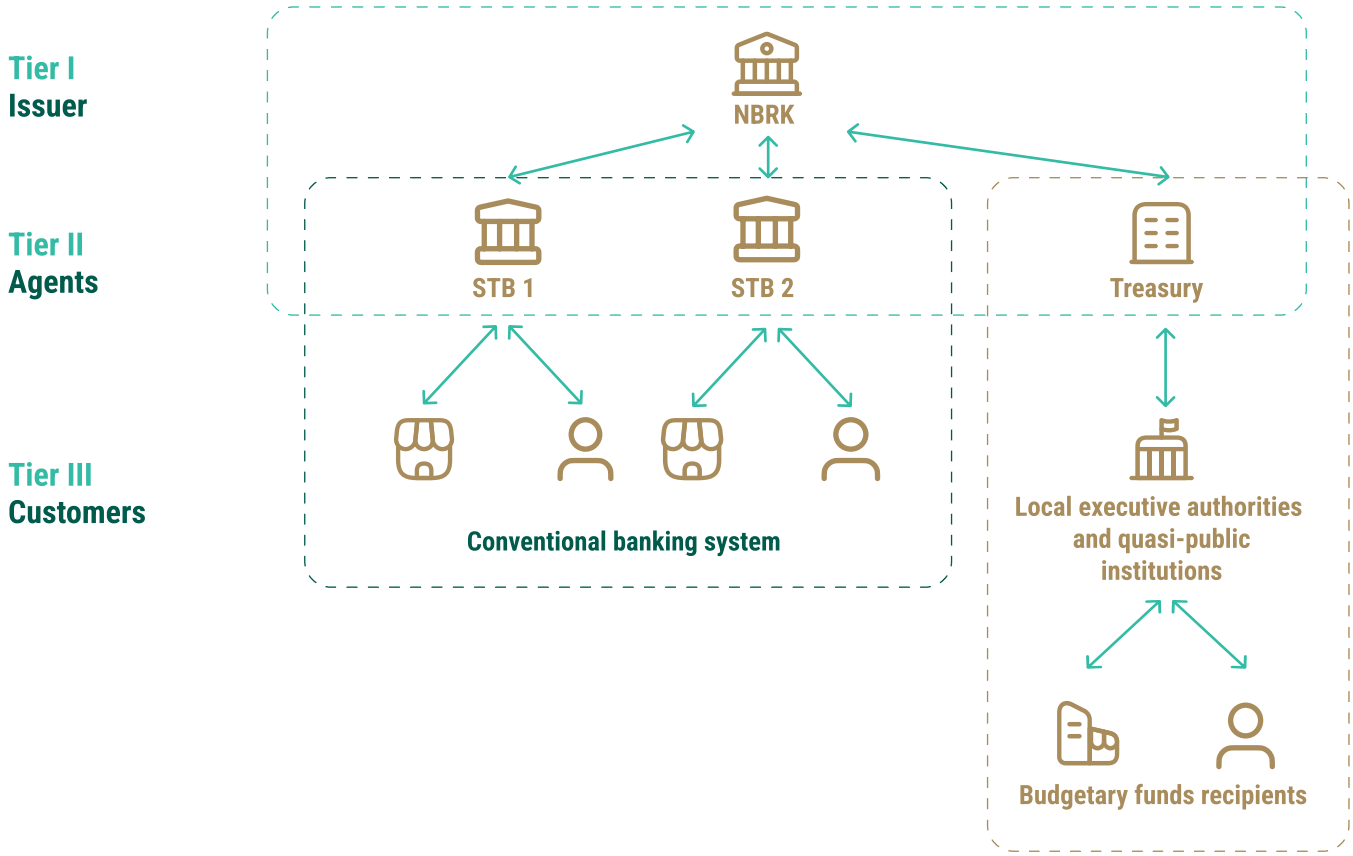
	Public funds	Non-public funds	
	Money from the central bank (hereinafter – CB)	**Money from commercial banks**	**Non-bank funds**
Description	Obligations of the CB for settlements in physical and digital format	Obligation of a commercial bank in the form of deposits held in the bank, which can be used for settlements	Obligation of a non-banking financial institution under the supervision of the relevant authorities
Issuer	CB	Commercial banks (STBs in Kazakhstan)	Payment service providers (hereinafter – PSP),which are not the banks
Users	General public and financial institutions	Bank customers	General public and financial institutions
Examples	- Funds in the real-time gross settlements (hereafter – RTGS); - Retail and wholesale CBDC; - Physical banknotes and coins.	- Tokenized deposits; - Customer's bank deposits; - Funds issued as loans.	- Stablecoins linked to fiat money; - Electronic money.

In addition to the above, DT is a legally recognized means of payment which is issued in the form of a unique digital sequence (tokens). The information about tokens is stored on special digital accounts (hereinafter – DA). The use of the token-based approach provides the technical capability of the built-in programmability of the DT, which in turn gives the DT a wide range of potential applications - from simplified integration with the world of decentralized finance due to a similar architecture to increasing the transparency of government spending using the token marking mechanism.

It is important to note that **DT is created not as a replacement for cash and non-cash funds, but as an addition to them.** After the implementation of DT, cash and non-cash money in Kazakhstan will be used in the same mode.

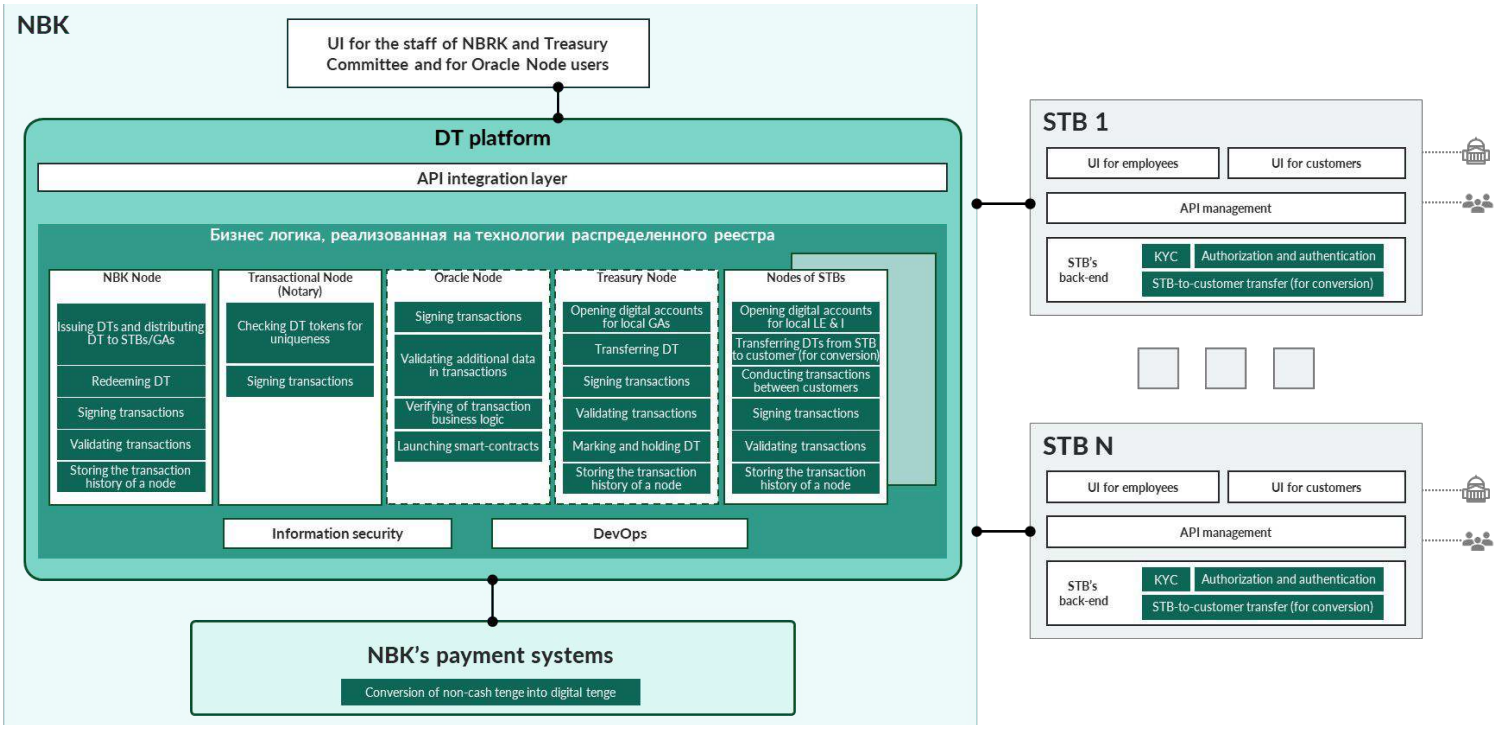
At the conceptual level of the DT architecture, it is implemented in accordance with a two-tier model (Figure 1), in which the NBK (Tier I) develops the design and basic functionality of the DT platform, and the STBs and Treasury (Tier II) provide connection to the DT platform and provision of service to individuals and legal entities (hereafter – LE & I).

Fig. 1 - Two-tier model of the DT platform



The main purpose of the two–tier architecture model is to ensure effective interaction between all participants of the DT platform (NBK, STBs, LEs & Is). STB connects to the DT platform through an API and provides customers with a user interface in mobile applications through which customers can open digital accounts on the DT platform, perform conversion from/to DT and perform operations with DT. The employees of the NBK can also interact with the DT platform to carry out operational control and receive reports. The top-level architecture of the platform is shown below (Figure 2).

Fig. 2 - Top-level architecture of the DT platform in 2024



Key participants of the DT platform:

NBK

approves requests for the issuance/repayment of DT, performs general monitoring of the platform and automatically verifies the uniqueness of the tokens involved in transactions. In addition, as part of the management of the National Fund, the NBK performs the functions of an Agent: maintains and manages the funds of the National Fund on the basis of a discretionary management contract;

STBs

provide individuals and legal entities with access to the DT platform and the capacity to open a DA through mobile applications, carry out identification (KYC) and onboarding of clients, participate in the generation of keys for the client's digital signature, sign their requests to the DT platform using a bank electronic digital signature (hereinafter – EDS), verify the digital signatures of the DT platform, initiate transactions on the DT platform, and initiate conversion at the “STB-NBK” level, perform conversion at the “client-STB” level, interact with international payment systems to ensure interoperability;

Treasury Committee

provides government agencies (hereinafter – GA) with access to the DT platform and the ability to open a DA, perform the transfer DT into non-cash funds, sign and validate transactions involving GAs, and also store the transaction history with the participation of the GA; by using the services of the Treasury Committee, GAs and LE under local executive bodies mark DT for targeted use, and also hold funds via a mechanism called "encumbrance”.

Individuals and legal entities

open DAs through STB mobile applications, use the DT to make payments and transfers.

Key components and services of the DT platform:

Due to the decentralized architecture model, all components of the DT platform can be divided into two categories: nodes and services.

Node is a component of a distributed registry network that performs certain functions.

Service is a third-party mechanism that is not part of the ledger itself, but is necessary for the interaction of the DT platform and other systems.

- **Nodes of financial organizations:** these are nodes of the STB, NBK and the Treasury, which verify the validity of transactions (verification of signatures, equality of the sum of inputs and outputs of transactions, etc.) and store transaction history. STB nodes open DAs for individuals and legal entities, and the Treasury node handles the GA. STB nodes make transfers between clients and banks, Treasury's infrastructure is capable of making transfers both between the GA itself and between GA and I&Legal entities on the STB nodes. The node of NBK performs the issue of DT to the STB node and redemption of DT as part of a cashless funds’ conversion transaction to DT. All such nodes have the technical capability to carry out DT holding using a mechanism called "encumbrance”, and the Treasury node is also capable of marking DT;

- **Transactional (notary) node:** transactional (notary) node does not validate the transaction itself and does not have full access to the transaction data. Its main task is to check for a single use of the token on the network using distributed ledger technology (hereafter – DLT) based on the unspent transaction output (hereafter – UTXO) model;
- **Oracle Node:** this network service provides smart contracts on the DT platform with information from the outside. It is the bridge between the DT platform and the outside world, expanding the possibilities of using smart contracts that require information outside the ledger: from the weather forecast to information about the arrival of goods at the warehouse. Oracles themselves are not a source of data - they only request and verify external sources, and then transfer the received information to a smart contract.
- **EDS signing and verification service:** this service provides security by signing messages from the DT platform, as well as by verifying the signature when receiving messages from the STB. This ensures the legal value of the exchange between the DT platform and the participants.
- **Service for interaction with the core banking system (hereinafter – CBS) of the NBK:** service exchanges files with the NBK CBS in the scenarios of converting non-cash tenge to DT and converting DT to non-cash tenge at the "STB-NBK" level upon receipt of a corresponding request from the STB. After receiving confirmation from the NBK CBS, the service initiates issue/repayment transactions on the DT platform;
- **Integration layer of the API:** intended for interaction with participants and organization of exchange within the framework of the DT platform.

International practice of exploring CBDC

Currently, at least 130 countries representing 98% of the world's gross domestic product are conducting research or work related to the capacity of creating a CBDC [2]. At least 67 jurisdictions have reached the advanced stage of study (development, piloting or launch) [ibid.]. According to forecasts of the Bank for International Settlements (hereinafter – BIS), up to 15 retail and 9 wholesale CBDC may be in circulation by 2030 [3].

To date, only four jurisdictions have implemented CBDC at the industrial level – CB of the Bahamas, CB of the Eastern Caribbean (hereinafter – ECCB), the Central Bank of Nigeria and the Bank of Jamaica.

It is worth noting that of all the above-mentioned CBs, at least two are experiencing difficulties with the technical implementation and adoption of CBDC as a full-fledged means of payment. ECCB has announced the planned shutdown of the DCash project in January 2024, due to the need to upgrade to a new version of the CBDC pilot project ("DCash 2.0") [4]. Whilst there are also a number of technical problems of the platform related to the lack of integration with the CBS of the commercial banls and periodic outages [5, 6]. The project of the Central Bank of Nigeria "E-naira" has experienced great difficulties with initial adoption, despite its successful technical implementation and proven 24/7 stability: in the first year of launch, the number of connected retail customers did not reach even 1% of the total number of active bank accounts [7].

In 2023, the number of wallets and transactions increased significantly, but the popularity of e-naira as a means of payment remains low – CBDC in Nigeria accounts for no more than 0.36% of the total foreign exchange turnover, despite 13 million open wallets [8, 9]. The main reasons include strict regulatory measures to encourage the use of digital currencies (cash-out limits) and the similarity of e-naira and mobile money functionalities.

These examples clearly demonstrate the critical importance of detailed strategic planning before launching CBDC, the necessity of integrating CBDC into the existing financial landscape and increasing the stability of platforms and the need to build effective communications via open dialogue with financial market participants to raise awareness.

The table below provides a summary with information on the four CBDCs that are or were in commercial operation:

Tab. 2 - Summary table with information about the launched CBDCs at the moment of 2024 [4, 9-14]

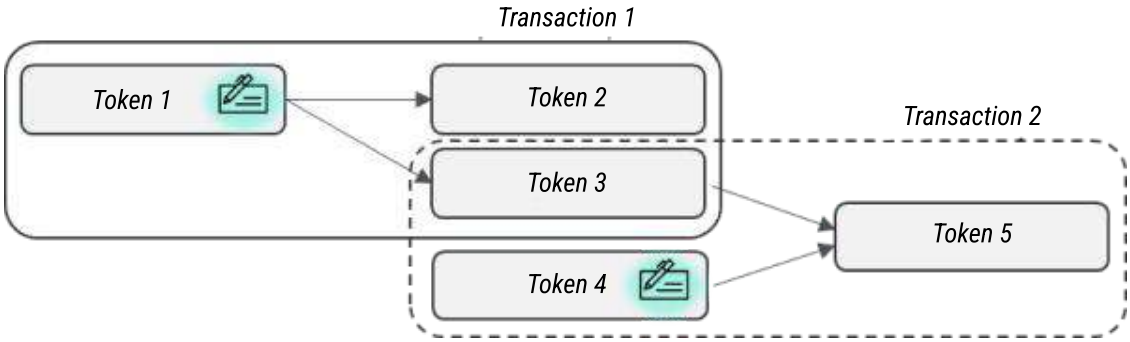
	Bahamas	Eastern Caribbean countries	Nigeria	Jamaica
Name of the CBDC	SandDolar	DCash	E-naira	JamDEX
Year of launch	2020	2021	2021	2023
Technology use	Distributed ledger	Distributed ledger	Distributed ledger	Centralized system
Architecture model	Two-tier	Two-tier	Two-tier	Two-tier
Account-based or token-based access	Account	Account	Account	Account
Coverage	120,000 retail wallets in 2024	Decommissioned, Dash 2.0 is scheduled to be launched in 2024-2025	13,000,000 retail wallets in 2023	260,000 retail wallets in 2024

As can be noted, all launched national digital currencies rely on a two-tier architecture involving banks or other financial organizations to conduct KYC procedures, provide access to a wallet, and otherwise work with end users. However, it is also worth noting that the distribution of powers and responsibilities between market participants depends on the specific jurisdiction.

For example, in the case of Nigeria, the Eastern Caribbean, and the Bahamas, it was their CBs that were responsible for developing a separate application for using digital currency, and in the case of Jamaica, access to CBDC is provided through commercial banking applications; CB of the Bahamas also pays great attention to measures to anti-money laundering and combating the financing of terrorism (hereinafter – AML/CFT) and is the owner of the relevant specialized platform; in other jurisdictions, banks and PSPs play a major role [10, 12, 13]. It is also extremely important that all the CBDC described above use account-based access, and the Bank of Jamaica also uses a centralized ledger as a technology platform. This fact is one of the arguments of the **ongoing discussion about the advantages of the account-based and token-based approaches.**

As the name suggests, the main difference between these two approaches is the fundamental essence that the CBDC platform operates on. In the case of a token-based approach, the system's operation relies on a specific "unit of value" (token). A transaction in such systems is a change of token owners, and the terms of the smart contract are contained in the token itself. The diagram below shows the movement of tokens during transactions using smart contracts

Fig. 3 - Transactions in a smart contract in case of a token-based approach



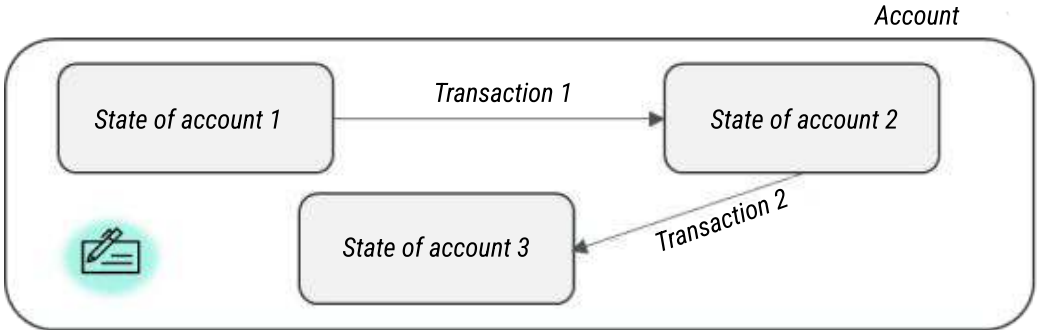
It is also worth noting that this approach has its own special features in terms of programmability:

1. **Programmability refers to a specific token.** The token defines the terms of the contract under which the tokens can be spent.
2. **UTXO model does not have the ability to save information about its state.** This means that each transaction creates a new token, and different transactions cannot refer to the same token.
3. **Transactions do not reference any input data outside of the tokens used.**
4. **The token-based approach is best suited for smart contracts that relate to a specific token, where it is not necessary to "remember" previous interactions, store and manage complex data.**
5. **The terms of the contract are recorded in the token at the time of token creation, i.e. at the time of the transaction itself.**

These properties are most applicable for marking and consequent improvement of funds traceability as well as for the implementation of scenarios with the holding of funds.

The account-based approach can be called more traditional: the vast majority of modern electronic and non-cash money systems use it. Therefore, the account plays the main role as a conditional part of the ledger that can store the state of the record on it. The transactions are carried out by changing the status of accounts, and the terms of the smart contract are tied to the accounts as entities.

Fig. 4 - Transactions in a smart contract in case of a account-based approach.



Programmability of such systems is different from that of token-based ones:

1. **In account-based approaches, the smart contracts are one of account types.** When a message (transaction) is received, special account is activated and executes the contract script code.
2. **The account stores its previous states and transactions update them.** The different transactions interact with the same account
3. **An account-based model is suitable for smart contracts where it is needed to remember previous interactions, store and manage complex data.**
4. **The contract terms and conditions are created at the time of creation of the account with which customers interact.**

Such programmability is most effective for cases of allocation of funds according to receipts (e.g., for crowdfunding, corporate health insurance, or financial leasing).

Another important difference between the two approaches is the way in which the user is authorized: in case of token-based CBDC, the user proves his right to perform transactions by signing transactions with his unique digital signature and by the verifiable fact of originality of the transferred tokens themselves, and in the case of account-based CBDC, the user's eligibility is verified by verification of his/her identity by the bank, PSP or other organization. Each approach has its own set of advantages and disadvantages:

CBDCs with token-based access

- enable greater level of anonymity for the user
- facilitate further potential integration with financial products from the world of decentralized finance

CBDCs with account-based access

- have a potentially higher level of performance
- have an extremely low risk of counterfeiting or double spending due to the user's identity and the availability of funds in his/her account
- are based on widely accepted principles and mechanisms which facilitates its further integration with existing PSP information systems.

The following table summarizes the characteristics of both access models:

Tab. 3 - Summary table of characteristics of account-based and token-based access models

Characteristics	Account-based access	Token-based access
Holder identification	Compulsory (the principle "I am, therefore I own")	Not required (principle of "I know, therefore I own")
Method of transferring value	Changing account status	Token transfer
Transparency	The owner's identity is known	The owner's identity may not be known
Risk of double spending	Managed through account balance	Verified for each token

Due to the presence of substantial arguments for using one or the other approach, **research on the use of a hybrid approach** gains more attraction from financial regulators. It is worth noting that the difference between account-based and token-based access is becoming less and less tangible with time and the development of the fintech industry – for example, the proliferation of biometric identification systems allows the creation of services for storing the unique digital signature of a CBDC user (sign of token-based model), access to which is provided after the user is identified by the service (sign of account-based model). Another approach is to create platforms within which there can be two types of access provisioning (for example, token-based access for wholesale CBDC and account-based access for retail CBDC or vice versa). All this allows to state that the choice of one or another approach, although it is one of the most important strategic forks in the creation of a national digital currency, does not finally deprive the regulator of the advantages of a non-chosen approach – **ultimately, the architecture and ecosystem of a particular CBDC prevails.**

The **cross-border payments based on wholesale digital currencies** remain another important aspect of CBDC exploration and implementation.

The issue of cross-border payments using CBDC is an extremely popular area of research – in particular, BIS surveys show that work on wholesale CBDC for most jurisdictions is driven primarily by a desire to improve cross-border payments [15]. Notably, it was with wholesale digital currencies that the first experiences with CBDC implementations were made: Jasper-Ubin and Stella in 2016 [16-17]. The further research has demonstrated the great potential of national digital currencies for cross-border payments by reducing the time it takes to receive funds and enabling new exchange models to be realized (in particular, payment versus payment, PvP, which involves the exchange of one digital currency for another, and delivery versus payment, DvP, which involves the exchange of securities for digital currency).

The most promising area of work in this area is the creation of a common distributed ledger platform for all participating countries – despite the complexity of decision-making regarding the system architecture and relatively high development costs, this approach enables full usage of the benefits of CBDC including the exchange models described above. A striking example of this approach is the mBridge project, previously implemented by BIS in cooperation with the Digital Currency Institute of the People's Bank of China, the Central Bank of the United Arab Emirates, the Central Bank of Thailand, the Hong Kong Monetary Authority and the Central Bank of Saudi Arabia [18]. Under mBridge, participating CBs provide access to their CBDCs to non-resident PSPs, which ultimately makes the platform as interoperable as possible. It also makes payments on it fast, reliable and transparent for the CB-participants. Currently, the CBs of the participating countries, based on a pilot project with real money transactions between PSPs of the four above-mentioned jurisdictions conducted jointly with the BIS, are implementing the transition of the mBridge platform to the status of a minimum viable product (minimum viable product, MVP) [ibid.]. The available results demonstrate the reliability and efficiency of the platform, which allows us to declare with a certain degree of confidence about the further development of the project.

The development of multiple cross-border payment projects using CBDC is gradually moving from the prototyping and pilot project stage to the pilot operation stage. At this stage, rising attention is being paid **to organizational and regulatory issues rather than to the technical aspects of a particular platform:** creating or finalizing common rules for using the platform, standardizing approaches to determining exchange rates, attracting new participants, etc. Another important factor is the emergence of commercial projects aimed at providing interoperability between different DLT systems using so-called "third-party distributed ledger networks" (side chains).

All this indicates the continuing growth of relevance of cross-border payments in terms of the existence of national digital currencies.

The aforementioned transition of many CBDC systems from prototyping and pilot projects to the industrial or pilot operation stage also raised the **issue of realization of payments for the intended purpose.** An example of such a solution is the experiment with "purpose bound money" (PBM) of the Monetary Authority of Singapore.

The Purpose bound money project can be identified as the creation of a third form of programmable financial instruments in addition to programmable payments and programmable money. Below is a table of the main differences between the three instruments.

Tab. 4 - Summary table with information on the different targeting payment instruments [19]

	Programmable payments	Programmable money	Purpose bound money (PBM)
Programming logic is transferred along with the unit of value	No	✓	✓
Programming logic may be developed by a third party other than the issuer	✓	No	✓
Bearer instrument	No	✓	✓

As can be noted, the fundamental difference between PBM and realizing programmability with most CBDC based on DLT networks is the ability to develop programming logic by a third party (PSPs and banks). Meanwhile, the main focus of the project is providing interoperability: the main functionality of PBM is the ability to create a so-called "wrapper" for the programmability of many types of financial instruments: CBDC, tokenized deposits, etc.

The e-commerce, contract automation (including property leasing), cross-border payments, trading, and charity are cited as the main areas of application. It is the latter area that is most consistent with the creation of marked funds – e.g., program the logic of the donated funds so that only a specific beneficiary can use them.

Results of the study of potential applications of the digital tenge

The analysis of potential areas of application of DT was carried out taking into account the following architectural and conceptual properties of the national digital currency:

1. **Two-tier architecture model,** maintaining the role of the STB and other PSPs;
2. **Token-based approach:** any transaction involves the transfer of unique digital sequences (tokens) from one owner to another. In this case, the UTXO mechanism mentioned above is also implemented – at each transaction old tokens are redeemed and new tokens are issued. For example, if a user has a token with a face value of 5000 DTs and then pays 150 DTs for bus fare, the original 5000 DTs token is divided – service provider receives a token of 150 DTs and the user is left with a change token of 4850 DTs. Additionally, it is also worth noting that the token origin data is known to the owner of the node – in this particular case, the STB may determine the "parent" token of 5000 DTs based on the change or payment token data.

3. **Functionality of self-executing contracts (smart contracts).** The smart contracts can automate contractual relationships in digital form: they can be designed to automatically execute transactions on the DT platform according to predefined contract terms and conditions;
4. **Functionality of holding DTs via an encumbrance mechanism.** The encumbered state of the token allows for additional programmability conditions: during each transaction, the platform checks whether the encumbrance condition is present in the transaction, and the contract code and encumbrance conditions will be checked at the transaction execution time;
5. **Functionality of marking DTs at the token level for intended use.** It allows transactions with such funds only for a predetermined purpose;
6. **Capacity to perform transactions with multiple end recipients.** It enables organizing payment splitting at the platform level;
7. **Existence of Oracle Nodes.** The use of Oracles provides smart contracts with capability to obtain verified information from external sources.

The combination of all the features above allows the DT platform to achieve the best results in the following areas:

- **Real estate market and marketplaces.**
  The capability to hold funds in a DA using a smart contract allows for an agreement between the parties without adding the risks related to intermediaries. The withdrawal of holdings can be accomplished by validating the fact that the property has been re-registered to the buyer by sending a request from the Oracle node to the appropriate government databases. This mechanism is actually an automated version of an escrow account actively used for various applications.

  In addition, marking of DT tokens for intended use can make participation in shared construction safer for the buyer: a certain part of the invested funds can be marked for intended use (for example, for the purchase of building materials), which in turn makes it impossible to illegally withdraw funds or steal them. It also positively affects the likelihood of timely disbursement of funds and commissioning of the facility under the contract.

  The aforementioned mechanism of safe transaction for real estate market is also applicable for various marketplaces. The delivery services can be the party validating the fact of service provision – after direct delivery of the goods and provision of the service, the STB node will receive confirmation with the help of the Oracle node. In both cases, automating the process through the DT platform reduces the number of intermediaries and costs reducing the number of associated risks (including due to the status of the DT as a national digital currency), and provides greater transparency of the entire process.

- **Agency agreements.**

  The most appropriate example to demonstrate the benefits of the DT platform in this area is delivery and cab services. When ordering delivery or transportation services, payment is made from the customer's DA with multiple recipients for tax deductions, payment of commission to the operator/taxi company and transfer of the income part to the driver/courier himself/herself. Depending on the conditions, it is possible to set up tax deductions via savings account and checking smart contract, by means of which the initiator of the transaction will transfer the amount to the DA of the relevant public authority at certain intervals (for example, once a month). As a result, the use of the DT platform will make it possible to achieve greater transparency of processes both for the users themselves and for the state authorities, to automate the process of tax payment and to reduce transaction costs in the future.

  A similar mechanism for tax payment has been successfully tested in the R&D environment of the DT platform as part of the 2023 works for value added tax (hereafter – VAT). The source of information about the need for payment may be an electronic invoice (hereinafter – EI), the information about which will be known to the Oracle node. An additional effect may also include simplifying the collection of reports: employee responsible for accounting only needs to compare the amount of turnover subject to VAT with the amount in the tax office. Such features of the DT platform can be useful for self-employed workers and small businesses due to the automation of a large number of accounting works and the absence of the need to manually double-check a large number of documents.

- **Utility bills.**

  The possibility of payments with multiple end recipients and obtaining information through the Oracle node enables the creation of service tp ensure targeted use of funds provided by the association of property owners. An important difference from existing mechanisms is the fact that transactions are made directly from users to service providers which significantly reduces the risks of misuse and costs; it also increases the overall transparency of the process.

- **Obligation/claims issuance operations of the STB.**

  Such transactions include bank guarantees, letters of credit, factoring and other derivative financial instruments. For example, two LEs choose a STB as an intermediary through which they issue obligations and authorize the right to make payments from their DAs after fulfilling the conditions recorded in the smart contract. The most interesting areas of potential application of smart contracts to simplify banking processes are cross-border payments, loan process automation and asset tokenization. All of these focus areas are being actively explored around the globe.

  It should also be noted that the application of DT may further optimize operational support in case of targeted lending to LEs: token marking in combination with the use of smart contracts and Oracle node will maximize automation and simplify the procedure of collecting documents confirming the fact of receipt of funds and purchase for both parties.

- **State aid.**

  The use of marked tokens for transactions with a certain counterparty (i.e., defining the conditions of transaction recipients and purpose of subsidized DTs) will significantly reduce the risk of corruption abuse and ensure the transparency of payments with the participation of the state. It will also automate the very process of receiving government subsidies through the possibility of obtaining relevant documents (e.g., EIs) through the Oracle node.

  Ensuring the designated use of funds will allow the DT platform to become one of the tools for effective financial planning and spending of public funds in the future. In budget planning, public organizations can categorize expenditure items without subjective intervention based on retrospective and real data and build financial models in an automated manner using the information obtained from the DT platform. The Treasury, in its turn, will be able to program the money so that planned funds are always spent only for their intended purpose. However, it is worth adding that in order to achieve such a goal, effective interagency cooperation is needed to create technical conditions (in particular, for the establishment of detailed categories and catalogues of goods, works and services).

- **Procurement process for services and goods with instant confirmation of service provision and payment.**

  The capacity to hold funds combined with the wide integration potential of the DT platform enables the realization of a smart procurement contract. The most appropriate example is the relationship between airlines and fuel suppliers. By initiating a smart contract through the DT platform, the airline transmits information to the fuel supplier about the planned refuelling of a future flight, and records the preliminary fuel volume and its price. This data is later used to plan airport refuelling procedures. On the day of refuelling, the aircraft commander requests the specified volume of fuel from the operator and sends an online application to the STB to hold the required amount of DTs on the airline's DA. A confirmation from the STB serves as a trigger for the aircraft refuelling process. After the service is performed, the funds are debited from the airline's DA, and the fuel supplier's and airline's commercial services are informed about the closure of the refuelling request with all reporting documents.

  A clear proof of the feasibility of such CBDC-based systems is the full-fledged supply chain finance platform unveiled in September 2023, developed by Chinese company JD.com in conjunction with the Industrial and Commercial Bank of China via smart contracts on the digital yuan platform [20]. Noting the advantages of the developed solution (automation of a large number of processes, speed of transactions and availability of state guarantees due to the status of the digital yuan), JD Group Vice President Li Bo also said that cooperation between industry, technology providers and financial organizations is needed to develop digital RMB-based supply chain finance systems [ibid.].

- **Charitable foundations and crowdfunding platforms.**
  The capacity to create smart contracts with certain conditions can radically change the existing ways of collecting donations for various purposes. For example, by creating an additional service integrated with the DT platform, it is possible to develop a mechanism for accumulating an amount over a certain period of time, and if the required amount is not reached after the deadline, the service automatically returns the money to the benefactors. Such functionality is quite common (the well-known crowdfunding platform Kickstarter exists on the basis of such mechanics), but in the case of the DT platform, its implementation will allow to create a fully automated mechanism free from the risks of errors due to the human factor. However, it is worth noting that an additional add-on with account-based access is required to create such a mechanism - this is what will allow for the accounting of donation funds.

  Another interesting area of research is the creation of a verified digital account for a charitable organization using smart contracts and the concept of "open API". Such account can be set up to transmit information to a web portal or a page in real time with the ability to track the charity's expenses to everyone. This functionality will increase the level of citizens' trust in such initiatives and reduce the likelihood of theft and misuse of donations.

- **Digital vouchers.**
  The use of Oracle nodes, third-party services and DT-based smart contracts can lead to significant optimization of complex processes of identification, reporting and transaction support for non-monetary measures of state support by creating digital vouchers. A similar mechanism was tested jointly with the Almaty City Akimat and JSC Kazpost within the framework of the pilot project in 2023 for free meals in schools. While visiting the canteen, a student at the school swiped its transportation card at the terminal, thereby confirming that he/she/they had received meal services. Based on this confirmation, the smart contracts of the DT platform automatically transfer DTs from the DA of the school to the DA of the service provider (canteen). The digital voucher mechanism ensures targeting and transparency of government support, as well as convenience for service providers and consumers. Its further scaling up will assist citizens by providing any non-monetary support measures without the risk of corruption schemes being realized: state assistance is not provided by allocating funds directly to the citizen, but by subsidizing providers to provide necessary services. As in the case of state subsidies, further development requires the creation of the necessary infrastructure in the form of classifiers and cataloguing of goods, works and services.

  It is important to note that the cases above are not exclusive to the Republic of Kazakhstan and the DT platform: similar business processes and relevant use cases can be found in many countries and jurisdictions. Moreover, there are examples of solving identical problems with existing non-cash-based tools. However, the uniqueness of CBDC in general and DT in particular lies in a combination of factors: national digital currencies are an obligation of the CB which means that the risks of financial intermediaries are eliminated or significantly reduced, while the token-based approach allows for innovative programmability mechanisms to be implemented on their basis: from marked tokens and targeted use to holding and smart contracts. It is these factors that make token-based CBDC the **most appropriate and effective tool to address the above challenges.**

Archetypes and scenarios for 2024

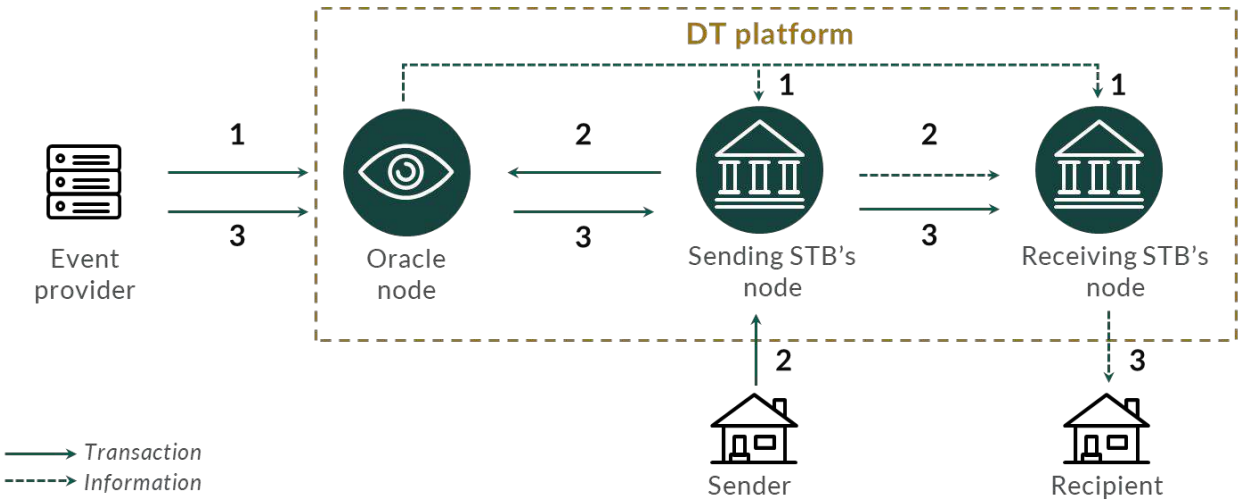
The work done in 2024 included 5 scenarios based on the three archetypes and one scenario based on the 2023 works. Below is a description of the three main archetypes used for the payment scenarios involving the state.

"Holding" archetype

The preliminary event is registered on the Oracle node: it includes the information about the sender, recipient, amount, time of holding validity and the type of holding (for a single transaction or infinite). The holding process is performed on the sender's DA, whereby tokens are held at the time of the transaction and the sender cannot spend the held funds until the holding time expires or an event occurs. Upon receipt of information about the event from the Oracle node, the disbursement of funds is initiated, i.e., transfer of funds to the recipient, which is possible only upon receipt of the approval of the Oracle node.

If the holding was infinite, the hold sign is transferred to the remained amount, and when the event occurs again, the Oracle node initiates another "unholding", until the amount of funds held is exhausted or the holding period expires. If a holding was registered under one transaction, no re-holding is allowed, even if the holding was not for the full amount. In case of "unholding" for partial amount, the balance is returned to the sender. In this case, the Oracle node acts as a controller, i.e. it is impossible to conduct holding and "unholding" transactions without confirmation from the Oracle node.

Fig. 5 – Scheme of interaction between participants within the archetype "Holding"



Description of steps:

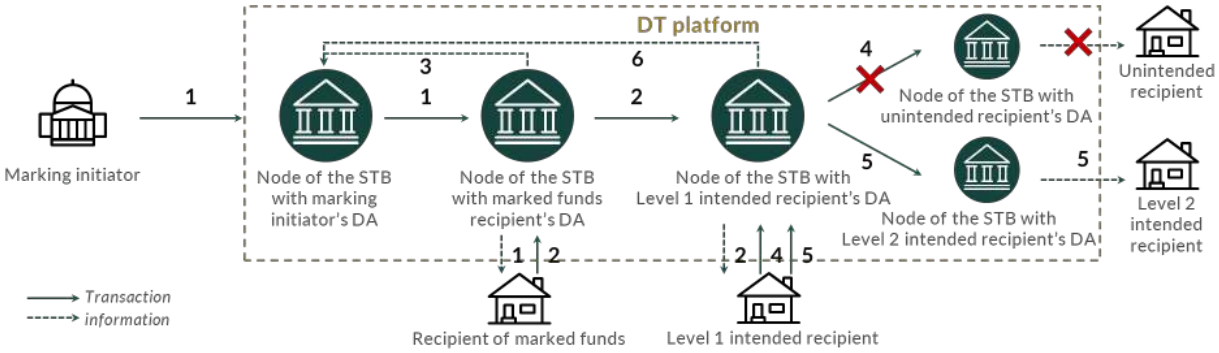
1. Event provider sends a request to register the event to the Oracle node. The nodes of the sending bank and the receiving bank receive information about the event.
2. Sender initiates request to hold funds with the registered event identifier. The holding is performed on the sender's DA with confirmation from the Oracle node. Information about the holding is received by the node of the receiving bank.
3. The event provider recognizes that an event has occurred, the conditions of which are registered on the Oracle node, and sends a request to the Oracle node to stop holding the funds. The funds are transferred from the sender's DA to the recipient's one.

"Marking" archetype

Marking with a public address (or a list of public addresses)

When conducting a marking transaction, the marking initiator specifies a list of public addresses of the intended recipients who can be recipients of the marked funds at each marking level. The marking conditions are stored on the node of the marking initiator and transmitted to the nodes of the intended recipients during transactions between them. Information about transactions with marked tokens is transmitted to the node of the marking initiator for traceability.

Fig. 6 – Scheme of interaction of participants within the framework of the "Public address marking" subarchetype



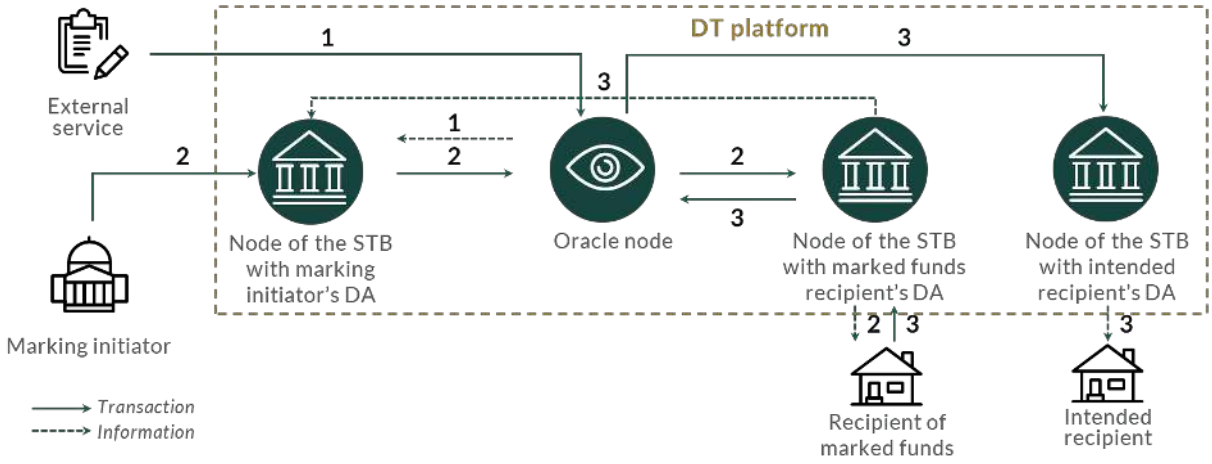
Description of steps:

1. Initiation of marking: the funds are transferred to the DA of the marking recipient for marking. When marking, the initiator of the marking indicates the depth of the marking and the limits for each marking level.
2. The recipient of marked funds initiates the transfer of the marked funds to the Level 1 intended recipient. Level 1 intended recipient receives marked funds.
3. The transaction data is transmitted to the node of the bank with the digital account (hereinafter - DA) of marking initiator to enable tracking marked DTs
4. Level 1 intended recipient initiates the transfer of marked funds to unintended recipient. This transaction is not possible, the marked funds remain on the account of Level 1 intended recipient.
5. Level 1 intended recipient initiates the transfer of the marked funds to Level 2 intended recipient. Level 2 intended recipient receives marked funds.
6. The transaction data is transmitted to the node of the bank with the DA of marking initiator to enable tracking marked DTs

Marking with a parameter

Previously, the marking parameter is registered on the Oracle node - a list of contracts under which settlements are made between clients. The parameter contains information about the contract number, the sender, the recipient, the maximum amount of transfer of the marked DT, the maximum amount of DTs that can be converted into non-cash/cash money, and the duration of the marking. Transactions with tokens marked with the parameter pass through the Oracle node. It monitors compliance with the registered terms of the agreement, particularly controls dynamically the amounts available for transfer to marked DT and that can be converted into non-cash/cash money. Information about transactions with tokens marked with the parameter is transmitted to the marking initiator node and the Oracle node for traceability.

Fig. 7 – Scheme of interaction of participants within the framework of the "Marking with a parameter" subarchetype



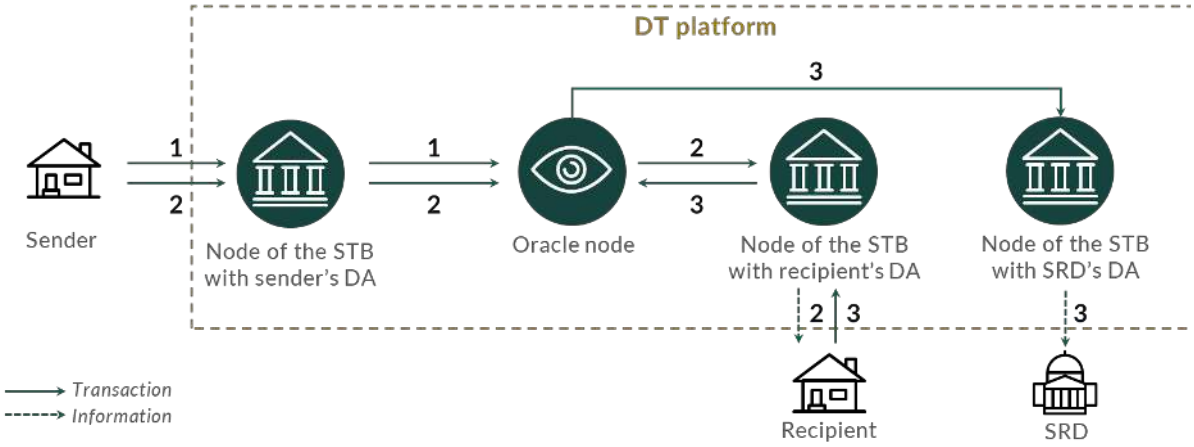
Description of steps:

1. An external service outside the DT platform sends a request to register a marking parameter on the Oracle node specifying the contracts within the framework of which transactions between clients can be made. Information about the parameter is sent to the bank with marking initiator's DA.
2. Marking initiator sends request for marking funds that indicates the registered marking parameter, which is confirmed by the Oracle node. The recipient of marked funds receives the marked funds.
3. The recipient of marked funds initiates a transaction with the marked tokens and indicates the contract under which these transactions are performed. The funds are transferred to the intended recipient's DA under the agreement after confirmation by the Oracle node. The transaction data is transmitted to the node of bank with marking initiator's DA and to the Oracle node to enable tracking marked DTs.

VAT

When a taxpayer registers (issues) an EI, the services of the State Revenue Committee (hereinafter – SRC) transmit the EI data to the Oracle node: EI ID, information about the sender and recipient, the amount of the payment without VAT, the amount of VAT. When making a payment for the EI, customers specify the invoice's ID and make the payment using tokens. If the client has only standard tokens, then at the time of the transaction the tokens are marked with VAT, the amount of the payment without VAT remains in the form of standard tokens. If the client already has marked VAT tokens, then he uses the already marked ones to pay the VAT amount to another client (one payment resolves the issue of taking VAT as a credit). In case of insufficient number of the tokens marked for VAT, additional marking is performed in the transaction. The recipient always receives part of the standard tokens and part of the VAT tokens as part of the EI payment. The customers can only spend VAT tokens to settle accounts with other customers via an EI or to pay taxes to the appropriate authority. The VAT tokens have no expiration date and become standard only upon transfer to the tax authority.

Fig. 8 – Scheme of interaction of participants within the framework of the "VAT" archetype



Description of steps:

Prerequisite: EI data has been added to the Oracle node

Transfer of VAT to the recipient

1. The sender sends a request through the STB channels to receive data on an EI. Based on the data from the EI, the Oracle node provides the data.
2. The sender initiates a VAT deduction transaction with an EI. The Oracle node verifies that the data from the transaction matches the data from the EI. According to the EI data, the recipient receives standard tokens (the main part of the payment) and tokens marked for VAT.

Transfer of funds to the State Revenue Department (hereafter – SRD)

3. The recipient sends a request for the transfer of marked for VAT tokens to the SRD, the request is verified by the Oracle node. During the transaction of VAT to SRD, the marking is removed, the SRD receives standard DT tokens.

Based on the three archetypes listed above, the **“Targeted use of funds from the National Fund”, “Intermediary road repairs”, “Digital VAT”, “Purchase of farm animals” and “Investment subsidies from the Ministry of Agriculture”** scenarios were implemented. Below is a mapping of scenarios and archetypes, as well as a description of the scenarios themselves.

Tab. 5 – Matching scenarios and archetypes

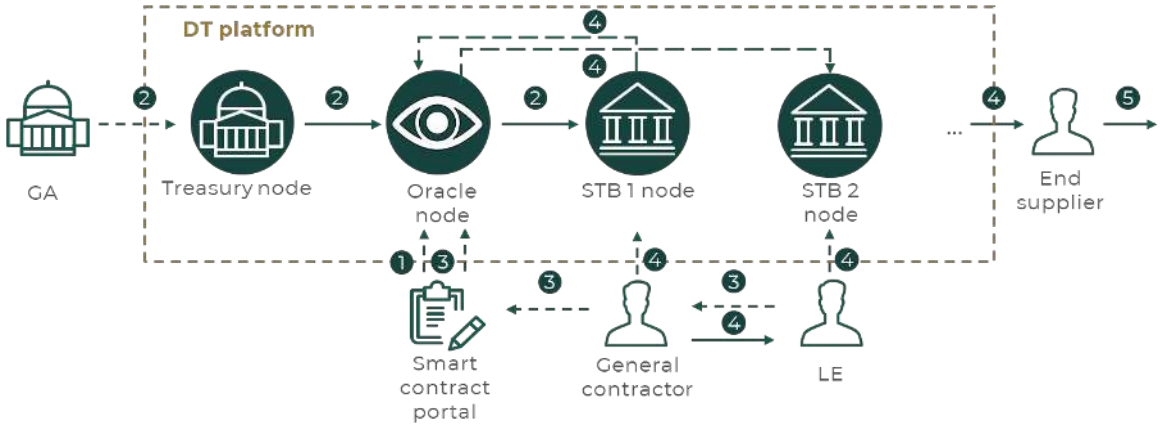
Scenario/Archetype	Marking	Holding
Targeted use of funds from the National Fund	**V**	
Intermediary road repairs	**V**	
Purchase of farm animals		**V**
Investment subsidies from the Ministry of Agriculture		**V**
Digital VAT	**V**	

“Targeted use of funds from the National Fund” and “Intermediary road repairs” scenarios

The "Marking" archetype is used for these scenarios. The main objective of these scenarios is to ensure the targeted allocation of funds: targeted funds for road repairs and from the National Fund to finance strategic infrastructure projects.

Below is a scheme for implementing scenarios with a new entity called the Smart Contract Portal. In the future, the Smart Contract Portal should become a main connecting link between the DT platform and GA/LE in the process of public procurement.

Fig. 9 – Scheme of interaction of participants in scenarios with the Smart Contract Portal



Description of steps:

1. The Smart Contract Portal sends a request for registration of the marking parameter (number or name of the state order for goods/services) to the Oracle node.
2. GA distributes and marks DTs via the Treasury node with the parameters of a specific project from the DA of the GA (on the Treasury Node) to the DA of the General contractor on the node of bank 1.
3. All contracts within the framework of the state order are created and signed on the Smart Contract Portal. The data of these contracts (the details of the customer/sender and the contractor/recipient, total amount of funds for the contract and the amount of funds that can be converted into non-cash/cash money), as well as changes to them, are transmitted to the Oracle node.
4. The LEs make payments from their DAs to the DAs of their contractors. The parameters of these transactions are validated and confirmed by the Oracle node.
5. For the final recipients of DT, the marking of tokens is removed and the LE-end supplier can convert standard tokens into cash/non-cash money.

Currently, under both scenarios, at least **84 billion DTs** were issued, and about **70** transactions were carried out between **14 legal entities.** The number of users and the number of transactions will grow due to the further scaling of scenarios in other areas.

Below are examples of interfaces for employees of the Treasury Committee to perform operations in the DT within the framework of the scenario:

Fig. 10 – Main page of the web interface for employees of the Treasury Committee

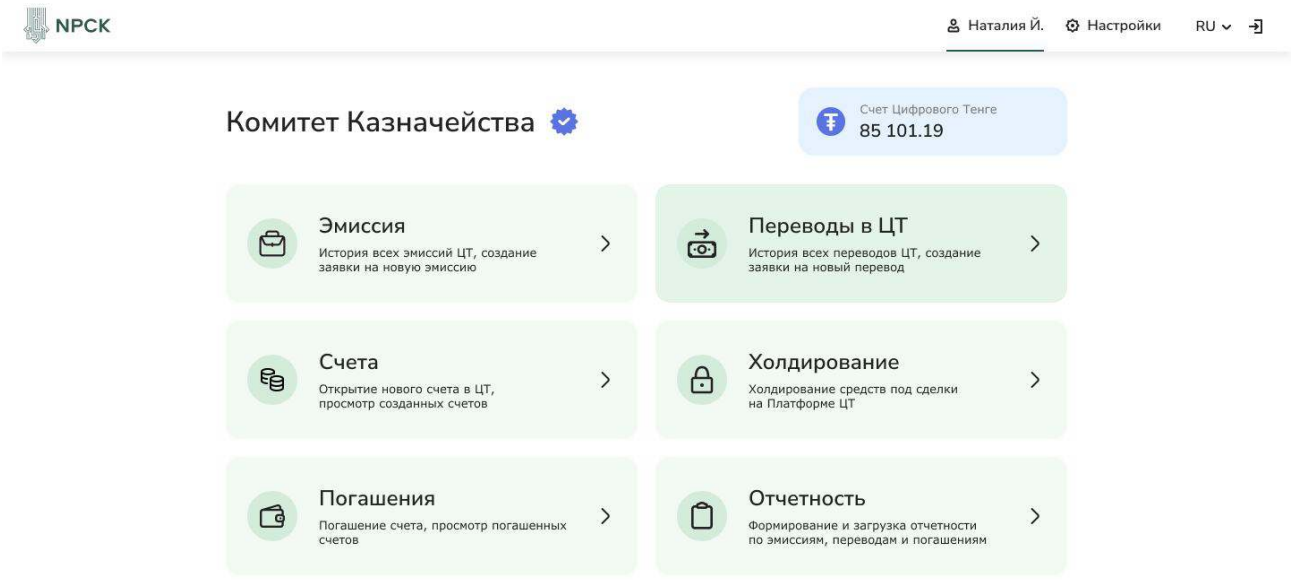


Fig. 11 – "Issuance" tab of the web interface for employees of the Treasury Committee

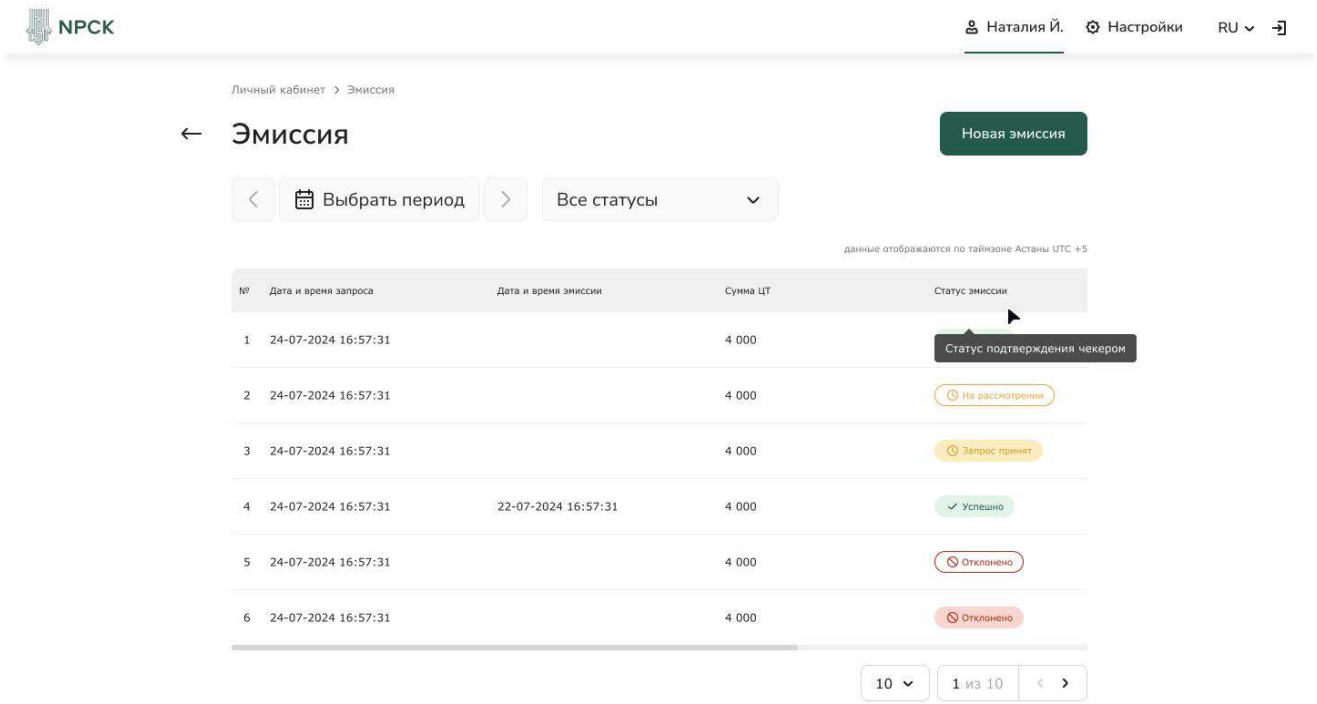


Fig. 12 – "Transfers in DT" tab of the web interface for employees of the Treasury Committee

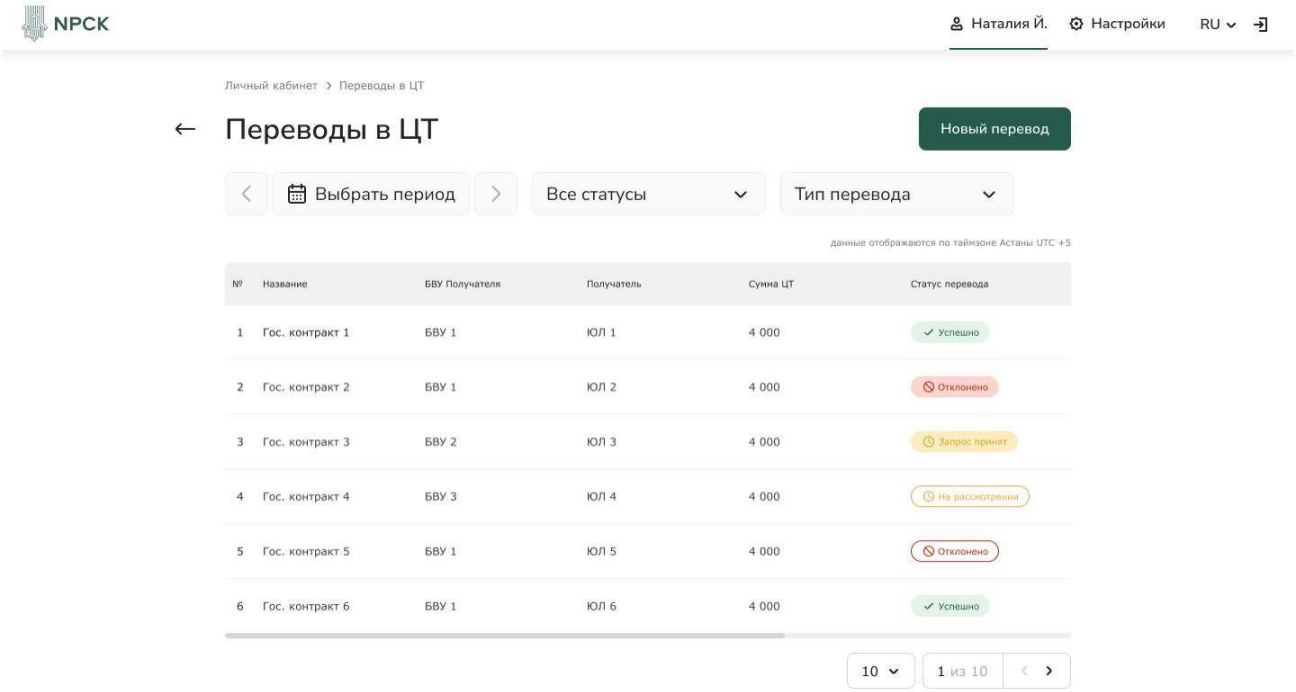


Fig. 13 – "Accounts" tab of the web interface for employees of the Treasury Committee

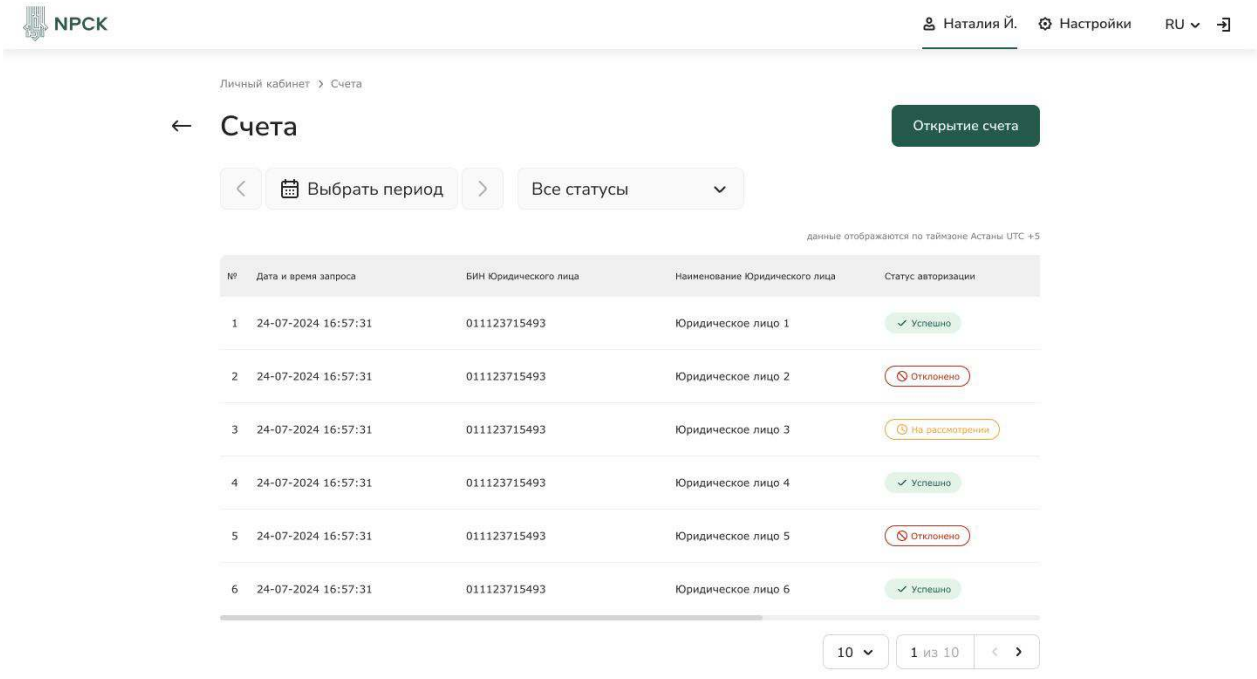


Fig. 14 – "Redeeming" tab of the web interface for Treasury Committee staff

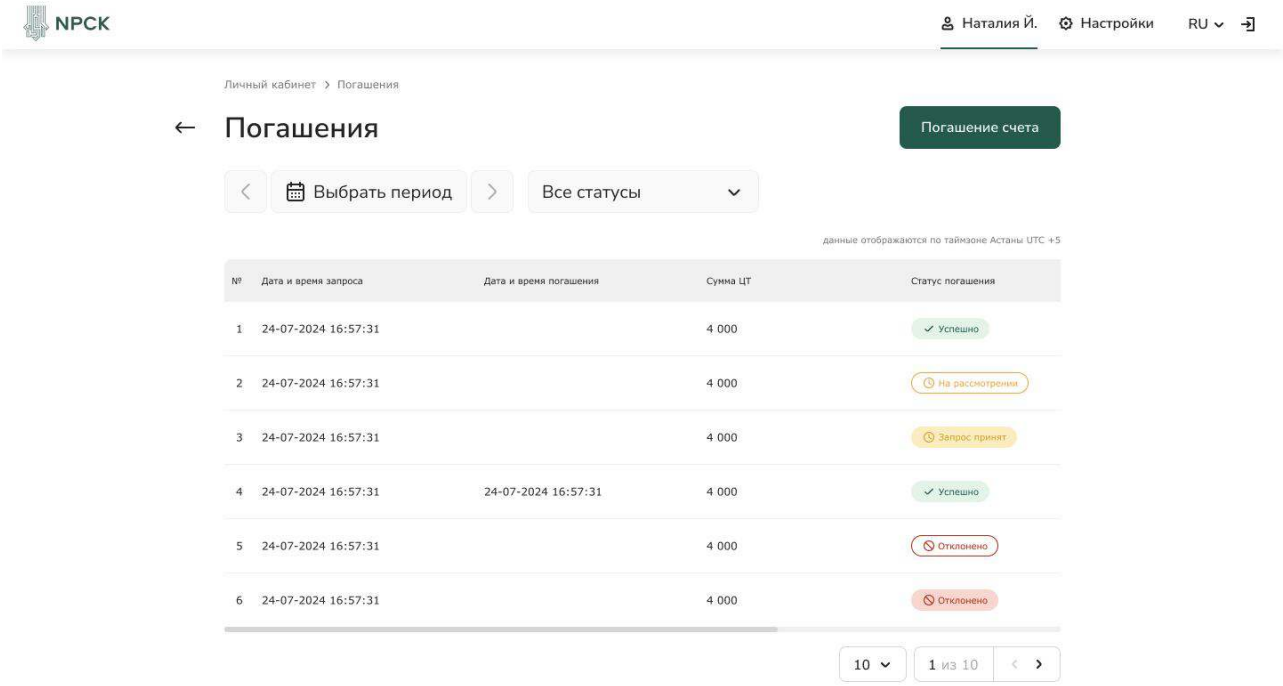


Fig. 15 – "Reports" tab of the web interface for Treasury Committee staff

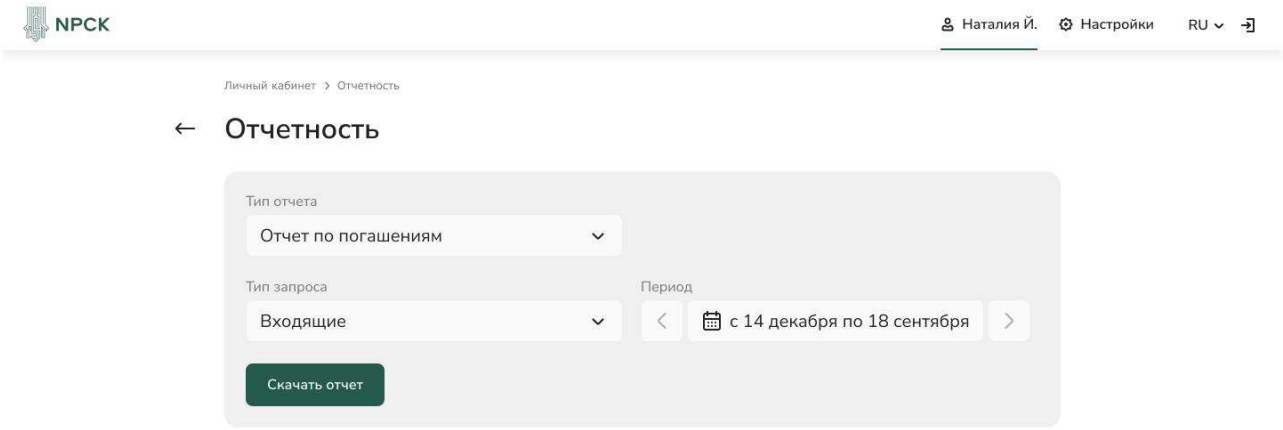
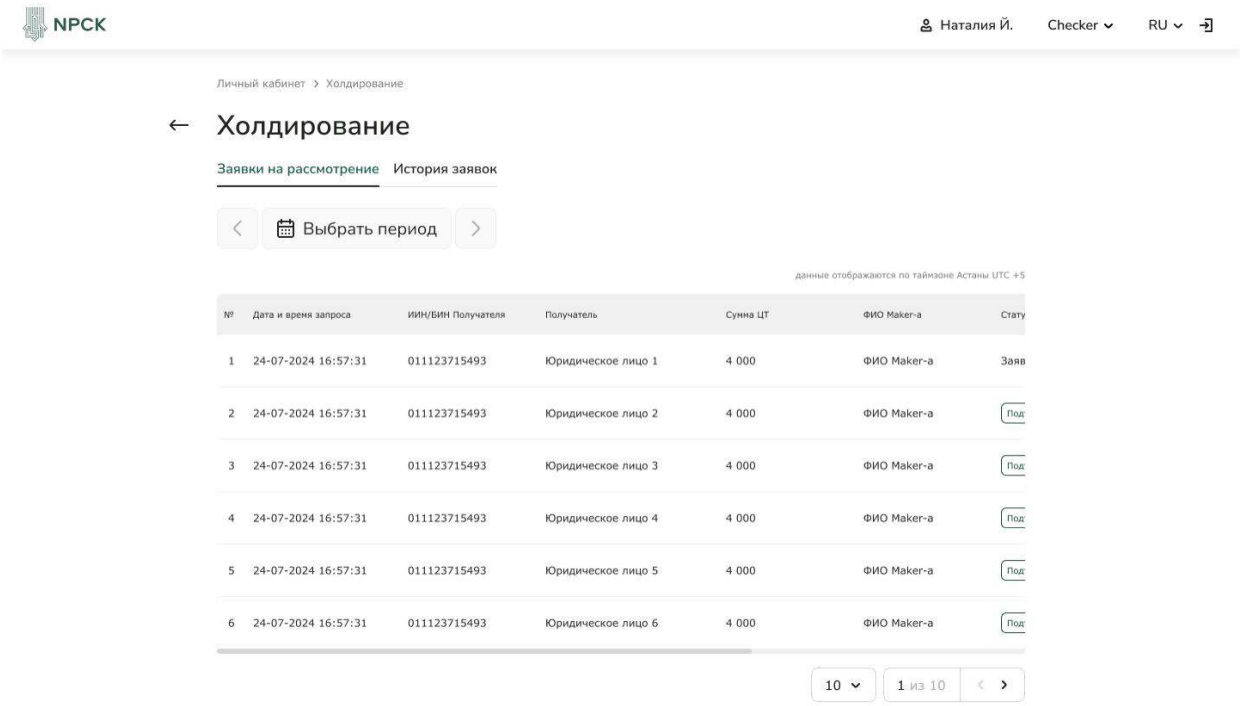


Fig. 16 – "Holding" tab of the web interface for employees of the Treasury Committee



A step-by-step implementation plan is provided for the use of DT in payments involving the state:

- 1 stage (2024) – marking with a **public address** or a list of **public addresses;**
- 2 stage (2025) – marking with the **availability parameter in the registry of contracts from the Smart Contract Portal;**
- 3 stage (after 2025) – marking with the parameter of **availability in the register of contracts from the Smart Contract Portal integrated with other government information systems.**

Advantages of scenarios:

In both scenarios, through the use of marked funds, targeted use of public funds and automation of a number of payment processes involving the state were achieved. This makes the process of allocating public funds more controlled and efficient, which in its turn makes further exploitation of the scenario beneficial for all market participants and the state.

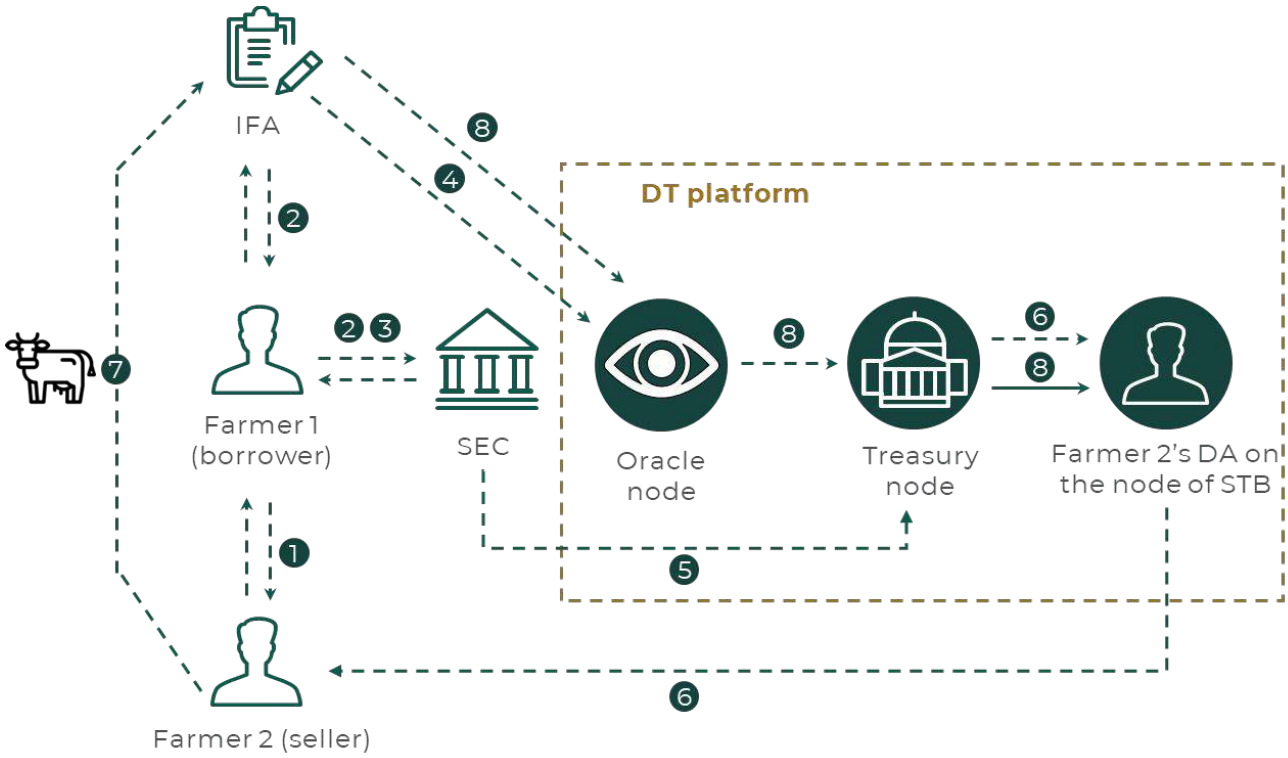
Benefits of using DT in a scenario:

Due to the "Marking" archetype implemented on the DT platform, it becomes possible to direct funds exclusively for their intended purpose. To date, marking by the LE identifier is provided, but in the future, it will be possible to create more integrated and comprehensive conditions for the use of funds, thereby eliminating the wrongful and improper use of public funds.

“Purchase of farm animals” scenario

This scenario utilizes the “Holding” archetype to automate the process of purchasing farm animals with government participation. The diagram below shows the implementation with a description of the steps:

Fig. 17 – Scheme of interaction of participants within the framework of the “Purchase of farm animals” scenario



Description of steps:

1. Farmers agree on the terms of the transactions.
2. Farmer 1 (borrower) provides a set of documents for obtaining a microloan for the purchase of farm animals to a socio-entrepreneurial corporation (hereinafter – SEC) and supporting documents from Farmer 2 (seller) on the ownership of animals for verification, through the information system called “Identification of farm animals" (hereinafter – IFA) and the details of the DA of Farmer 2 (seller).
3. SEC signs a loan agreement with Farmer 1 (borrower) and uploads the data to the accounting systems.
4. The event registration data is transmitted to the Oracle node.
5. SEC initiates a holding request at the Treasury node.
6. Information about held funds is sent through the STB channels to Farmer 2 (Seller).
7. After receiving a notification that the funds are being held, Farmer 2 (Seller) changes the owners of the animals through the IFA and transfers the animals to Farmer 1.
8. IFA sends a request to the Oracle node to stop holding the funds. The funds are being transferred from the SEC account to the Farmer 2 (seller) account. Farmer 2 can use or convert the received DT into cash/non-cash tenge.

The scenario is currently undergoing final testing before launch.

Scenario benefits

With the help of the “Holding” archetype, automation of the process of state subsidies to farmers is achieved which in its turn reduces the possibility of errors due to the human factor, guarantees the targeted use of funds and has a positive effect on the overall speed of allocation of subsidies and their transparency. This is important both for the source of subsidies (the state) interested in achieving the goals of subsidization and for the recipients of funds due to the simplification and acceleration of the process itself.

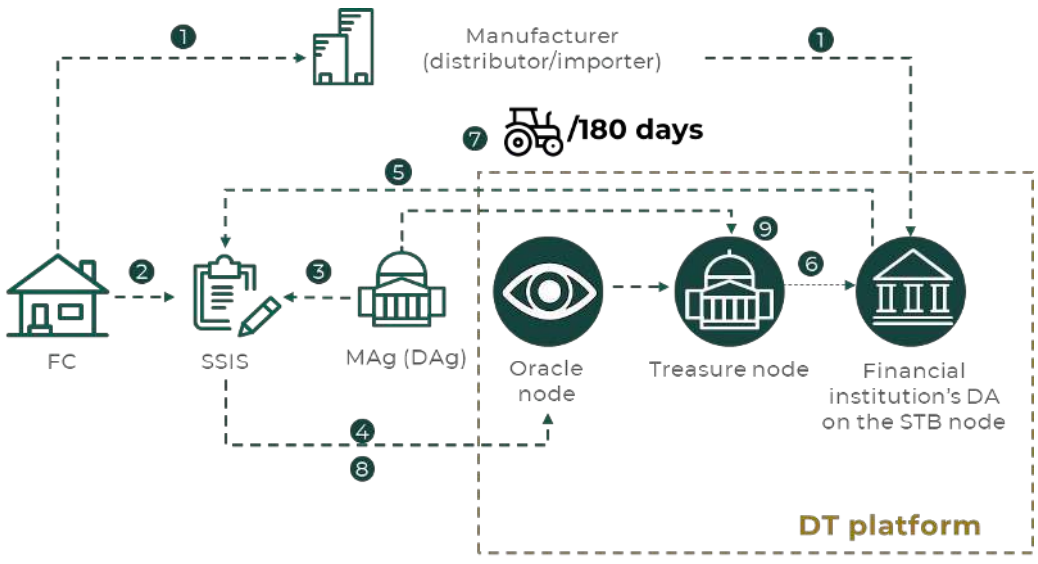
Advantage of using DT in a scenario

The feasibility of using the “Holding” archetype on the DT platform enables the automation of holding and transferring public funds when certain conditions are met. The further development of the scenario and its scaling depends on the implementation of additional services and mechanisms outside the digital currency platform – for example, one of the most promising directions of work is the creation of a marketplace of farm animals with the possibility of receiving subsidies from the state.

“Investment subsidies from the Ministry of Agriculture” scenario

As in the case of the previous scenario, the holding archetype is used for implementation. Below is an implementation diagram with a description of steps:

Fig. 18 – Scheme of interaction of participants within the framework of the “Investment subsidies from the Ministry of Agriculture” scenario



Description of steps:

1. The farming company (hereinafter – FC) preliminarily receives a price quotation from the Manufacturer and approval for financing (leasing) from a financial institution for the purchase of agricultural machinery.
2. FC submits an application for the equipment leasing under the investment subsidy program using the advance payment method through the state subsidy information system (hereafter – SSIS).
3. Ministry of Agriculture (hereinafter – MAg), represented by the regional Department of Agriculture (hereinafter – DAg), is reviewing the application via the SSIS.
4. The event registration data is transmitted to the Oracle node
5. DAg on the Treasury node initiates a holding request.
6. Information about the funds being held is sent to the financial institution through the STB channels.
7. After the transfer of the leased item to the FC and receipt of the relevant documents from the FC, the financial institution uploads supporting documents on the actual cost and the fact of transfer of the leased item to SSIS.
8. SSIS sends a request to the Oracle node to stop holding the funds. The funds are being transferred from the DAg's DA to the DA of a financial institution that can use or convert the received DTs into cash or non-cash tenge.
9. In the absence of a trigger from SSIS about the occurrence of an event within 180 calendar days, funds are stop being held on the DAg account (funds remain on the Treasury node).

The scenario is currently undergoing final testing before launch.

Scenario benefits

This scenario enables automation of the process of government investment subsidies consequently making it possible to execute transactions instantaneously, guaranteeing targeted use of allocated funds and reducing the risk of errors due to the human factor. Such aspects are important for the source of the subsidy (the state) interested in achieving the goals of subsidization and for the recipients because of the speed of the whole process.

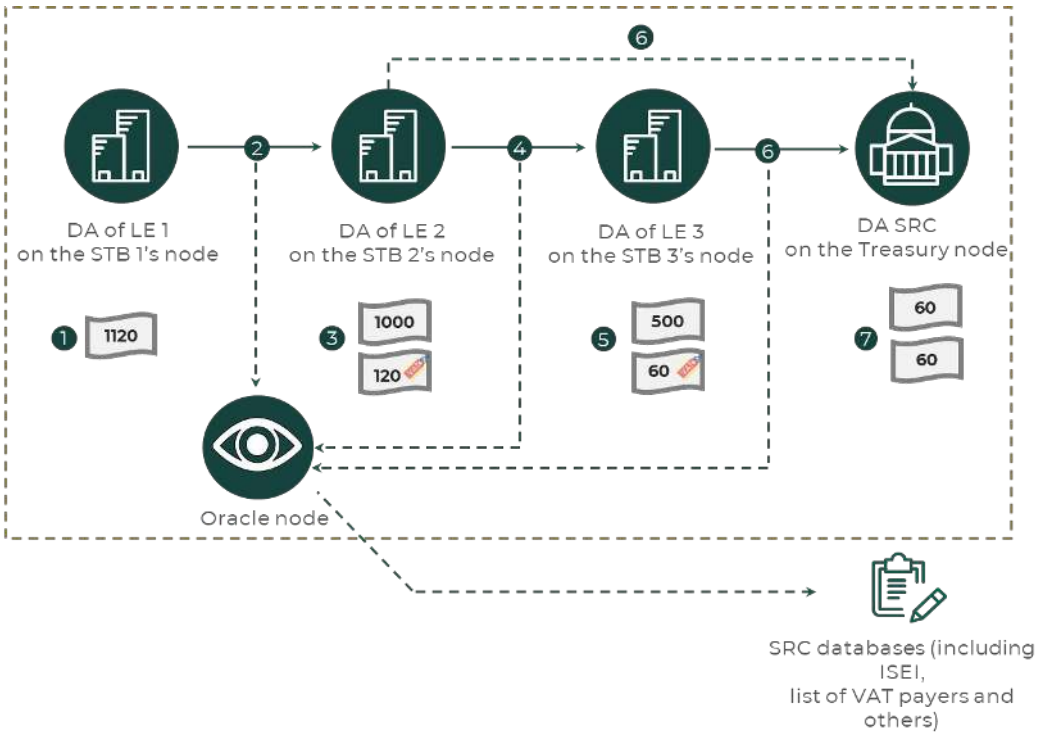
Benefits of using DT in a scenario

The use of the "Holding" archetype coupled with certain features of the DT design (in particular, the status of the national digital currency as a means of payment) makes government subsidy processes more transparent and reliable without creating risks to financial stability.

“Digital VAT” scenario

This scenario is based on a fundamentally new approach of the payment and refund of VAT through a substantially enhanced tokenization mechanism. The diagram below describes the steps:

Fig. 19 – Scheme of interaction of participants within the framework of the “Digital VAT” scenario



There are two types of tokens used in the scenario: **standard** (they do not have any restrictions) and **marked** ones (these can only be used in two cases: either to pay VAT to the state or to pay part of the payment according to an EI to a counterparty from the list of VAT payers of the SRC).

Description of steps:

1. LE 1 has standard tokens on its DA.
2. LE 1 initiates a payment using the identifier of an incoming EI from LE 2 for 1120 DTs (including the VAT of 120 DTs). During the transaction, based on the information received in advance via the EI on the Oracle node from the SRC information systems, it is verified that the data from the transaction corresponds to the data from the EI and the tokens for the amount of VAT are marked. The payment information is forwarded to the SRC information systems via the Oracle node.
3. LE 2 receives 1000 standard and 120 tokenized tokens on its DA on the STB 2’s node.
4. LE 2 initiates a payment using the identifier of an incoming EI from LE 3 to 560 DTs (including VAT in 60 DTs), and uses 500 standard and 60 marked tokens. Therefore, information on the amount of VAT that can be offset for LE 2 is sent to the SRC information systems through the Oracle node.
5. LE 3 receives 500 standard and 60 marked DTs on its DA on the STB 3’s node.
6. LE 2 and LE 3 pay VAT (60 marked DTs each) to the DA of SRC on the Treasury node
7. When marked DTs are transferred to the DAs of the tax authorities, the tokens become standard: in the end tax authorities have standard DTs.

Currently, as part of the "Digital VAT" scenario, **37 million DTs** were issued, the first **3 transactions were carried out, 6 first LEs were connected to the platform.** The numbers of users and transactions are going to increase **during the further implementation of the pilot project.**

Scenario benefits

With the help of the "VAT" archetype, this scenario guarantees the receipt of VAT by the state Treasury and the impossibility to commit offenses with sham payments via fictitious EIs. Radical reduction in the number of desk audits for LEs-participants is also possible in the long term. In addition, the implementation of this scenario enabled quick refund of the amount of excess VAT (within 15 working days) and made it possible to offset excess VAT against current tax debts or against future tax payments. Therefore, it is possible for a taxpayer without existing debts to refund the excess VAT balance to his bank account. Such innovative features of the DT platform create a unique combination of benefits for both taxpayers and the government.

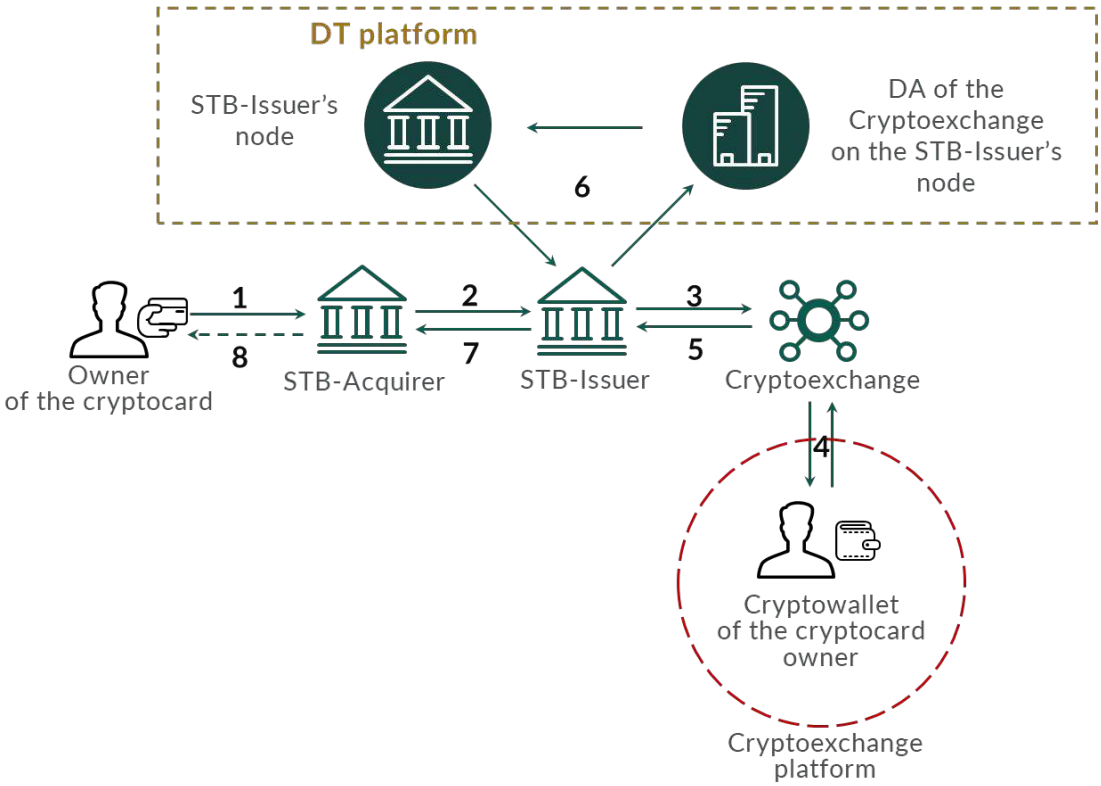
Benefits of using DT in a scenario

The implementation of the above advantages on the platform of the national digital currency makes it possible to achieve transparency of VAT payments and guarantees VAT receipts to the Treasury with minimal improvements on the part of banks.

"Cryptocard" scenario

This scenario is being developed with the use of the results of the 2023 work on integrating the DT platform with representatives of the world of decentralized finance (decentralized finance, hereafter - DeFi). Its testing is supposed to be carried out within the experimental (R&D) circuit. The scheme below provides the description of all steps:

Fig. 20 – Scheme of interaction of participants within the framework of the "Cryptocard" scenario



Description of steps:

1. The owner of the cryptocard is authorized on the cryptoexchange platform. The cryptoexchange has access to the cryptowallet of the cryptocard owner. The cryptocard owner has sufficient amount of cryptocurrency on the cryptowallet and makes a purchase of goods or services using a POS terminal.
2. The STB-Acquirer processes the transaction as a normal operation and sends a request to the STB-Issuer. It is worth noting that the STB-Acquirer does not have and should not have any information about the scenario and the cryptocard itself - this is just a regular transaction for the STB-Acquirer.
3. The STB-Issuer is able to understand that the payment is made via a cryptocard. It sends a request to the cryptoexchange.
4. The cryptoexchange determines the exchange rate for "cryptocurrency-DT" pair at the time of payment. It also verifies that the owner of the crypto card has sufficient amount of cryptocurrency on the crypto wallet to make this payment. If the cryptowallet balance is OK, the cryptoexchange debits funds from the cryptowallet at the time of payment or later.
5. The cryptoexchange sends a response to the STB-Issuer's request ("balance is sufficient").
6. The STB-Issuer verifies that the balance of the cryptoexchange's DA on the DT platform is sufficient. Then, it debits the DTs from the cryptoexchange's DA by using the appropriate API method.
7. The STB-Issuer confirms that the payment has been made and the funds have been debited accordingly by converting the DTs into non-cash money and then sending them to the STB-Acquirer's DA later or at the time of payment.
8. The owner of the cryptocard receives a notification about successful payment.

The work is currently underway to launch the scenario.

Scenario benefits

This scenario allows to test the potential of the DT platform as a bridge between the world of traditional and decentralized finance. The experience gained in the course of development and testing will help clarify approaches to regulation and circulation of digital assets in the future and will also contribute to wider CBDC application and adoption in Kazakhstan.

Benefits of using DT in a scenario

The regulatory status of the DT as a national digital currency and utilized technological solutions (in particular, the token-based access model) make it possible to implement this scenario without a large number of integration works and without creating additional risks for the country's financial stability.

Plans for 2025

The following areas are planned for 2025 as part of the development of the Digital Tenge project:

Approval of the legislative framework for the functioning of the DT

An appropriate regulatory framework is needed for the comprehensive implementation of the national digital currency and its benefits. It is planned to approve the legislative framework for the functioning of the DT in 2025 based on the work of 2023 and 2024.

Development of payment scenarios with the involvement of state

The scenarios described above based on the archetypes “Marking”, “Holding” and “VAT” will develop in terms of increasing the number of participants, enlarging the volume of transactions, improving functionality and integrating with existing information systems and databases.

Conducting a pilot project on the use of DT for the implementation of payments with a specific purpose in the field of health insurance

The results obtained in 2024 indicate the great potential of the DT in making payments for a specific purpose. The health insurance is the area in which the application of these properties of a national digital currency seems most justified.

Cross-border payments

In 2025, it is planned to test the basic scenario of cross-border payments in national digital currencies under the conditions of full integration with all participants.

Scenario development within the R&D circuit

Such scenarios include the issuance of stablecoins, the development of the above-described "Cryptocard" scenario and other scenarios to improve the functionality of the DT platform.

Integration with external data sources and NPCK systems

This focus area provides for both the integration of the DT platform with government information systems (via the Oracle node) and with R&D systems (for example, with the Open API platform)

Preparation and subsequent commissioning of the DT platform

2025 is the last year in terms of the phased implementation of the national digital currency. Putting the DT platform into commercial operation will not only fulfill this plan, but will also create a critical component of the nation's financial digital infrastructure.

All of the above works will be carried out within the framework of the developed Roadmap of the Digital Tenge project for 2025.

Conclusion

The Digital Tenge project is the foundation for building an innovative and efficient national payment infrastructure. The development of the national digital currency is carried out with respect to international experience and current trends in the financial market. The step-by-step implementation of the DT allows to simultaneously create new platform functionality for use in application scenarios and conduct pilot projects to test hypotheses. In particular, 2024 will be marked by the practical application of the DT to increase the efficiency and transparency of government spending, but at the same time the questions of integration with the world of DeFi and cross-border payments were also actively explored.

CBDC continue to be the driver of building a new type of economy. The further development of the programmability of digital currencies, as well as integration with public and private databases, will create fundamentally new financial products and instruments. It is also important that digital currencies around the world are becoming more and more interoperable, and their impact on public financial institutions makes payments involving the state fast, efficient and transparent.

Certainly, a range of work is needed to unlock the full potential of digital currencies. These include both improving the properties of technology platforms and building a full-fledged ecosystem. The experience of DT and other digital currencies clearly demonstrates that an open dialogue and the involvement of all stakeholders in a constructive discussion are important to achieve these objectives.

Reference list

1. Nili, C. and Waliczek, S. (2024) Modernizing financial markets with wholesale central bank digital currency, World Economic Forum official website. Available at: https://www3.weforum.org/docs/WEF_Modernizing_Financial_Markets_with_Wholesale_Central_Bank_Digital_Currency_2024.pdf
2. Central Bank Digital Currency tracker (2024) Atlantic Council. Available at: https://www.atlanticcouncil.org/cbdctracker
3. Kosse, A. and Mattei , I. (2023) Making headway – Results of the 2022 BIS survey on central bank digital currencies and crypto, Bank of International Settlement official website. Available at: https://www.bis.org/publ/bppdf/bispap136.pdf
4. ECCB to launch DCash 2.0 following pilot project closure (2024) St Vincent Times. Available at: https://www.stvincenttimes.com/eccb-to-launch-dcash-2-0-following-pilot-project-closure
5. Eastern Caribbean looking for CBDC vendors for next DCash iteration (2024) Ledger Insights - blockchain for enterprise. Available at: https://www.ledgerinsights.com/eastern-caribbean-cbdc-vendors-dcash
6. Wyss, J. (2022) DCash, Caribbean digital currency, remains offline for second week, Bloomberg.com. Available at: https://www.bloomberg.com/news/articles/2022-01-28/caribbean-digital-currency-dcash-remains-offline-for-2nd-week
7. Tunji, S. (2024) ENAIRA makes up less than 1% of currency in circulation as of March 2024 , Nairametrics. Available at: https://nairametrics.com/2024/07/21/enaira-makes-up-less-than-1-of-currency-in-circulation-as-of-march-2024
8. Emmanuel, O. (2024) ENAIRA adoption remains low, less than 1% in circulation as of March 2024, Tekedia. Available at: https://www.tekedia.com/enaira-adoption-remains-low-less-than-1-in-circulation-as-of-march-2024
9. Eleanya, F. (2024) Enaira: Once upon an unloved CBDC, Businessday NG. Available at: https://businessday.ng/news/article/enaira-once-upon-an-unloved-cbdc
10. Soderberg, G. et al (2022). Behind the Scenes of Central Bank Digital Currency Emerging Trends, Insights, and Policy Lessons, International Monetary Fund official website. Available at: https://www.imf.org/en/Publications/fintech-notes/Issues/2022/02/07/Behind-the-Scenes-of-Central-Bank-Digital-Currency-512174
11. Bahamas Sand Dollar CBDC has $2.1m in circulation after 3 years (2024) Ledger Insights. Available at: https://www.ledgerinsights.com/bahamas-sand-dollar-cbdc-has-2-1m-in-circulation-after-3-years/
12. Noll, F. (2024) Observations from the retail CBDCs of the Caribbean, Federal Reserve Bank of Kansas City. Available at: https://www.kansascityfed.org/research/payments-system-research-briefings/observations-from-the-retail-cbdcs-of-the-caribbean
13. Ree, J. (2023) Nigeria's ENAIRA, one year after, International Monetary Fund official website. Available at: https://www.imf.org/-/media/Files/Publications/WP/2023/English/wpiea2023104-print-pdf.ashx
14. Sole Jamaican CBDC wallet provider questions JAM-DEX progress (2024) Ledger Insights. Available at: https://www.ledgerinsights.com/sole-jamaican-cbdc-wallet-provider-questions-jam-dex-progress
15. Iorio, A.D., Kosse, A. and Mattei, I. (2024) Embracing diversity, advancing together - results of the 2023 BIS survey on central bank digital currencies and Crypto, The Bank for International Settlements official website. Available at: https://www.bis.org/publ/bppdf/bispap147.pdf
16. Jasper–Ubin Design Paper (2019) Enabling Cross-Border High Value Transfer Using Distributed Ledger Technologies, Bank of Canada, Monetary Authority of Singapore official website. Available at: https://www.mas.gov.sg/-/media/Jasper-Ubin-Design-Paper.pdf
17. Synchronised cross-border payments - Stella project report (2019) European Central Bank official website. Available at: https://www.ecb.europa.eu/press/intro/publications/pdf/ecb.miptopical190604.en.pdf
18. Project mBridge reached minimum viable product stage (2024) The Bank for International Settlements official website. Available at: https://www.bis.org/about/bisih/topics/cbdc/mcbdc_bridge.htm
19. Purpose bound money (PBM) technical whitepaper (2023) Monetary Authority of Singapore official website. Available at: https://www.mas.gov.sg/-/media/mas-media-library/development/fintech/pbm/pbm-technical-whitepaper.pdf
20. How do Digital RMB smart contracts work? First supply chain finance use cases (2023) Ledger Insights. Available at: https://www.ledgerinsights.com/digital-rmb-smart-contracts-cbdc