NATIONAL BANK OF KAZAKHSTAN

NATIONAL PAYMENT
CORPORATION OF KAZAKHSTAN

DIGITAL TENGE

RESULTS OF THE FIRST IMPLEMENTATION PHASE
WHITE PAPER 2023

Almaty, December 2023

Abbreviations

AML/CFT	Anti-Money Laundering/Countering the Financing of Terrorism
ABS	Automated banking system
API	Application programming interface
BIS	Bank of International Settlements
CB	Central bank
CBDC	Central bank digital currency
CI/CD	Continous integration/continous development
DeFi	Decentralized finance
DvP	Delivery versus payment
DLT	Distributed ledger technology
DT	Digital Tenge
EDS	Electronic digital signature
GDP	Gross domestic product
IPS	International payment system
KYC	Know your customer
MVP	Minimum viable product
NBK	National Bank of Kazakhstan
NFC	Near-field communication
PoC	Proof of concept
POS	Point of sale
PvP	Payment versus payment
Q&A	Questions and Answers
QR-code	Quick Response code
R&D	Research and Development
UTXO	Unspent transaction output
UI/UX	User’s interface, User experience
VAT	Value added tax

Contents

Summary

The history of the "Digital Tenge" project (hereinafter - DT) begins in 2021 - during that year the National Bank of the Republic of Kazakhstan (hereinafter - NBK) began the research of possible implementation of central banks digital currency (hereinafter - CBDC). Obtained results were lately utilized to test a number of hypotheses and subsequently confirmed the possibility of technological realization of the project. In 2022, the NBK started the study on the need to implement DT in collaboration with market participants, expert community and international partners, and by the end of the same year, based on the results of the study, the decision to implement DT in three phases until the end of 2025 was made.

The first phase of the DT implementation in 2023 consisted of the start of the national digital currency platform's limited production made in collaboration with commercial banks and international payment systems (hereinafter - IPS). In addition to that, research activities to test hypotheses regarding the functionality of the digital tenge were continued. In order to achieve the objectives, two loops of the DT platform were created - industrial and experimental (also known as "R&D circuit" or "technological sandbox").

On November 15, 2023, the first stage of the digital tenge platform's industrial loop was officialy started. Together with the Almaty City Akimat and Kazpost JSC, a **pilot project of "digital vouchers"** for free meals in schools was launched. In addition, together with Visa , Mastercard and 4 commercial banks (Halyk Bank, Altyn Bank, Bank CenterCredit, Eurasian Bank) **the world's first CBDC bank cards linked to DT accounts** were introduced. Such cards are able to provide capabilities to spend, withdraw cash and conduct transactions in DT anywhere in the world and within a familiar user path.

Работы в экспериментальном контуре включали в себя апробацию идей участников рынка, победивших в конкурсе идей Digital Tenge Ideathon 2022, а также тестирование трансграничных платежей, выпуска обеспеченных ЦТ стейблкоинов и токенизации ценных бумаг.

The experimental loop was focused on testing the ideas of market participants who won the Digital Tenge Ideathon 2022 idea competition, as well as on testing cross-border payments, issuance of DT-backed stablecoins and tokenization of securities.

During this year, the further development of the national digital currency was discussed in numerous discussions and sessions with market participants, international financial organizations, other central banks (hereinafter - CBs), and international communities. Such activities and recieved feedback helped to define the trajectory of DT development until full-fledged implementation in 2025 and to find answers to a number of questions regarding architectural and other trade-offs.

This document provides information on the current status of the Digital Tenge project and the results obtained in both industrial and experimental loop in 2023. In addition, this document also describes plans for implementation in 2024 and 2025 in the fields of technology, regulation and business processes.

Мнения о проекте

Rafal Trepka

General Manager Central Asia at Mastercard

«Mastercard has been a longstanding partner of governments worldwide in modernizing payment systems, including the development of CBDCs. We collaborate with central banks globally, assisting in the exploration, testing, deployment, and security of these new forms of currency. Mastercard facilitates CBDC payments through its network, provides consulting support to central banks, offers a CBDC sandbox for testing and cybersecurity solutions for CBDCs.

The National Bank of Kazakhstan is one of the leaders in Central Bank Digital Currency (CBDC) innovations globally, spearheading transformative initiatives in collaboration with private financial institutions and international partners like Mastercard.

Mastercard emphasizes the importance of simple, secure, and convenient payment methods for emerging forms of money, aiming to foster interoperability across different payment systems for a thriving digital economy. Celebrating the 30th anniversary of the national currency Tenge, Mastercard, the Eurasian Bank and the National Payments Corporation announced the issuance of the first CBDC card in Eurasia, enabling easy Digital Tenge transactions in Kazakhstan and internationally, combining advantages of digital currency with Mastercard's network security features.

We are delighted to join forces with the National Bank of Kazakhstan in further exploration and introduction of groundbreaking innovations within the Digital Tenge project.»

Мнения о проекте

Cristina Doros

Vice President, Regional Manager Central Asia and Azerbaijan at Visa

«The launch of the world's first Visa cards linked to the digital tenge is a big and important step for the development of Kazakhstan's cashless economy. Visa works closely with customers and partners to ensure the best user experience when using new forms of money, and we are delighted to be part of the launch of the first-of-its-kind CBDC payment card. We would like to thank the National Bank of Kazakhstan, the National Payment Corporation, Halyk Bank, Bank CenterCredit and Altyn Bank for their cooperation and look forward to continuing our work to advance the future of digital payments. The new Visa-based digital tenge payment cards can be accepted at any point where Visa cards are accepted. We are interested in continuing to work with the National Payment Corporation and partners to develop digital currency during the next stages of implementation.»

Мнения о проекте

John Velissarios

Independent advisor

«It is a great honour and distinct pleasure to write this introduction to the Digital Tenge Final Report. I’ve had the privilege of not only being involved with the National Bank of Kazakhstan’s Digital Tenge project since its inception close to 3 years ago but have had the privilege of driving innovation in the global domain of Central Bank Digital Currency for nearly a decade, even before the term was coined. This involvement has meant leading great international teams on some of the most innovative ‘lighthouse’ projects. These projects, pave the way for future innovation that show the promise to transform finance and the way we deal with something that touches every aspect of our daily lives: money

The National Bank of Kazakhstan’s Digital Tenge project is a beacon of transformative development. Since its inception nearly three years ago, we have been taken along on an epic journey for the team, stakeholders and, ultimately, everyday people of the great Republic of Kazakhstan. The Digital Tenge project has progressed from concept (phase one, in 2021) to pilot (phase two, 2022) and to limited production (phase three) launched on November 15, 2023. This epic milestone marks the beginning of its broader deployment in the coming years.

The development of the project in 2023 encompasses every aspect of CBDC — seeking to transform financial markets domestically, regionally and globally, as much as it pertains to Kazakhstan’s international trade and economic reach. The Digital Tenge will be watched closely by central banks, governments and markets worldwide, redefining what can be achieved by the true spirit of innovation.

This was achieved through the development of a general-purpose CBDC, spanning retail, wholesale and cross-border topics under a single umbrella. The team and everyone aware of such developments, recognises that designing a system like this brings challenges, but it offers the reward of creating a more inclusive, accessible, innovative and sovereign society.

Furthermore, exponential returns will come from new inventions and innovations that have yet to be defined but enabled and, dare I say, empowered by the rollout of a general purpose CBDC – the Digital Tenge.

APRIL
2021

Digital Tenge Public Discussion Report

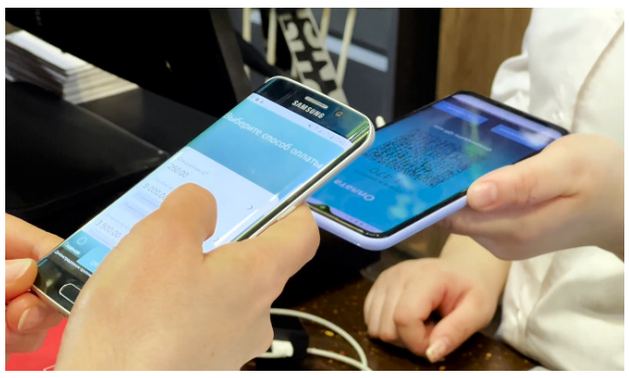
MAY
2021

Report on the results of the Digital Tenge pilot project (White Paper)

DECEMBER
2021

Decision-making Framework

JULE
2022



Pilot project with real consumers and merchants

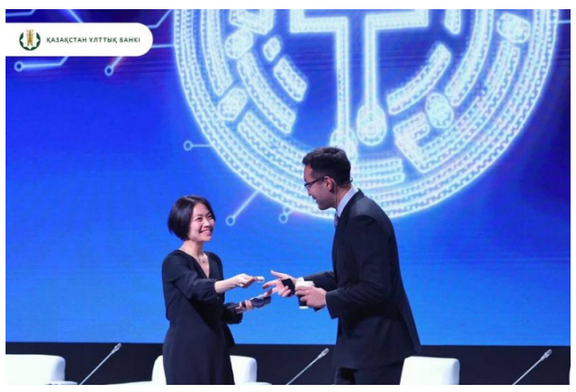
OCTOBER
2022

Digital Tenge Report 2022 (White Paper)

DECEMBER
2022

Status Report. Digital Tenge: implementation plan for Phase One

SEPTEMBER
2023



Launch of retail digital tenge

NOVEMBER
2023

Partners

Technology partner

Media coverage in 2023

- 3,660 articles and materials related to the Digital Tenge project
- 30 public speeches, including presentations at conferences, seminars and round tables
- 10 lectures in universities of Almaty and Astana
- 4 meetings with experts and opinion leaders

Introduction

What is the digital tenge?

Digital Tenge is **a third and digital form of money** that is used **alongside cash and non-cash money**. DT combines the properties of both cash and non-cash money and **additionally provides new opportunities for all users**.

As in the case of cash money, DTs are an obligation of the NBK, so **settlements in DTs do not carry the risks of financial intermediaries**. With the help of DTs, it is possible **to pay without Internet access** (in offline mode) including in the peer-to-peer (device-to-device) payment format. As part of the project implementation, the capability of the DT platform to conduct up to 15 such transactions in a chainin offline mode was successfully tested in 2022. Also, like cash, DT has an increased level of anonymity and state guarantees compared to non-cash funds.

As in the case of non-cash money, DTs can be used for payments **through existing architecture** - internet acquiring, mobile applications of commercial banks, POS-terminals, QR-codes, NFC, etc. DTs retain the advantages of non-cash payments: the ability to make a payment without physical contact, the ability to conduct transactions via cell phone, the ability to seamlessly embed payment into the user experience, and the convenience of storing and accessing funds digitally.

DT meets the new requirements of the digital economy: DT can be used for payments that are simultaneously **instant**, **invisible**, **smart**, **inexpensive**, as well as **safe** and **secure.**

At the same time, DT is a legal tender issued in the form of a unique digital sequence (tokens) or electronic records stored in special digital accounts. This allows DT to be also “smart” money with built-in programmability. This feature of DT ensures its wide range of applications - from **integration with the world of decentralized finance** (hereinafter - DeFi) to **increasing the transparency of public spending**.

It is important to note that with the launch of DTs **cash and non-cash money in Kazakhstan will be used in the same way as before**. The national digital currency will be integrated into the financial landscape of Kazakhstan and will function as a complement to the existing types of payment.

The main advantages of digital tenge

DT opens new perspectives and opportunities for all users: individuals, commercial banks, merchants, government agencies, payment systems, fintech companies and other market participants.

The key benefits of implementing DT are:

Developing innovation. DT promotes debelopment of financial technology thus facilitating access to financial services and creating new opportunities for entrepreneurship and business;

Payment security. The use of modern cryptographic technologies by the DT platform ensures a high level of transaction security;

Payment accessibility. DT can make financial services accessible to a wide segment of the population including remote and hard-to-reach regions;

Payment efficiency. DT can accelerate and simplify payments thus reducing costs and increasing the speed of financial transactions;

Balance between transparency and anonymity. The capability of the DT platform to “color” tokens and to remove “color” automatically ensures the targeted spending of public payments without imposing threats to the anonymity of citizens and with the preservation of banking secrecy;

Payment convenience. DT can be used for instant payments via the means familiar to the user (smartphones and cards).

DT offers unique opportunities and has advantages over other forms of payment. It increases the speed, security and accessibility of payments, thereby enriching the existing financial system. However, it does not eliminate or replace existing mechanisms, but offers additional options and flexibility for citizens and businesses. The implementation of DT is carried out taking into account national interests and within the framework of an open and constructive dialog with market participants to ensure long-term and sustainable development of the economy of the Republic of Kazakhstan.

Development of digital tenge in the context of the international agenda

CBs of various jurisdictions and states around the world are planning to implement CBDC. As of today, 129 countries that represents 98% of the world GDP are experimenting with digital currencies. The number of research projects on the topic of digital currency is constantly growing. Numerous CBs are at different stages of digital currency development, and each of them chooses its own approach to digital currency implementation by combining new technologies and traditional solutions.

Currently, there are several wide-spread trends in the development of CBDC, and the Digital Tenge project is developing in line with them. Such trends include:

1. Development of wholesale CBDCs to improve efficiency of cross-border payments

CBDCs have great potential to solve the problems related to existing limitations of modern cross-border payment systems. For this reason, projects on cross-border settlements in digital currencies (such as mBridge, Jura, Icebreaker, Mariana and others) are being actively implemented around the world. The implementation of cross-border settlements with the help of CBDCs will significantly accelerate the finalization of settlements and reduce transaction costs, thus contributing to the intensification of economic relations between countries.

> ***The NBK is also actively exploring the topic of cross-border settlement: in 2023, cross-border transactions with the Hong Kong Monetary Authority were tested via CBDC Connector SWIFT. Addittionaly, the NBK has also been granted observer status in another prominent cross-border initiative CBDC mBridge in 2023.***

2. Ensuring efficient integration with thefinancial market participants' systems by using APIs

In order to provide market participants with capabilities to interact effectively with digital currency platforms, a broad set of simple and standardized API functions are required.

> ***In 2023, the NBK provided a list of key API methods and corresponding descriptions for commercial banks and external participants within both industrial and R&D loops. Additionally, the mechanism for all participants to connect to the DT platform for functionality tests was created. The use of standardized API methods combined with the provision of all necessary documentation ensured the simplest and most convenient connection of participants to the DT platform regardless of the participants' information systems' specifics.***

3. Using CBDC platforms to provide interoperability between traditional financial industry and DeFi/digital asset industry.

The platform of a national digital currency should be compatible with the already existing financial infrastructure, but digital currencies are built using the latest technologies and solutions. This gives digital currencies the ability to unite the worlds of traditional and decentralized finances. The Central Bank of Singapore's Guardian project, the UDPN universal digital payment network and the related work of the Bank for International Settlements (hereinafter - BIS) are some of the most prominent examples of such integration.

> ***The NBK is actively exploring the interoperability of the DT platform with other digital asset and DeFi platforms. In 2023, a research experiment tested the issuance of DT-backed stablecoins by a stock exchange and a digital asset market participant.***

4. Exploring alternative forms of tokenized money

Tokenized deposits and stablecoins issued by commercial banks are the key areas of various CBDCs projects around the globe. Provision of such instruments will help commercial banks in solving the liquidity problem by using them in normal banking activities.

At the next stages of the Digital Tenge project, the NBK plans to conduct a study of additional forms of tokenized money with subsequent testing of selected scenarios with market participants. The main aims of this analysis are to assess the benefits and advantages provided by introducing such instruments and to develop a strategy for further development.

5. Ensuring a balance between privacy and CBDC programmability

The issue of information privacy is vital for all CBs. For example, a new BIS project called Tourbillon is focused on finding ways to improve the cyber resilience, scalability, and privacy of CBDCs and analyzing the trade-offs between these characteristics.

При этом существует достаточный уровень отслеживаемости для обеспечения требований KYC и ПОД/ФТ со стороны БВУ. The DT functionality provides the ability to customize user anonymity: any user can independently determine whether or not to show personal data to other participants in the transaction. At the same time, there is a sufficient level of traceability for commercial banks to meet the KYC and AML/CFT requirements.

6. Utilizing the programmability of CBDCs for improving settlement efficiency and implementing innovative services

In addition to the basic functionality of CBDCs, innovative features are being actively explored: implementation of smart contracts, built-in programmability and offline payments. For example, the Rosalind project by BIS is focused on investigating programmability of payments, offline transactions, reservation of CBDCs during purchases and conducting payments at the moment of delivery.

The Digital Tenge project is investigating the implementation of built-in programmability (by setting certain usage restrictions in the token structure) and the creation of smart contracts. As part of the works done in 2023, the capability of creating and executing smart contracts was implemented in collaboration with market participants. Further study and implementation of smart contracts will be continued in the next stages of the DT platform development.

Goals and Objectives of the Project

Ниже приведена сводная таблица задач и достигнутых результатов. The key objectives for 2023 were to launch the DT in limited production mode with key scenarios of the DT lifecycle and to conduct a study on the development of advanced DT functionality. The table below summarizes the objectives and achieved results .

Table 1 – Key objectives for 2023 and achieved results

	Objective	Achieved results
1	Ensuring efficient integration with the financial market participants'	External participants and banks (Kazpost, Altyn Bank, Eurasian Bank, Halyk Bank of Kazakhstan, BankCenterCredit) with different IT systems received access to the DT platform via implemented APIs
2	Interoperability with the digital assets industry and DeFi	The integration with Binance platform and KASE stock exchange to test the issuance of stablecoins backed by DTs was completed and tested
3	Implementation of innovative services (including those based on programmability of the CBDC) to improve the efficiency of payments	The implementation of smart contracts within the research scenarios "Sale of tokenized assets", "Pedometer" and "VAT deduction" was completed
4	Integration of the DT platform with the existing payment infrastructure	The DT platform was integrated with the NBK infrastructure for DT issuance and redemption. The integration with IPS for payments in DT was also completed
5	Conducting testing with real consumers and merchants in an open environment	Starting from November 2023, the DT platform was launched in limited production mode with 5 banks and focus group participants
6	Conducting research on market participants' scenarios, cross-border payments and integration with distributed ledger (hereinafter - DLT) networks	The integration of the DT platform with the research scenarios participants was completed and innovative DT functionality (including smart contracts and cross-border payments) was subsequently tested

The results of the project's objectives in Table 1 were achieved through the implementation of key scenarios. Table 2 presents the objectives and corresponding scenarios within which these objectives are realized.

Table 2 – Matrix of scenarios and completed objectives

	Objective/Scenario	Digital Vouchers	CBDC Card	R&D - Cross-border payments	R&D - Issuance of stablecoins (Binance)	R&D - Issuance of stablecoins (KASE)	R&D - Sale of tokenised assets	R&D - Pedometer	R&D - VAT Deduction
1	Ensuring efficient integration with the financial market participants'	✓	✓	✓	✓	✓	✓	✓	✓
2	Interoperability with the digital assets industry and DeFi			✓	✓	✓	✓		
3	Implementation of innovative services (including those based on programmability of the CBDC) to improve the efficiency of paymetns			✓	✓	✓	✓		✓
4	Integration of the DT platform with the existing payment infrastructure	✓	✓						
5	Conducting testing with real consumers and merchants in an open environment	✓	✓						
6	Conducting research on market participants' scenarios, cross-border payments and integration with DLT networks			✓	✓	✓	✓	✓	✓

Scope of the Project

As mentioned above, work in 2023 was carried out in two main loops:

- Limited production mode (**industrial loop**) - working on the DT platform in accordance with the functionality of user scenarios followed by the launch of the DT platform in mimited production mode with key life cycle scenarios being implemented;

- R&D works (**experimental loop**) - working on the DT platform to conduct testings of research hypotheses related to innovative properties of CBDCs in a closed environment.

The description of works within two loops and obtained results are presented below.

List of scenarios and key actors in the scenarios within the industrial circuit

As part of the preparation for limited production mode, two scenarios for further implementation were selected in collaboration with market participants. These scenarios were developed to test all key stages of the DT life cycle. Their implementation is the first stage of the introduction of DT in the Republic of Kazakhstan.

Table 3 – Industrial loop scenarios

	Scenario	Description
1	Digital vouchers	Implementation of a digital voucher mechanism to automate payments from schools to catering service providers (canteens) in accordance with the state policy of providing free meals for students
2	CBDC card	Implementation of a digital bank card linked to a DT account to enable payment in the DT (purchases and transfers)

A set of sub-scenarios was generated for each scenario. The table below presents the complete list of sub-scenarios for the industrial loop.

Table 4 – List of sub-scenarios of industrial circuit scenarios

	Sub-scenario	Description
1	Opening an account for a legal entity on the DT platform	Initial creation of digital accounts for legal enitity's on banks' node
2	Opening an account for an individual on the DT platform	Initial creation of digital accounts for individuals on banks' node
3	Conversion of non-cash tenge into DT at the "bank - NBK" level	Conversion of non-cash tenge into DT upon the bank's request sent to the NBK
4	Conversion of non-cash tenge into DT at the "legal entity - bank" level	Conversion of non-cash tenge into DT upon the legal entity's request sent to the bank
5	Conversion of non-cash tenge into DT at the "individual - bank" level	Conversion of non-cash tenge into DT upon the individual's request sent to the bank
6	Legal entity-to-legal entity payment upon request from technology integrator	Transfer of DT from the digital account of one legal entity to the digital account of another legal entity due to the request of the technology integrator (payment initiation occurs when any individual's card is applied to the technology integrator`s validator)

Table 4 – List of sub-scenarios of industrial circuit scenarios (continued)

	Scenario	Description
7	Payment from legal entity to list of individuals	Transfer of DT from a digital account of a legal entity to a digital card of an individual via customizable register
8	Individual-to-individual transfer	Transfer of DT from an individual to another one by phone number, the sender's device is connected to the Internet
9	Purchase by card in DT	Purchase in DT conducted by applying a CBDC card to the merchant's POS-terminal capable of accepting payment in DT
10	Purchase by card (conversion)	Purchase conducted by applying a CBDC card to the merchant's ordinary POS-terminal: conversion of DT into non-cash tenge upon request from the bank's customer occurs at the time of purchase and the payment is subsequently done by using non-cash tenge
11	Conversion of DT into non-cash tenge at the "legal entity - bank" level	Conversion of DT into non-cash tenge upon the legal entity's request sent to the bank
12	Conversion of DT into non-cash tenge at the "individual - bank" level	Conversion of DT into non-cash tenge upon the individual's request sent to the bank
13	Conversion of non-cash tenge into DT at the "bank - NBK" level	Conversion of DT into non-cash tenge upon the bank's request sent to the NBK
14	Monitoring (web-interface)	Analytics on DT issuance and redemption
15	Blocking the bank (web-interface)	Blocking the bank's operations on the DT platform
16	Operating day management (web-interface)	Change in the number of working days/weekend days

The table below shows the DT platform's participants and users with their roles and functionalities required to enable the realization of scenarios and operations with DT. They interact with each other according to a two-tier model:

Table 5 – Participants and users of the industrial loop and their functionality

Participant/User	General functions	Features of the industrial loop's scenarios
Participants		
NBK	Tier 1 infrastructural participant. It guarantees a single use of tokens and their legitimacy as a means of payment.	The NBK is the operator of the DT platform. It issues DTs, redeems CTs and monitors the operation of the CT platform
Commercial bank	Tier 2 infrastructural participant. It guarantees a transaction validity.	Banks open digital accounts for users to make payments in DT, hold tokens and conduct transactions upon request from users, convert non-cash tenge into DT and vice versa

Table 5 – Participants and users of the industrial loop and their functionality (continued)

Participant/User	General functions	Особенности сценариев ОПЭ
Пользователи платформы ЦТ		
Legal entities	They have access to the DT platform through their bank's apps	Legal entities are customers of the banks. They can open digital accounts on the bank's node and initiate transactions in DT. Only one DT account can be opened in one bank in limited production phase
Individuals	They have access to the DT platform through their bank's apps	Individuals are customers of the banks. They can open digital accounts on the bank's node and initiate transactions in DT. Only one DT account can be opened in one bank in limited production phase

List of scenarios and key actors in the scenarios within the experimental circuit

In addition to the launch of the DT platform in limited production mode with key life cycle scenarios, several R&D scenarios **focused on researching the innovative DT functionality** were realized. To select the final scenarios of the R&D loop, numerous round tables (including with international organizations - Visa, MasterCard, R3, BIS, etc.), design sessions, profile meetings, and discussion sessions with the expert community and opinion leaders were conducted within the framework of Digital Tenge Hub. Following the Digital Tenge Ideathon 2022, a number of winning projects were selected for further implementation. The selection criteria included benefits for consumers, business and government, innovativeness of the scenarios, the applicability of smart contracts and programmability of DT. The scenarios proposed by the winners were implemented in 2023 in the pilot circuit.

In addition to the scenarios mentioned above, the scenarios of **cross-border payments** and **issuance of stablecoins backed by DTs** were analyzed and tested within the experimental loop.

Table 6 – Experimental loop scenarios

	Scenario	Description
1	Cross-border payments via SWIFT CBDC Connector	Cross-border payments based on the CBDC Connector tool developed by SWIFT with the participation of the Hong Kong Monetary Authority.
2	Issuance of stablecoins backed by DT on the Binance platform	Issuance of a new type of DT-backed stablecoins on the Binance platform
3	Issuance of stablecoins backed by DT on the KASE platform	Issuance of a new type of DT-backed stablecoins on the KASE platform for tokenized assets payments
4	Sale of tokenised assets	Implementation of a tokenization platform with exchange functionality to sell tokenized assets and integration with the DT platform for real-time payment and settlement finalization
5	Pedometer	Implementation of a pedometer application to test the use of DT in health promotion programs
6	Value-added tax (hereinafter - VAT) Deduction	Implementation of a smart contract for automatic deduction of VAT from the transaction of purchasing goods at the merchant

The R&D scenarios utilize the same architectural approach as the industrial loop's ones: a two-tier model with clients (individuals and legal entities) accessing the DT platform by opening accounts on the banks' nodes. For the purposes of testing the scenarios of the pilot loop, the functionality of the banks was emulated.

Information security challenges

Taking into account the planned scenarios, expected transaction volume and infrastructure requirements, the following information security tasks were selected as key ones:

- Ensuring secure transaction execution
- Ensuring the identification of vulnerabilities in applications and container images;
- Ensuring secure development of the DT platform's code in accordance with best practices;
- Minimizing the possibility of unauthorized exploitation of the system through unintended source code execution branches;
- Preventing unauthorized modification and/or destruction of information processed on the DT platform;
- Embedding security tools into the CI/CD process;
- Ensuring cryptographic protection of information.

The result of conducted analysis is a comprehensive threat model with risk classification and mitigation measures.

ANALYZING KEY SECURITY THREATS TO THE DIGITAL TENGE PLATFORM

14 THREAT CATEGORY

154 CONTROLS TO MINIMIZE THREATS

14 TYPES OF PERPETRATORS

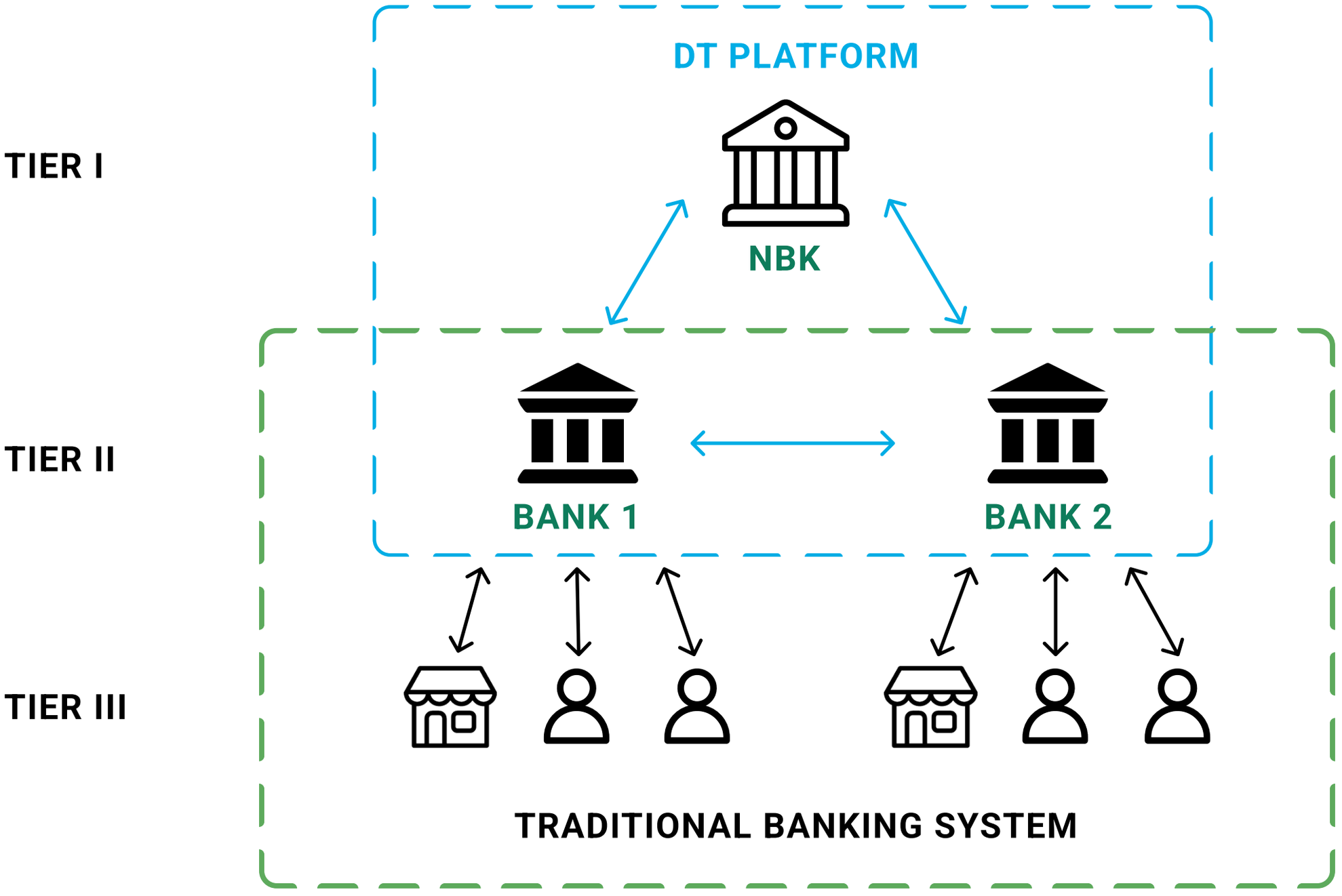
5 SECURITY DOMAINS

Design of the Platform

The architecture of the platform in limited production mode

The DT platform is implemented in accordance with a two-tier model (Figure 1): the CB (first tier) develops the design and basic functionality of the CBDC platform and banks (second tier) connect to the CBDC platform and provide services to individuals and legal entities.

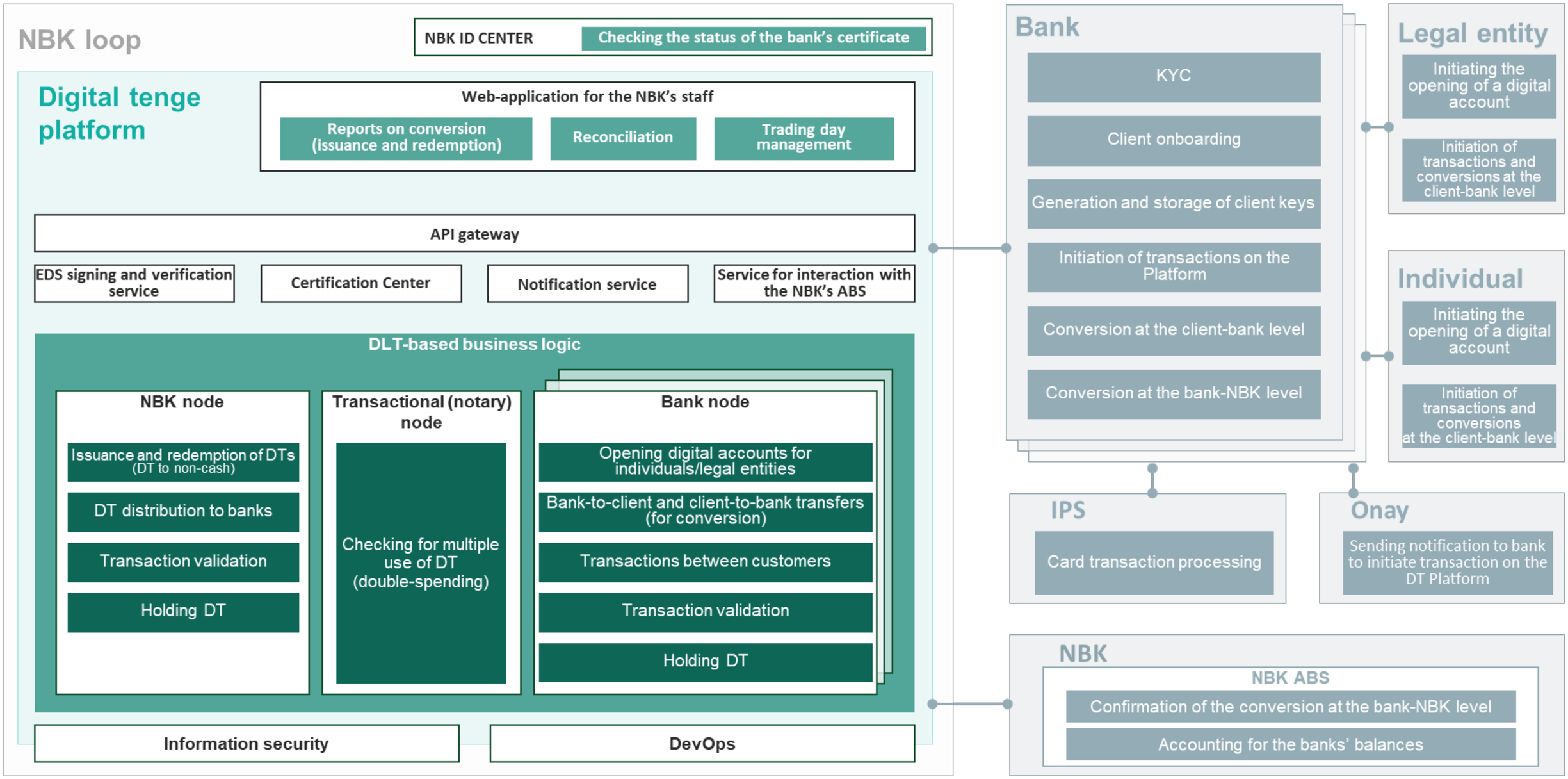
Figure 1 - Two-tier model of the DT platform



This architecture ensures efficient interaction between the participants of the DT platform (the NBK and banks) and the users (legal entities and individuals). The banks connect to the DT platform with the use of APIs and provide customers with a user interface in mobile applications through which customers can open digital accounts on the DT platform, convert DTs into cash/non-cash tenge (and vice versa) and conduct transactions with DTs. The NBK can also interact with the DT platform for operational control and reporting.

To enable the implementation of all DT scenarios, the DT platform has a set of functions of participants at different levels to ensure their efficient interaction (Figure 2).

Figure 2 – Top-level architecture of the DT platform



Key actors and services with which the DT platform interacts:

NBK: the NBK approves requests for issuance/redemption of DTs and receives reportы from the banks within the existing area of responsibility;

Banks: they identify (KYC) and onboard clients, generate and store client keys, sign their requests to the DT platform with electronic digital signature (hereinafter - EDS), verify the EDS of the DT platform, sign requests for client transactions with client signature, initiate transactions on the DT platform, initiate conversion at the “bank-NBK” level and perform conversion at the “client-bank” level. Banks provide access to the DT platform for individuals and legal entities. Their mobile applications provide capability to open digital accounts and initiate transactions on the DT platform. CBDC cards linked to the customer's digital account are also issued for individuals by banks, and such approach makes the DT platform interoperable due to the interaction between banks and international payment systems (hereinafter - IPS). The DT platform provides a seamless experience for the banks’ customers by conducting transactions in non-cash tenge after converting DT into non-cash tenge at the moment of purchase;

Technological Integrator (Onay): the banks interact with the technological integrator Onay, which is the event provider in the digital vouchers scenario. Onay sends notifications to the banks to initiate transactions on the DT platform;

NBK’s automated banking system (hereinafter – ABS): the DT platform interacts with the NBK’s ABS which transfers funds between the bank’s correspondent accounts at the NBK and the DT liability account thus confirming the conversion at the “bank-NBK” level;

Certification Center: in the National payment corporation’s loop, there is a certification center providing the certificate status when requesting its verification. It is accessed by the EDS signing and verification service to verify the bank’s certificate.

Key components of the DT platform:

Validation nodes: validation nodes are the nodes operated by the banks and NBK. They perform transaction validity checks (signature verification, equality of the sum of transaction inputs and outputs, etc.) and storage of transaction history. Digital accounts of individuals and legal entities are opened at the banks’ nodes. These nodes carry out transfers between customers and banks. The NBK’s node issues DTs, distributes DTs to the banks and redeem DTs. The NBK’s and banks’s nodes have the capability to hold DTs via encumbrance mechanism;

Non-validating nodes: non-validating nodes (emission nodes) include transactional (notary) node (cluster of transactional (notary) nodes). Transactional (notary) node does not validate the transaction itself and does not have full access to the transaction data. Its main task is to verify that the token has been used once in the DLT-network on the basis of the Unspent Transaction Output (hereinafter - UTXO) model;

EDS signing and verification service: the service provides security by signing messages from the DT platform and by verifying the signature when receiving messages from the bank. This ensures the legal validity of the exchange of financial information between the DT platform, participants and the NBK;

ID Center: this service is required to conduct transfers by using phone number/individuals’ identification number/ business identification number and to display names of individuals/legal entities in the transaction history. The service stores mapping of individuals’ public addresses with phone number, individual identification number, first name, patronymic and surname. The same approach is used for legal entities - the service stores mapping of egal entities’ public addresses with legal entities’ business identification number and name. This information is only available to the servicing bank;

Notification service: it is created to send notifications about the transaction status to external participants of the DT platform;

Service for interaction with the NBK’s ABS: the service exchanges the information with the NBK’s ABS in the scenarios of non-cash-tenge-to-DT and DT-to-non-cash-tenge conversions at the “bank-NBK” level after receiving corresponding request from the bank. After receiving confirmation from the NBK’s ABS, the service initiates issuance/ redemption transactions on the DT platform;

API gateway: it is designed to interact with participants and organize exchanges within the DT platform.

Target architecture

At the very beginning of the Digital Tenge project, a fundamental decision **to utilize the DLT-based architecture** was made. It was lately followed by subsequent step-by-step research on innovative technologies provided by such architecture and numerous testings. Both functional and non-functional capabilities of the DT platform were tested from 2021 to 2023 which resulted in accumulating information about the strengths of the DT platform and opportunities for its development.

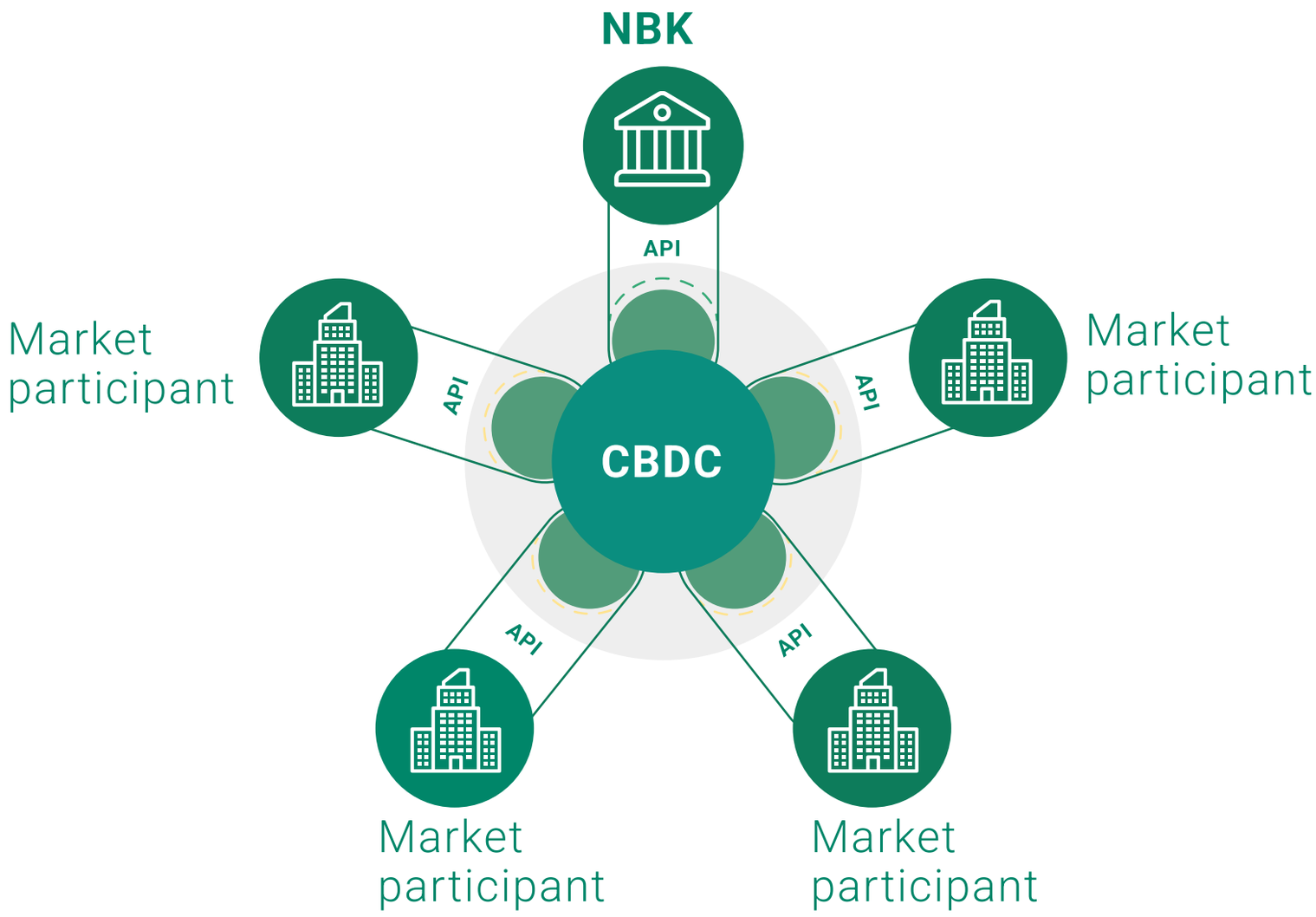
Based on the experience gained and within the framework of the 2023 work, the options for the DT platform development were thoroughly analyzed for further implementation in the period from 2024 to 2025. After carefull consideration, it was decided to select the distributed model option with the following properties and functionality:

- Market participants' nodes **are directly managed by market participants themselves**. They can implement their own business logic and scenarios including possible migration to their own infrastructure;
- A market participant **manages its node independently**;
- It will be necessary **to elaborate on the NBK's control and supervision requirements in order to find an optimal balance between the stability of payments and the possibility for market participants to create their own services based on DTs**;
- The NBK should have sufficient regulatory mechanisms in place to deal with possible problems of market participants in the release process.

Implementing such an architectural model will achieve the following benefits:

- High degree of innovativeness;
- Providing the market participants with tools to implemen ttheir own business logic;
- Wide scalability of the DT platform.

Figure 3 – Selected target architecture model



- The foundation of this architecture is a distributed registry network **in which participants have direct access to their nodes**
- Participants can develop and implement **their own business logic**
- Data is distributed among the nodes on a **need-to-know**[1] basis
- It will be necessary to elaborate on the NBK's control and supervision requirements in order to find **an optimal balance between the stability of payments and the possibility for market participants to create their own services based on DTs**
- **Requirement**: market participants should learn the principles of the DT platform in order to work with it
- **Requirement:** The NBK should have sufficient regulatory mechanisms in place to deal with possible problems of market participants in the release process

Innovations

Speed of updates implementation and deployment

Advantages provided by DLT

Scalability

Duration of transaction processing

Control and supervision of the NBK

Stability of payments

Commercial banks' capabilities

[1]Data duplication on all nodes is not required for CBDC systems

- depends on the design

It is also planned to explore the following architectural trade-offs:

- Algorithm for managing smart contracts;
- Possibility to improve the platform and create additional modules for integration with other payment systems (e.g., instant payment system);
- Mechanism for market participants' operations analysis for the NBK.

The study on these and other issues of the DT platform's target architecture will be conducted in collaboration with the expert community and market participants. The implementation of the above-described variant of the distributed model will be carried out in stages and with a limited number of initial market participants. Moreover, both the NBK and market participants will need to collaborate in order to solve the issue of transferring market participants' nodes to their infrastructure.

Results of the Project

Results of the industrial loop's scenarios

Digital Vouchers scenario

Description:

This scenario was focused on creating the mechanism of automated payment for social lunches in school canteens in Almaty with the use of Onay card.

In the framework of the scenario, instant payment for meal services is carried out using the infrastructure of special card validators and cards of the involved technological integrator Onay. To confirm receipt of services, users (school students) apply the cards provided by integrator to the pre-installed validators.

Brief sequence of events with all participants of the scenario is presented below:

a school student applies Onay card to the validator to pay for lunch in the canteen. After that, Onay transmits the signal to the bank (in this scenario its functions are performed by Kazpost JSC) that initiates a transaction on the DT platform to transfer DT from the school's digital account to that of canteen to compensate for the cost of providing lunch.

Table 7 – Participants of the Digital Vouchers scenario

	Participant	Functionality
1	NBK	Implementation of a "digital voucher" mechanism to automate payments between schools and canteens in the framework of the state policy of providing free meals for schoolchildren
2	National payment corporation	Provision of infrastructure for the DT platform
3	Onay	- Provision of cards to schoolchildren, installation of terminals - Realization of schoolchildren accounting system - Integration with the bank's systems, transfer of information on transactions to the bank
4	Bank (Kazpost)	- Integration with Onay and DT platform - Conversion to/from DT - Opening digital accounts for clients and related maintenance
5	Legal entity (school)	- Generation of lists of school children for "voucher" payment - Conversion to/from DT - Transfer of funds to the merchant's account (based on data from Onay)
6	Merchant (canteen)	Receipt of funds from the school, use of DT (e.g. conversion of DT into non-cash tenge)
7	School students	Use of Onay cards for payment in the canteen (via Onay validator)

Table 8 - Sub-scenarios realized by Kazpost in the industrial loop's Digital Vouchers scenario (as part of integration with the DT platform)

	Sub-scenario	Implemented by Kazpost
1	Opening an account for a legal entity on the DT platform	✓
2	Opening an account for an individual on the DT platform	
3	Conversion of non-cash tenge into DT at the "bank - NBK" level	✓
4	Conversion of non-cash tenge into DT at the "legal entity - bank" level	✓
5	Conversion of non-cash tenge into DT at the "individual - bank" level	
6	Legal entity-to-legal entity payment upon request from technology integrator	✓
7	Payment from legal entity to list of individuals	
8	Individual-to-individual transfer	
9	Purchase by card in DT	
10	Purchase by card (conversion)	
11	Conversion of DT into non-cash tenge at the "legal entity - bank" level	✓
12	Conversion of non-cash tenge into DT at the "bank - NBK" level	
13	Conversion of non-cash tenge into DT at the "bank - NBK" level	✓

Demonstration:

The photos below depict the process of students paying for their lunches by swiping the Onay card at the validator.

Figure 4 - Students applying their Onay cards to the validator in the school canteen

Value:

The Digital Vouchers scenario is designed to test an automated payment system that reduces the number of intermediaries, speeds up payments between participants and reduces the likelihood of errors.

Value of using DT:

The scenario tested the DT platform as a tool for implementing a voucher scheme. The use of DT demonstrated the feasibility of automated instant settlements between legal entities and merchants, as well as the transparency of payments for all payment participants.

Scalability:

This scenario can be scaled to other cases of payments using voucher schemes. Scaling of the scenario will lead to full integration of the DT platform into the existing payment landscape of the Republic of Kazakhstan, reduce losses in public spendings and increase the convenience of payments and transparency of targeted spending.

CBDC Card scenario

Description:

This scenario was focused on the mplementation of a digital bank card linked to a digital account to enable transactions in DT (purchases and transfers). The scenario involves individuals from focus group and several banks: focus group participants receive DTs to a digital account opened with the participating bank. The scenario implements the mechanism of "register distribution" for transferring funds from the digital account of a legal entity to several individuals' digital accounts.

The scenario includes processing of a digital card linked to a digital account in DT. Individuals can make purchases at merchants, transfer their DTs to digital accounts of other individuals, utilize online marketplaces, and withdraw funds from ATMs by using sevices provided by IPS (Visa/Mastercard) networks.

A purchase at merchant can be made either with payment in DT (a mechanism for accepting DT through a specialized POS-terminal is implemented) or by instant conversion of DT into non-cash tenge. In case of instant conversion, the number of participating merchants is not determined in advance due to completed integration of existing payment mechanisms (QR and POS-terminals) and the banks' infrastructure with the DT platform.

CBDC card can be used to make any purchases of goods and services both inside and outside the Republic of Kazakhstan (similar to a bank card). The balance of the digital account with the DT can be displayed in the mobile application of the bank. The functionality of digital accounts within the scenario is similar to that of bank current/card accounts.

Table 9 – Participants of the CBDC Card scenario

	Participant	Функционал
1	NBK	Issuance and redemption of DTs at the “bank-NBK” level
2	National payment corporation	Provision of infrastructure for the DT platform Conversion to/from DT
3	Distributing DT legal entity	Registry distribution of DT to focus group participants
4	Banks (Altyn Bank, Eurasian Bank, Halyk Bank, Bank CenterCredit)	Conversion to/from CT Opening digital accounts for clients (legal entities and individuals) and related maintenance
5	Merchants (legal entites)	Acceptance of payments in DT (in case of having customized POS-terminal accepting DT) Acceptance of payments by digital card (by converting DT into non-cash tenge) In case of having digital account - conversion to/from DT
6	Individuals	Conversion to/from DT (including for purchases at regular POS terminals) Transfers to other individuals by phone number Purchases at merchants by using digital virtual/physical card

Table 10 - Sub-scenarios realized by the banks in the industrial loop’s CBDC Card scenario (as part of integration with the DT platform)

	Sub-scenario	Altyn Bank	Eurasian Bank	Halyk Bank	Bank CenterCredit
1	Opening an account for a legal entity on the DT platform	✓	✓	✓	✓
2	Opening an account for an individual on the DT platform	✓	✓	✓	✓
3	Conversion of non-cash tenge into DT at the “bank - NBK” level	✓		✓	✓
4	Conversion of non-cash tenge into DT at the “legal entity - bank” level	✓		✓	✓
5	Conversion of non-cash tenge into DT at the “individual - bank” level				
6	Legal entity-to-legal entity payment upon request from technology integrator				
7	Payment from legal entity to list of individuals	✓		✓	✓
8	Individual-to-individual transfer		✓ *(between the bank’s customers)*		

Table 10 - Sub-scenarios realized by the banks in the industrial loop's CBDC Card scenario (as part of integration with the DT platform) (continued)

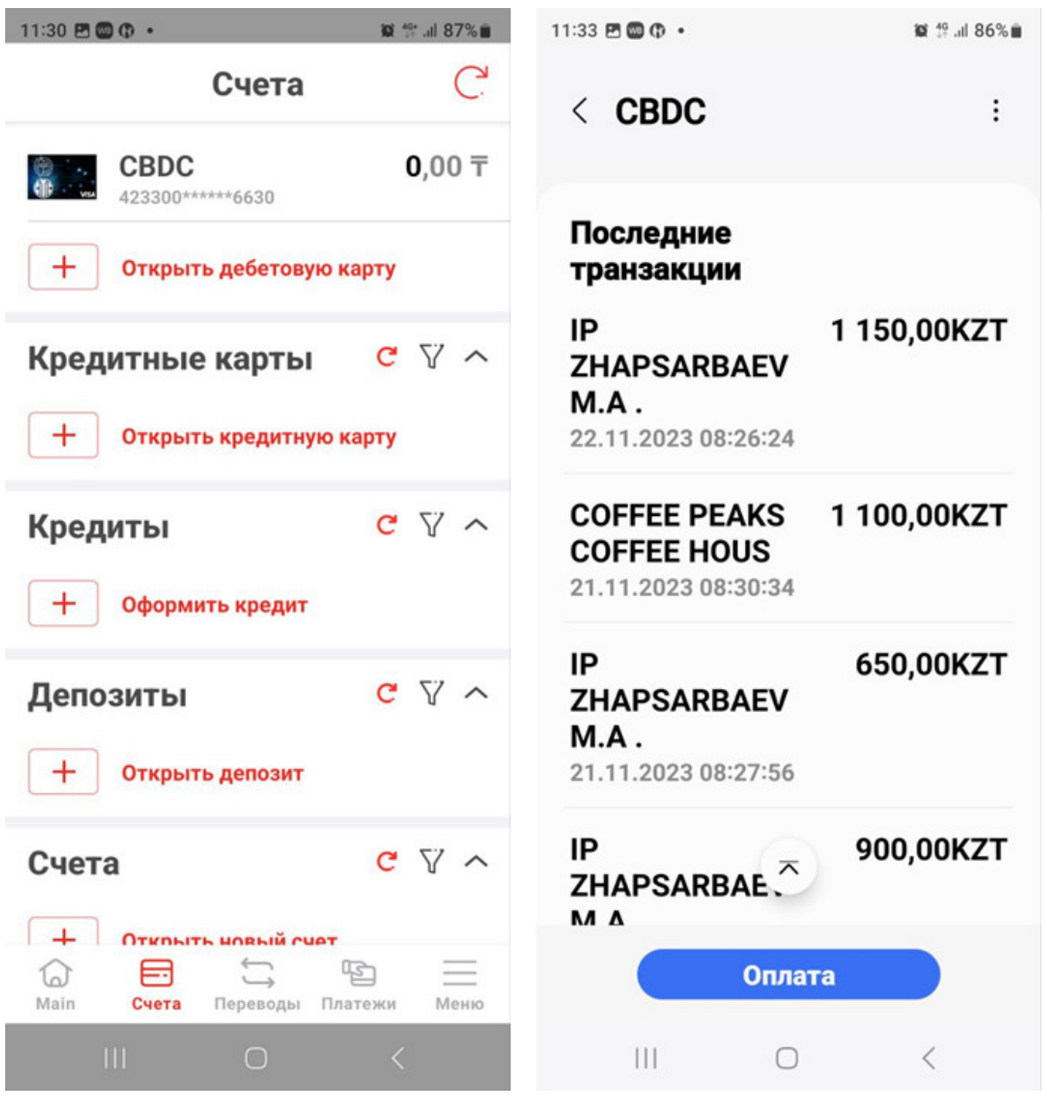
	Sub-scenario	Altyn Bank	Eurasian Bank	Halyk Bank	Bank CenterCredit
9	Purchase by card in DT		✓		
10	Purchase by card (conversion)	✓	✓	✓	✓
	Issuance of virtual cards	✓	✓	✓	✓
	Issuance of real cards		✓	✓	✓
	Purchase using the bank's POS-terminals	✓	✓	✓	✓
	Purchase using other bank's POS-terminals	✓	✓	✓	✓
	E-commerce	✓	✓		
	Mobile apps	✓ *(Android, iOS)*	✓ *(Android)*		✓ *(Android, iOS)*
11	Returns (manual mode)	✓	✓		✓
12	Conversion of DT into non-cash tenge at the "legal entity - bank" level	✓	✓	✓	✓
13	Conversion of DT into non-cash tenge at the "individual - bank" level	✓		✓	✓
	Withdrawal from the bank's ATMs	✓	✓	✓	✓
	Withdrawal from other bank's ATMs	✓			
14	Conversion of non-cash tenge into DT at the "bank - NBK" level	✓	✓	✓	✓

Demonstration:

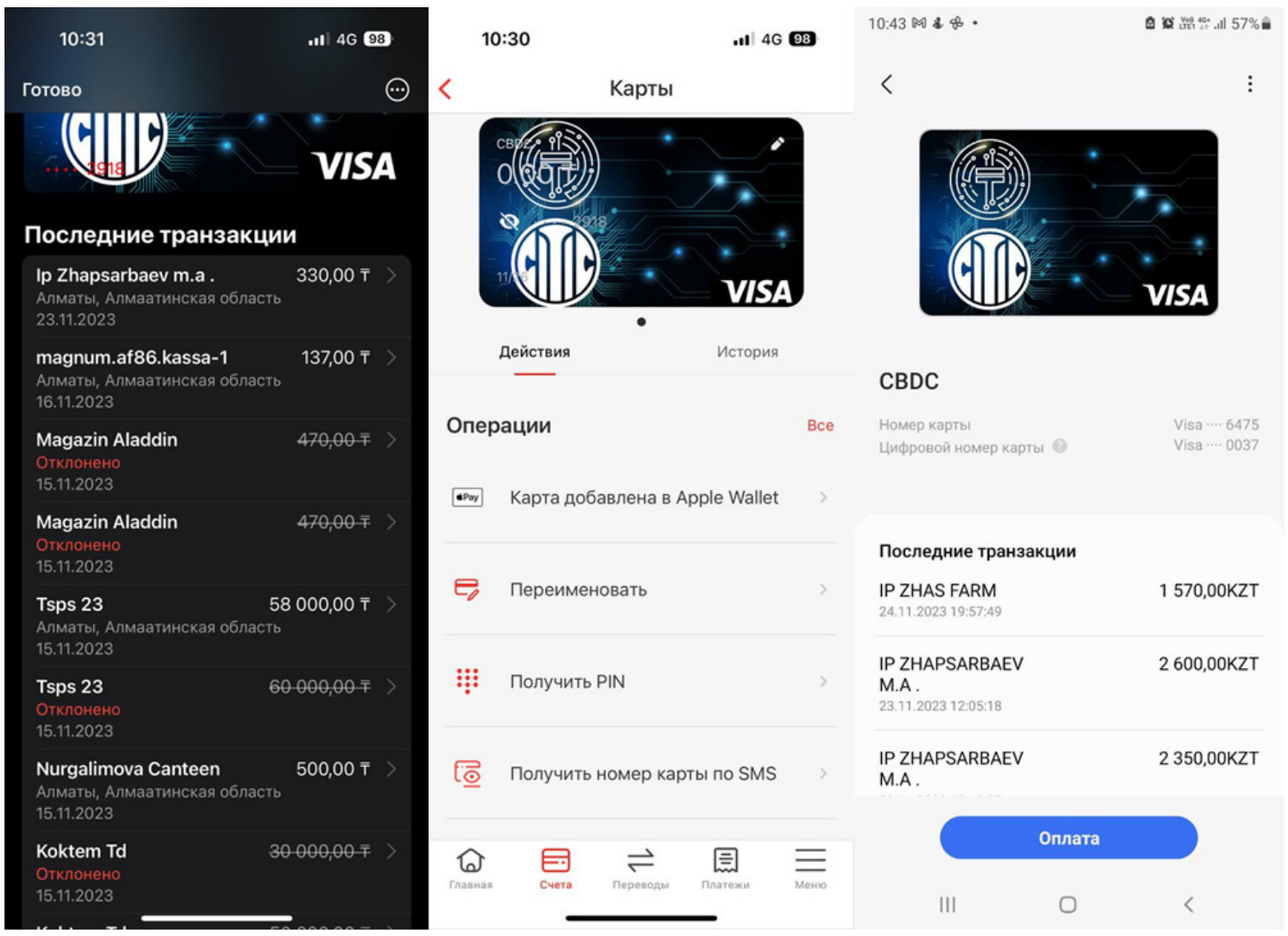
The screnshots and images of the banks' apps and cards are presented below

1. Altyn Bank

1.1. Altyn Bank - Mobile app:

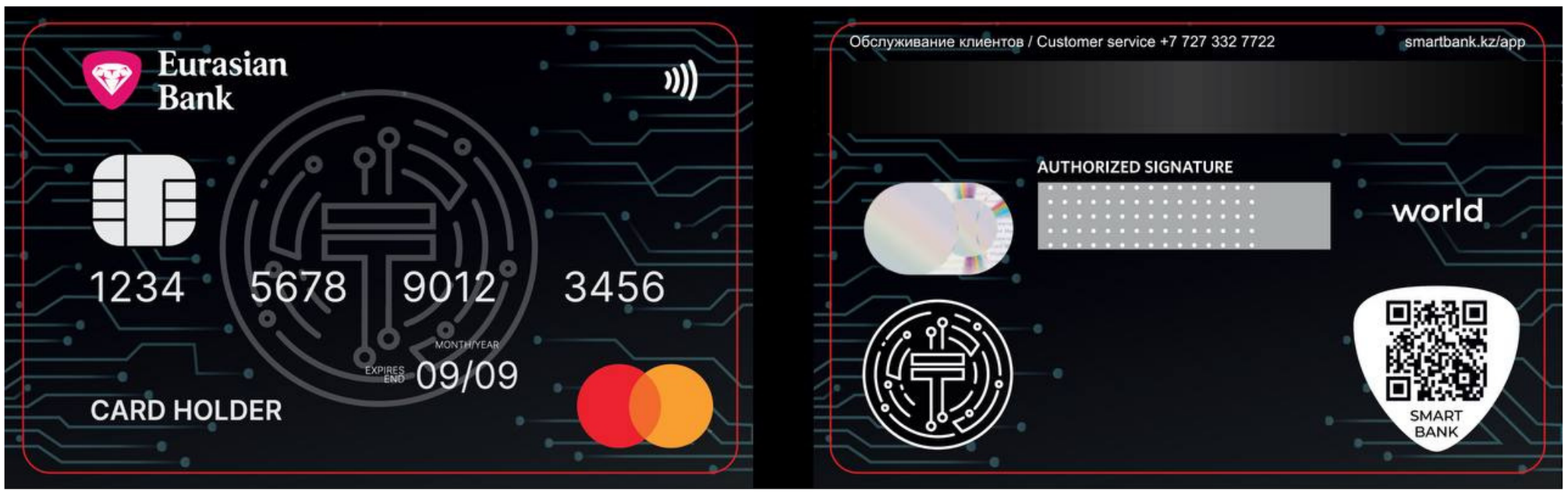


1.2. Altyn Bank - Google Pay/Apple Pay/Samsung Pay:

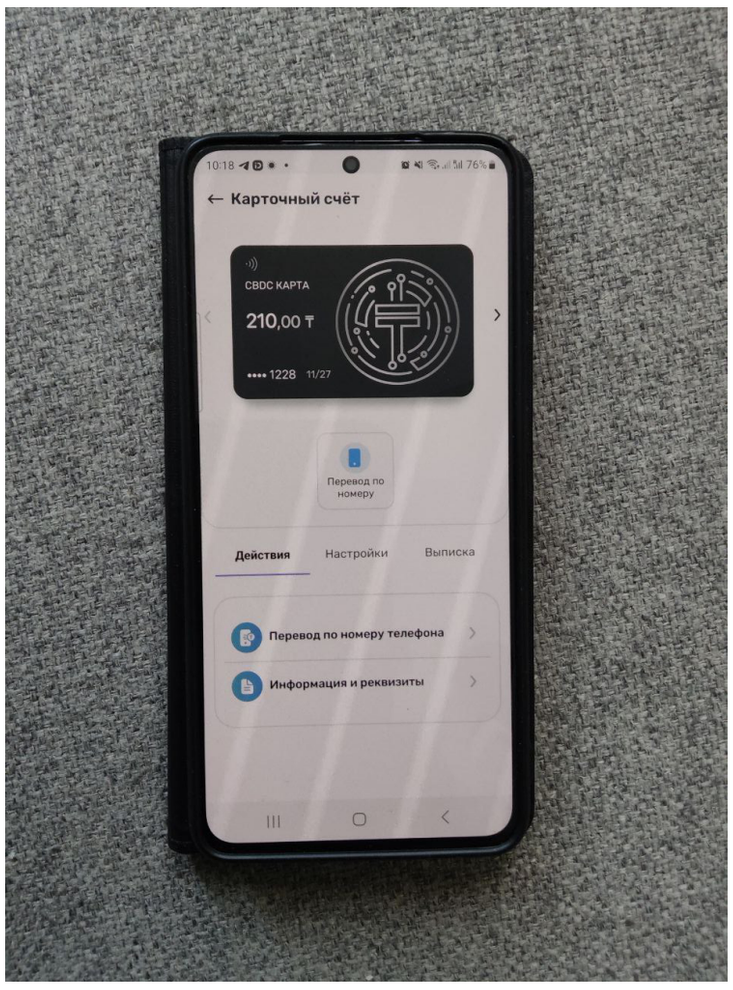


2. Eurasian Bank

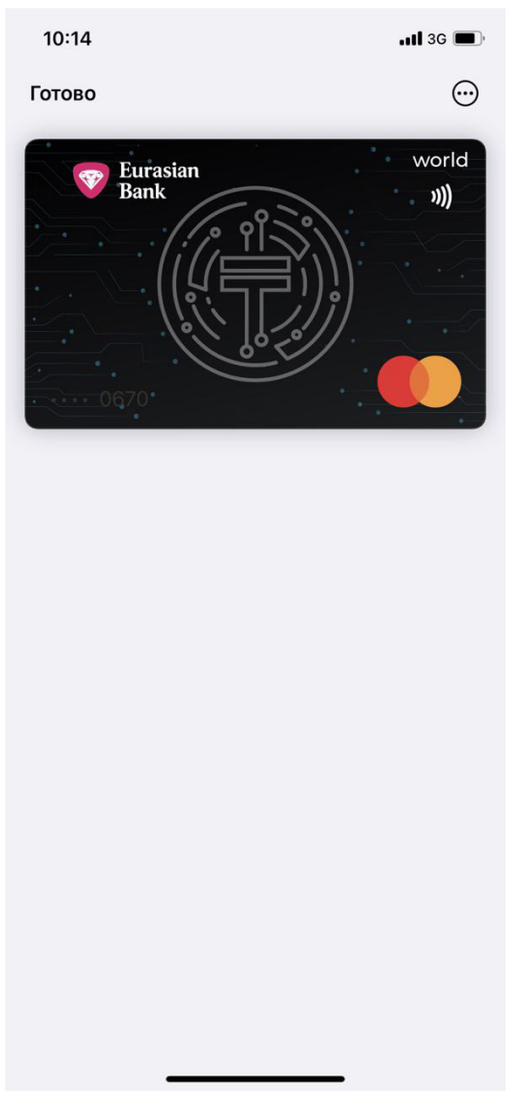
2.1. Eurasian Bank - Card:



2.2. Eurasian Bank - Mobile app:



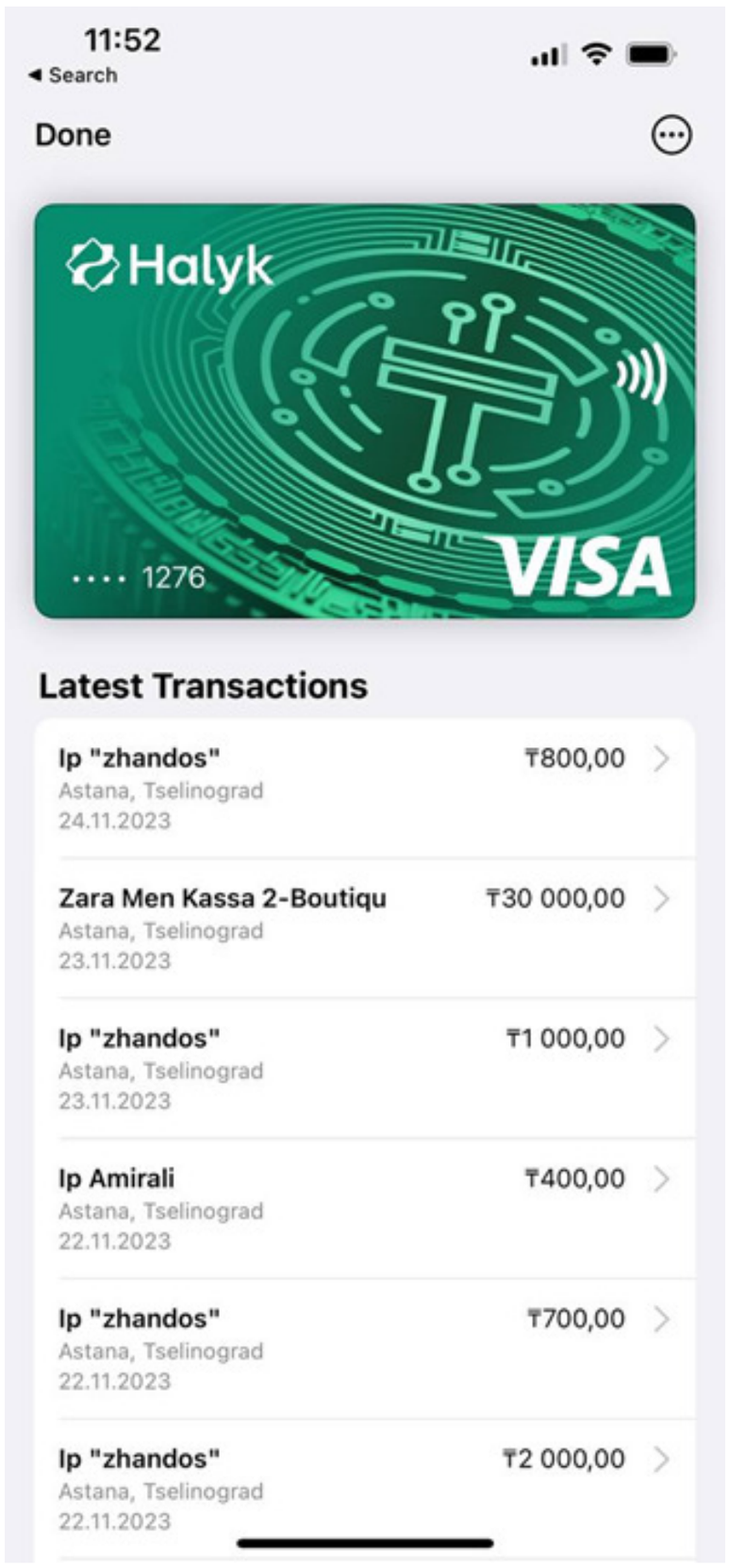
2.3. Eurasian Bank - Google Pay/Apple Pay/Samsung Pay:



3. Halyk Bank

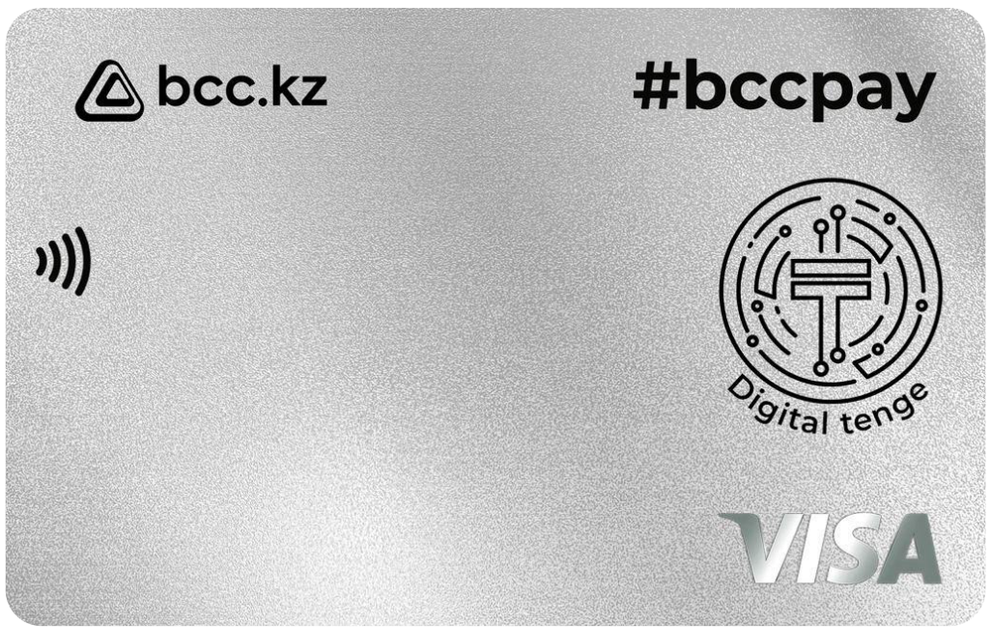
3.1. Halyk Bank - Card:

3.2. Halyk Bank - Google Pay/Apple Pay/Samsung Pay:

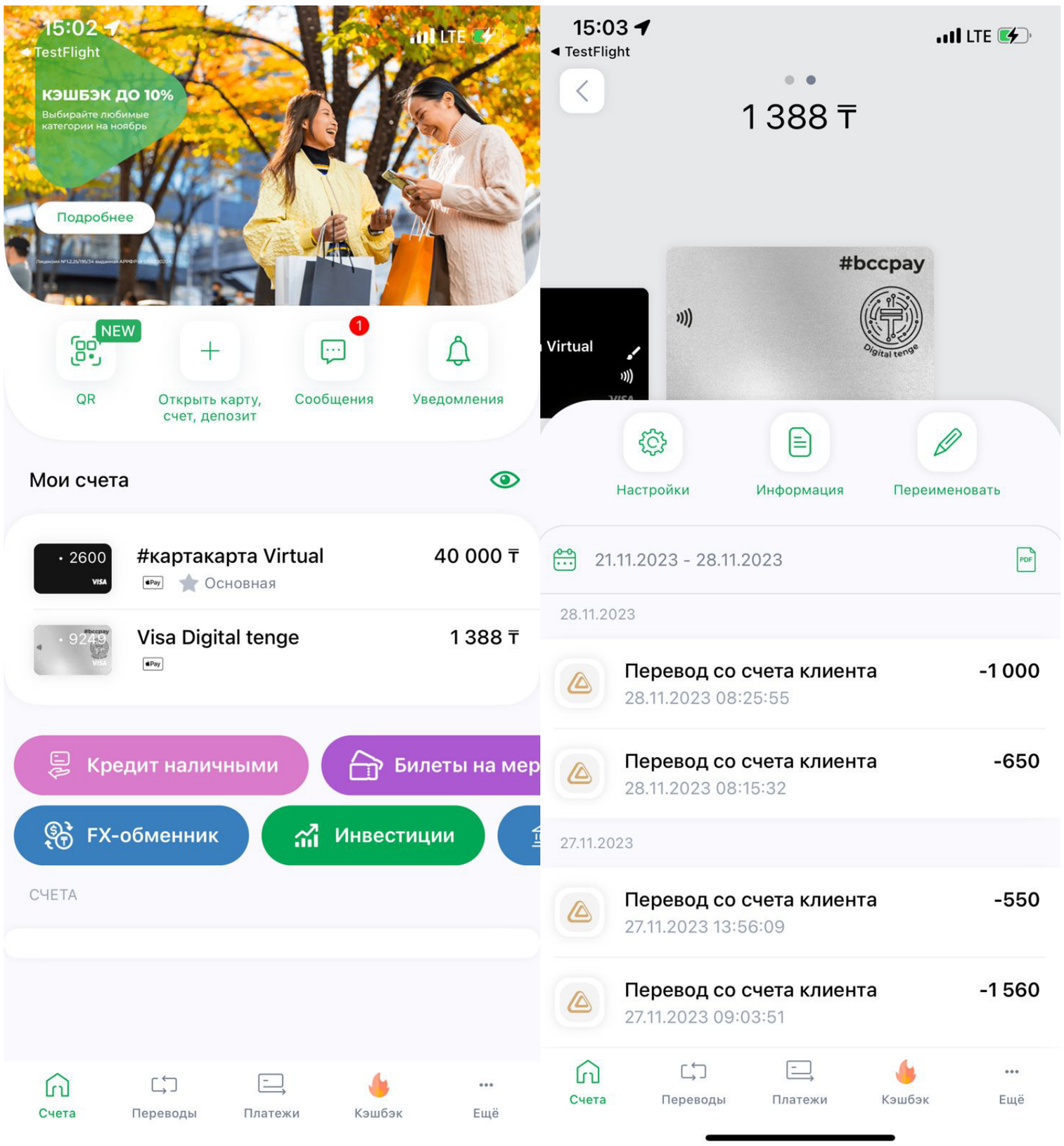


4. Bank CenterCredit

4.1. Bank CenterCredit - Card:



4.2.Bank CenterCredit - Mobile app:



4.3. Bank CenterCredit - Google Pay/Apple Pay/Samsung Pay:

Value:

In this scenario, **for the first time in the history of CBDC development**, payments in national digital currency by using virtual and physical bank cards both within one bank and between different banks with the participation of IPS (Visa/Mastercard) were tested by indiviuduals. The results of the scenario demonstrated the interoperability of different systems and services with the possibility of instant payments.

Value of using DT:

The DT platform was tested under conditions of integration with payment systems and the banks' services. As a resultm, the viability of DTs as a full-fledged means of payment was proved. A scenario of seamless payments (transition from one form of money to another: DT, non-cash and cash) also proved its feasibility.

Scalability:

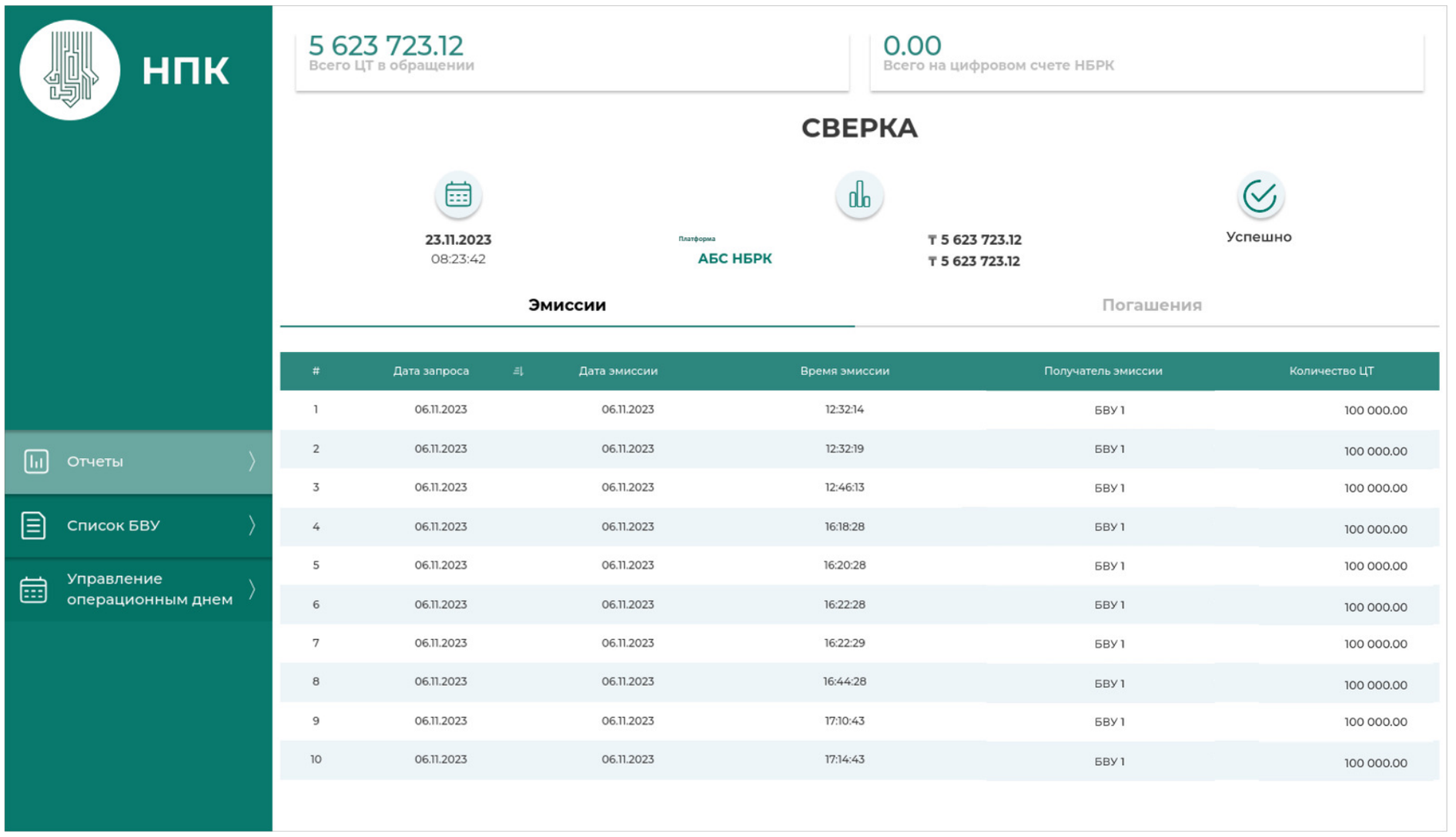
Further scaling up of this part will inevitably lead to the DT platform becoming an integral part of the payment system of Kazakhstan. Moreover, it will also provide additional opportunities for users: smart contracts, payment programmability, customizable anonymity, offline transactions and others.

Scenario for monitoring the DT platform

In addition, several additional scenarios were developed to monitor the banks' actions on the platform, to collect analytics on the issuance and redemption of DTs at the banks' level and to set up and modify operating days.

For these scenarios, a web interface for National payment corporation's employees was developed. Examples of the web interface screens are presented below.

Figure 5 – List of DT issuance and redemptions requests sent by different banks



#	Дата запроса	Дата эмиссии	Время эмиссии	Получатель эмиссии	Количество ЦТ
1	06.11.2023	06.11.2023	12:32:14	БВУ 1	100 000.00
2	06.11.2023	06.11.2023	12:32:19	БВУ 1	100 000.00
3	06.11.2023	06.11.2023	12:46:13	БВУ 1	100 000.00
4	06.11.2023	06.11.2023	16:18:28	БВУ 1	100 000.00
5	06.11.2023	06.11.2023	16:20:28	БВУ 1	100 000.00
6	06.11.2023	06.11.2023	16:22:28	БВУ 1	100 000.00
7	06.11.2023	06.11.2023	16:22:29	БВУ 1	100 000.00
8	06.11.2023	06.11.2023	16:44:28	БВУ 1	100 000.00
9	06.11.2023	06.11.2023	17:10:43	БВУ 1	100 000.00
10	06.11.2023	06.11.2023	17:14:43	БВУ 1	100 000.00

Figure 6 – Operating day management

Results of the industrial loop’s scenarios - analytical data and results of the user survey

More than 8.5 thousand transactions were conducted on the DT platform during the month. Analytical data on transactions within the Digital Vouchers and CBDC Card scenarios and summarized information on the opinions of focus group participants are presented below.

ANALYTICAL DATA

DIGITAL VOUCHER SCENARIOS

ҚАЗПОЧТА

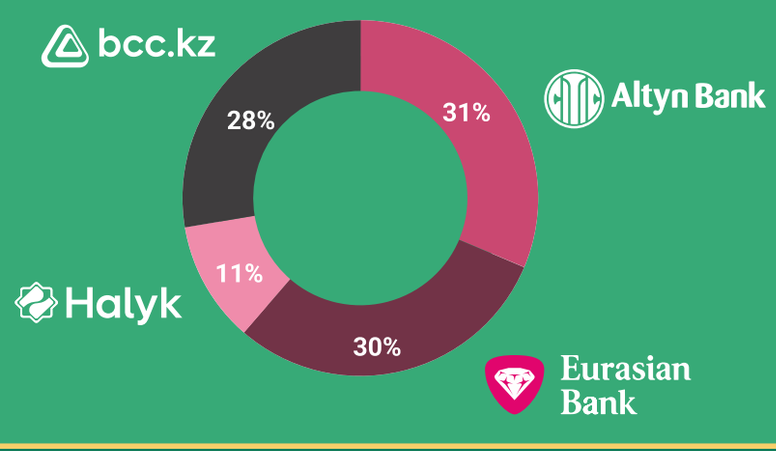
7 492
total number of transactions

499
average number of transactions per day

100% OF TRANSACTIONS DURING THE LIMITED PRODUCTION MODE WERE SUCCESSFULLY PROCESSED AND EXECUTED ON THE CT PLATFORM

CBDC CARD SCENARIO

PERCENTAGE OF CUSTOMERS PER BANKS



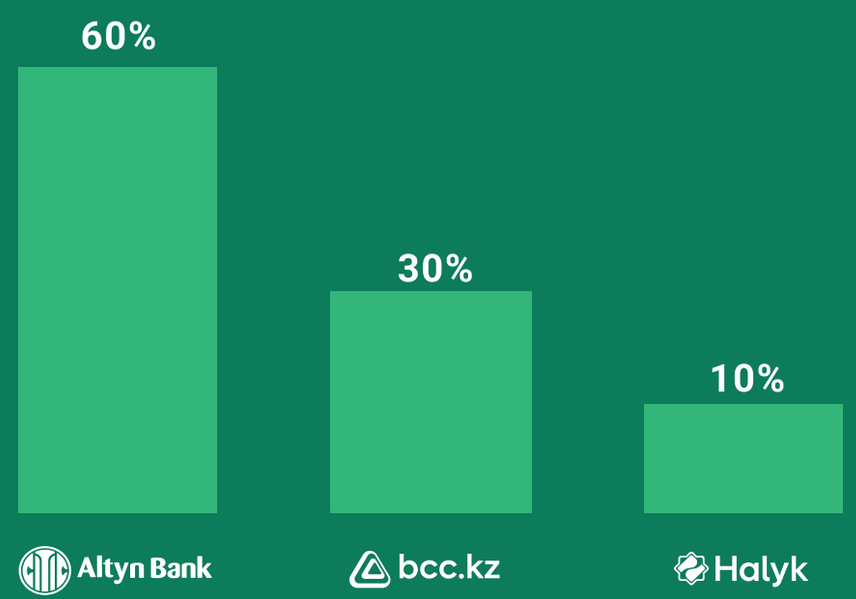
USERS' TRANSACTIONS VIA DIGITAL CARD

1 714
total number of transactions

3 779
average check in DT

68
average number of transactions per day

DISTRIBUTION OF ISSUED DTs PER BANK



NUMBER OF TRANSACTIONS IN DT PER BANK

SURVEY RESULTS

PERCENTAGE OF PARTICIPANTS WHO SUCCESSFULLY TESTED USE OF THE CBDC CARD

NUMBER OF USERS WHO SUCCESSFULLY TESTED FOLLOWING CBDC CARD FUNCTIONALITY

100%

PURCHASE VIA POS-TERMINAL

82%

WITHDRAWING MONEY FROM AN ATM

THE MAIN PROBLEM IS THE INABILITY TO WITHDRAW FROM OTHER BANKS ATMS. THE BANKS' BUSINESS PROCESSES NEED TO BE IMPROVED

87%

ONLINE PURCHASES

THE MAIN PROBLEMS ARE DIFFICULTIES WITH MAKING PAYMENTS IN OTHER CURRENCIES AND LACK OF TRANSACTION CONFIRMATION THE BANKS' BUSINESS PROCESSES NEED TO BE IMPROVED

98%

OF FOCUS GROUP PARTICIPANTS

ARE WILLING TO PARTICIPATE FURTHER IN DT TESTING

PARTICIPANTS ARE INTERESTED IN ADDITIONAL FUNCTIONALITY OF DT

- **83%** OFFLINE-PAYMENTS
- **67%** CROSS-BORDER PAYMENTS
- **53%** PROGRAMMABLE PAYMENTS
- **50%** SMART CONTRACTS
- **4%** OTHER

OTHER

- DT transfers between different banks
- Transferring DT to other accounts with non-cash tenge
- Managing multiple digital accounts from a single application
- Automatic deductions to state authorities
- Transaction traceability

Results of the experimental loop’s scenarios

The participants' goals during the implementation of the experimental loop’s scenarios were to develop functionality based on the existing tools of the DT platform and to integrate their systems with the DT platform. As a result, participants' own applications were developed and new possibilities of using DT were demonstrated.

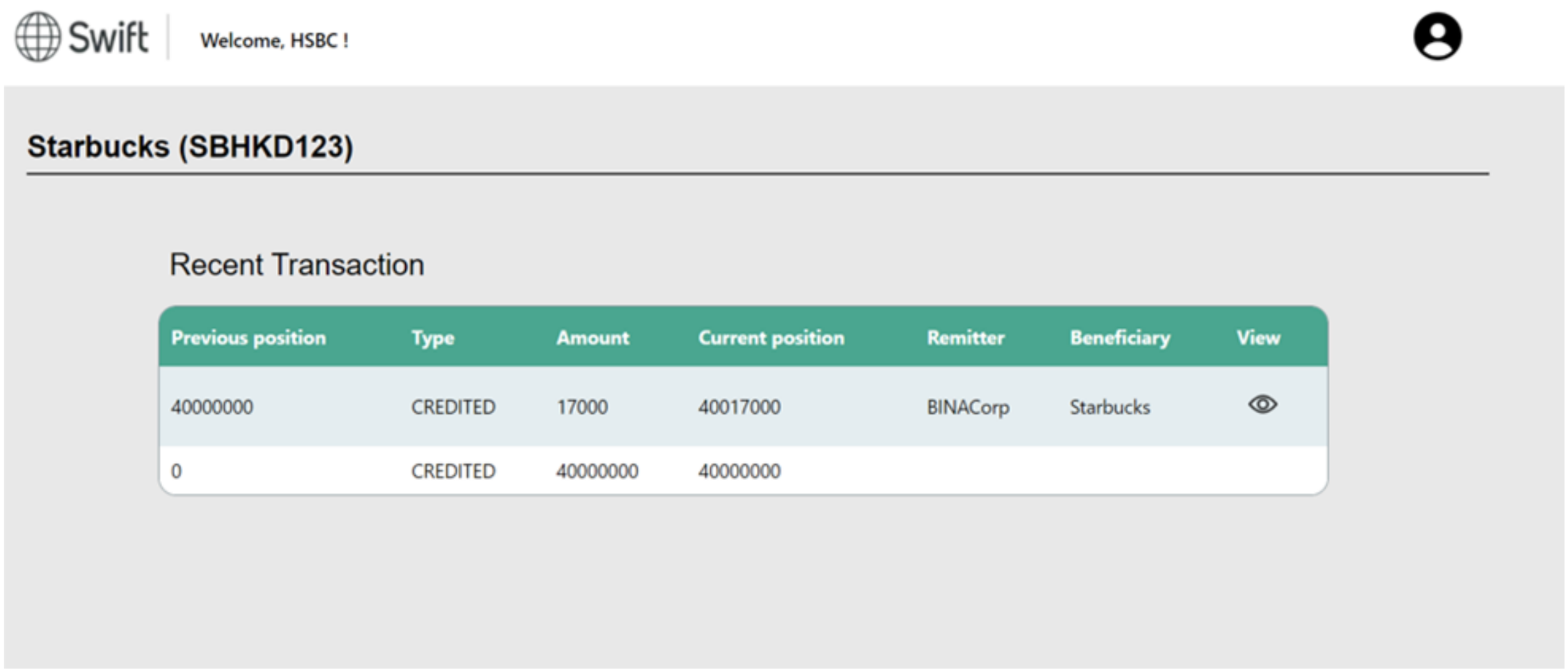
Cross-border Payments via SWIFT CBDC Connector scenario

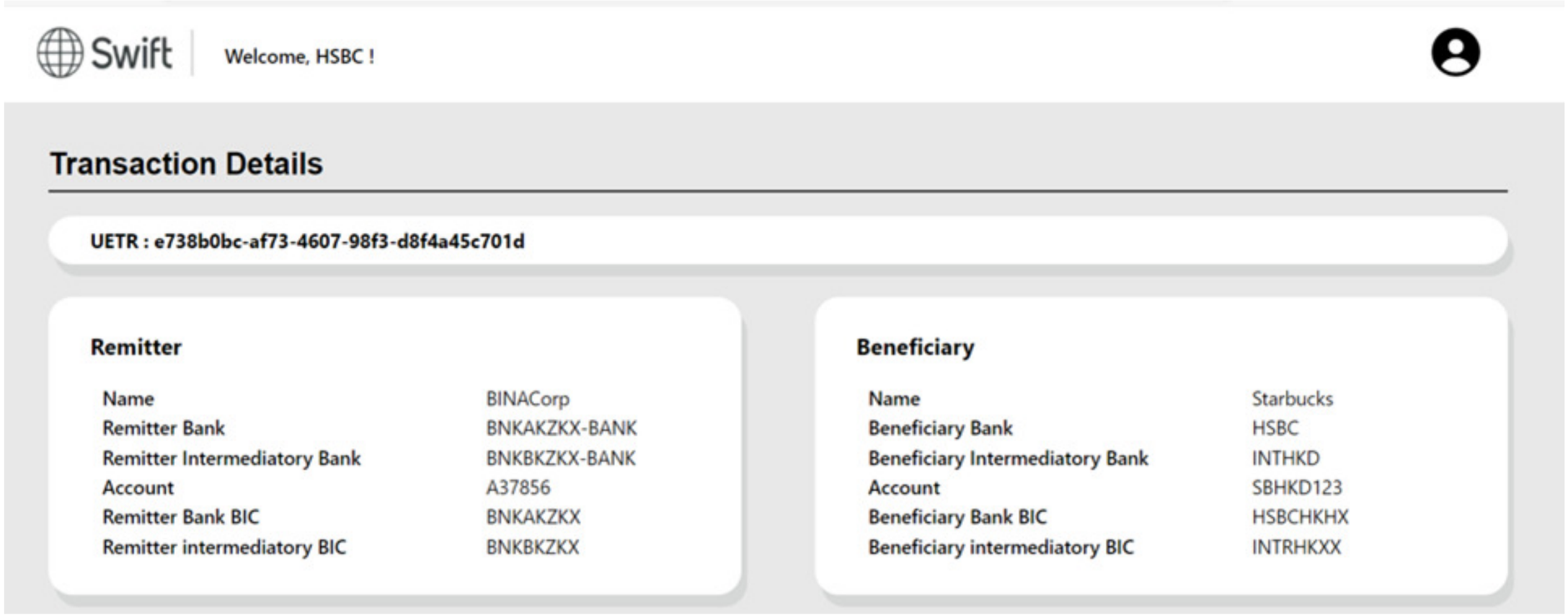
Description:

The feasibility of conducting cross-border transactions in the payment-versus-payment (hereinafter - PvP) mode was tested in this scenario. Cross-border transaction was initiated by bank clients through the intermediation of the commercial banks and several CBs. The exchange of messages about the transactions conducted was completed via the CBDC Connector from SWIFT. The international standard ISO 20022 was used for message transmission. Blocking/ unblocking of the transferred tokens was made in the each participant’s infrastructure, and the value was transferred off-chain.

Demonstration:

The screenshots below depict web-interfaces with information about the conducted payment (information about the transaction from the receiving bank: transaction amount and transaction participants; transaction details from the receiving bank: information about the sender from Kazakhstan and the payee from Hong Kong).





Value:

This scenario was implemented as the first stage in the development of cross-border payments using DTs. Cross-border payments using CBDC will provide users of different networks in different countries with capabilities to make transfers and payments as quickly and efficiently as possible.

Value of using DT:

During the implementation of the scenario, the DT platform was connected to the SWIFT CBDC Connector. Test transactions between the NBK and the Hong Kong Monetary Authority (sending a message from one network and receiving a message in the other network) were tested. The scenario proved the feasibility of using the DT platform for cross-border payments. The use of DT in such payments increases payment transparency and make payments as quick and reliable as possible thus promoting innovation in the financial sector.

Scalability:

The next stages of the project development include testing cross-border transmission of financial messages and tokens with other CBs via SWIFT and other interaction channels. The implementation of cross-border payments will simplify payment and settlement processes, reduce transaction costs and lead to the standardization of processes for all participating CBs.

Issuance of Stablecoins Backed by DT on the Binance platform scenario

Description:

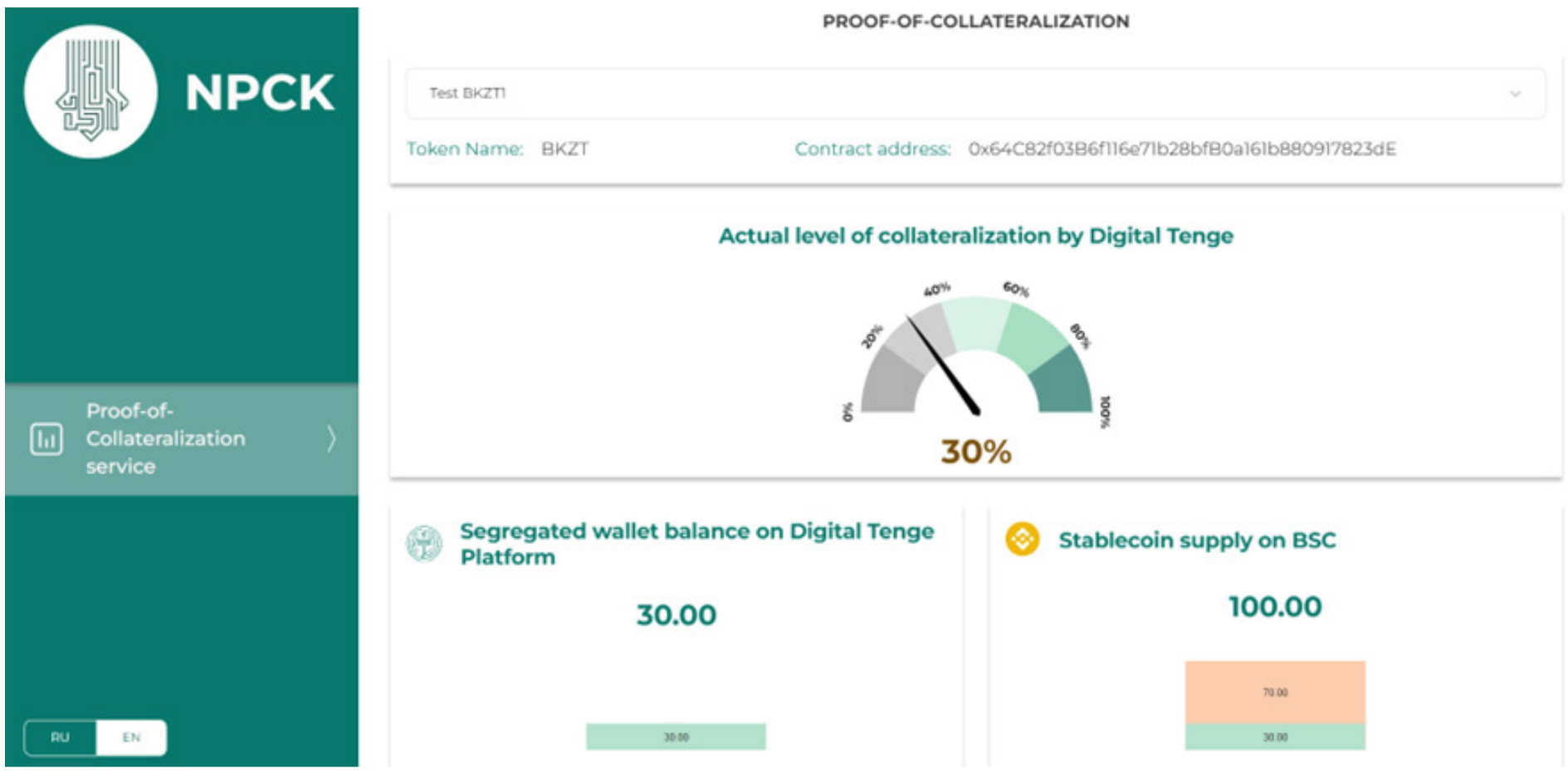
This scenario was designed to test a new type of stablecoins backed by CBDC and issued on a separate platform of a participant from the DeFi industry - Binance.

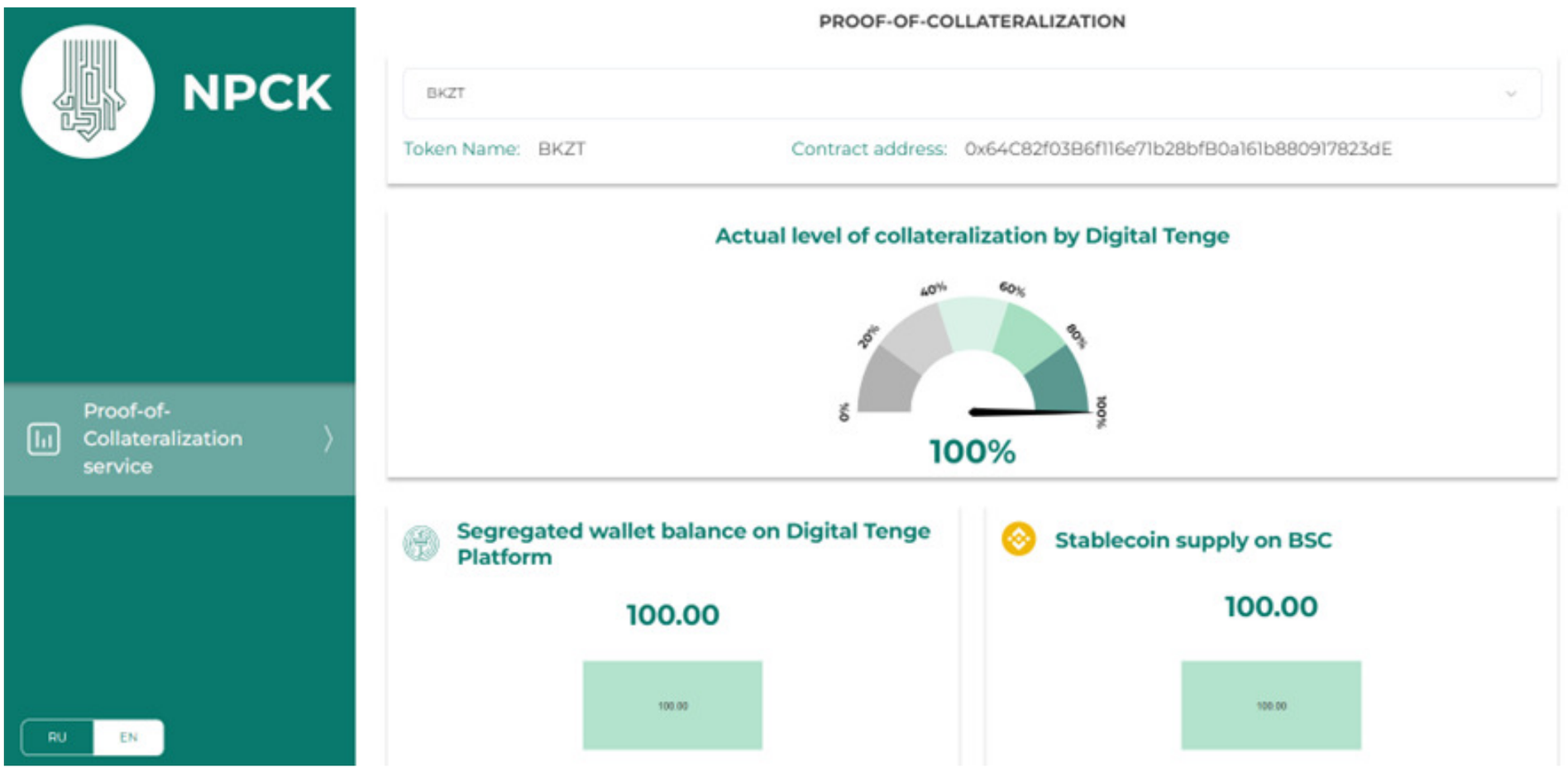
During the scenario, Binance opened two accounts on the DT platform: a main account and a special (segregated) account designed to hold DTs as reserves for stablecoins. On its platform, Binance issued stablecoins in the amount backed by DTs held on the segregated account on the DT platform.

An additional service was developed for user convinience. Its main aim was to provide end-users with capability to independently verify in real time that the number of stablecoins issued by the Binance platform does not exceed the number of the DTs stored in a segregated account on the DT platform. With the help of the web service, the user could check whether the stablecoins were backed by DTs.

Demonstration:

The screenshots below depict web-interfaces with the information about number of stablecoins and corresponding number of DTs in a segreagated account also known as proof of collateralization (the first screenshot demonstrates the situation of insufficient backing by DT while the second one shows that all stablecoins are backed by DT).





Value:

The DeFi market is actively developing offering new services and services. The key driver for the DeFi industry development is the established market of digital assets (cryptocurrencies, stablecoins, etc.). Regulators are proposing new tools to meet consumer demands for affordable, fast and innovative financial services. One of the options is the integration of the DeFi marketplace and the DT platform. As a token-based digital currency, DT has the potential to significantly simplify the interaction between traditional finance and the world of cryptocurrencies.

Value of using DT:

Due to the fact that DTs are guaranteed by the state, the use of DTs as collateral for stablecoins seems as a reasonable approach of creating financial instrument that is reliable for users. In addition, the transparency of securing the reliability of the stablecoin is ensured: using the web-interface, any user could check the sufficiency of the stablecoin collateral linked to the DT at any time.

Scalability:

As a development of this scenario, it is planned to implement a smart contract that guarantees the matching of the level of DT and stablecoin reserves (HTLC smart contract). This smart contract is designed to eliminate counterparty risk - its application will make it impossible to issue stablecoins on a separate platform in excess of the volume of DT on a segregated account on the DT platform (the ratio of the value of stablecoin to the volume of CT in the proportion of 1:1 will be guaranteed with the help of an algorithm).

Issuance of Stablecoins Backed by DT on the KASE platform scenario

Description:

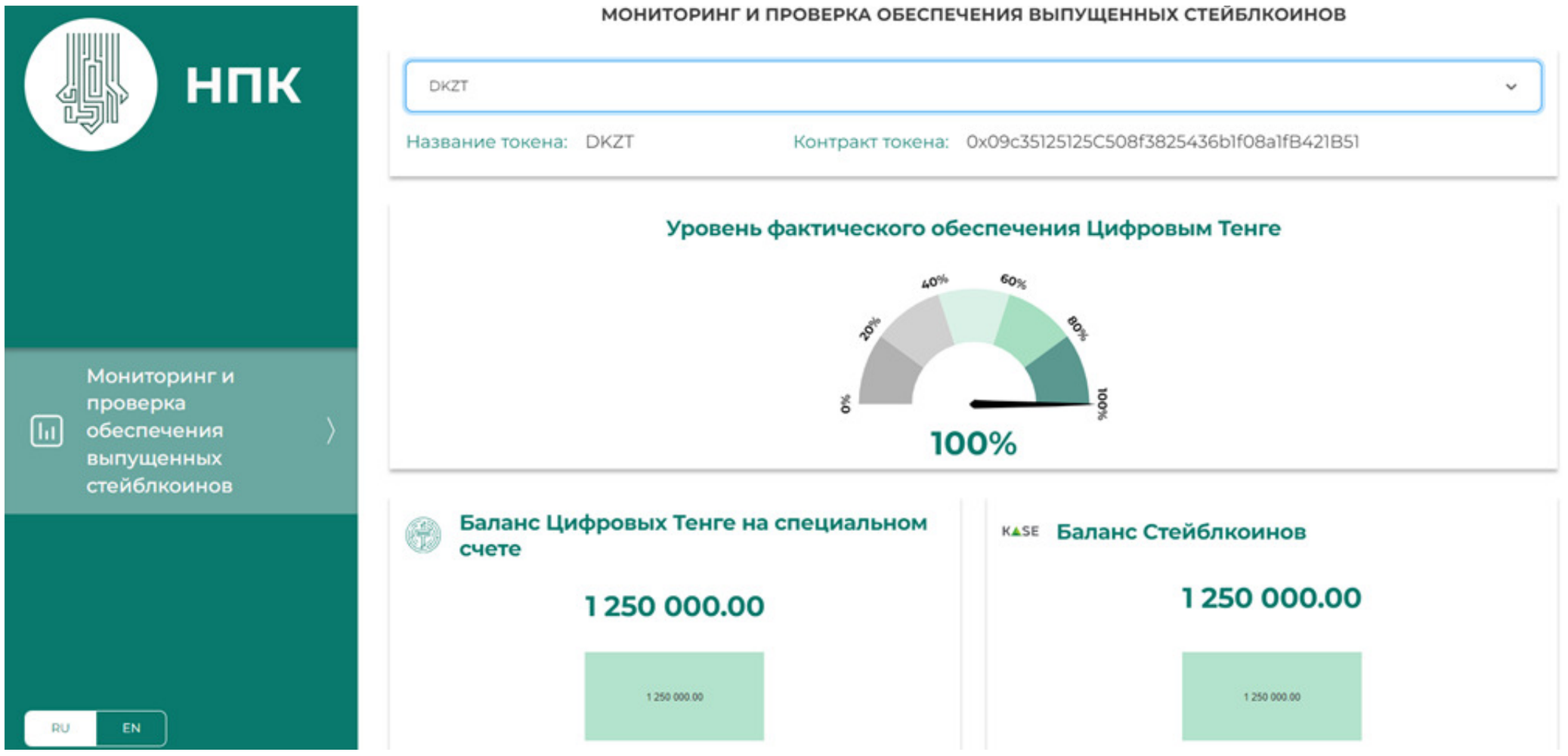
During the implementation of this scenariom, the KASE stock exchange was issuing tokenized assets on a separate platform . On the KASE platform, a separate type of stablecoins backed by DTs was issued, which could be used on the KASE platform as a means of payment for tokenized assets.

KASE opened two accounts on the DT platform for the issuance of stablecoins: ta main account and a special (segregated) account designed to hold DTs as reserves for stablecoins. After that, KASE was issuing stablecoins in the volume equal to that of DT held on the segregated account on the DT platform.

Also, in order to check the ratio of the number of issued stablecoins on the KASE platform to its collateral on the DT platform, a web service similar to the web service from the scenario with the Binance platform was implemented.

Demonstration:

The screenshot below depicts web-interface showing emulated situation with all issued stablecoins being fully backed by DT.



Value:

This scenario is another example of completed integration of two different platforms (the DT platform and a stock exchange platform)

Value of using DT:

As a result of this scenario, the possibility of issuing KASE stablecoins on the KASE platform is demonstrated. In addition to that, the possibility of using stablcoins for payments for tokenized assets was investigated.

Similar to the Binance scenario, DTs are the collateral for stablecoins issued by KASE. When purchasing a stablecoin, the user could at any time check the number of DTs held on a segregated account on the DT platform and thus make sure that the stablecoin was fully backed by digital currency.

Scalability:

The next stage of this scenario development is the issuance and circulation of tokenized securities on the distributed register platform with the use of DT as a mean of payment.

The implementation of this scenario (as well as the scenario with Binance) demonstrates the compatibility of different platforms. In the future, it is planned to expand the functionality and the number of DeFi market platforms integrated with the CT platform.

Sale of Tokenised Assets scenario

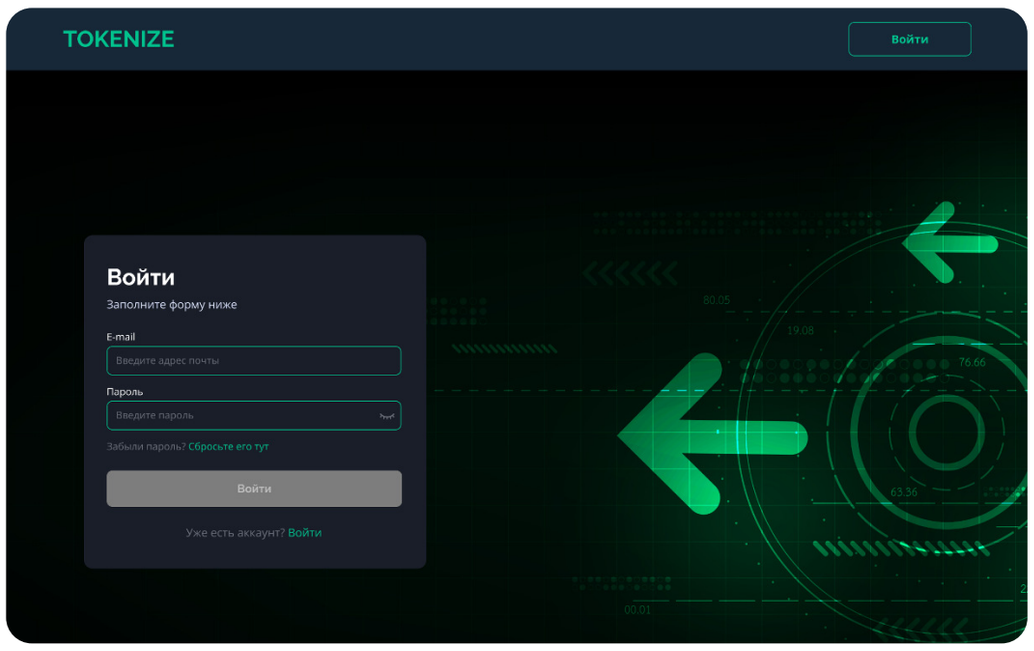
Description:

This scenario was implemented in order to create an asset tokenization platform with the functionality of an exchange and the ability to make payments in DT.

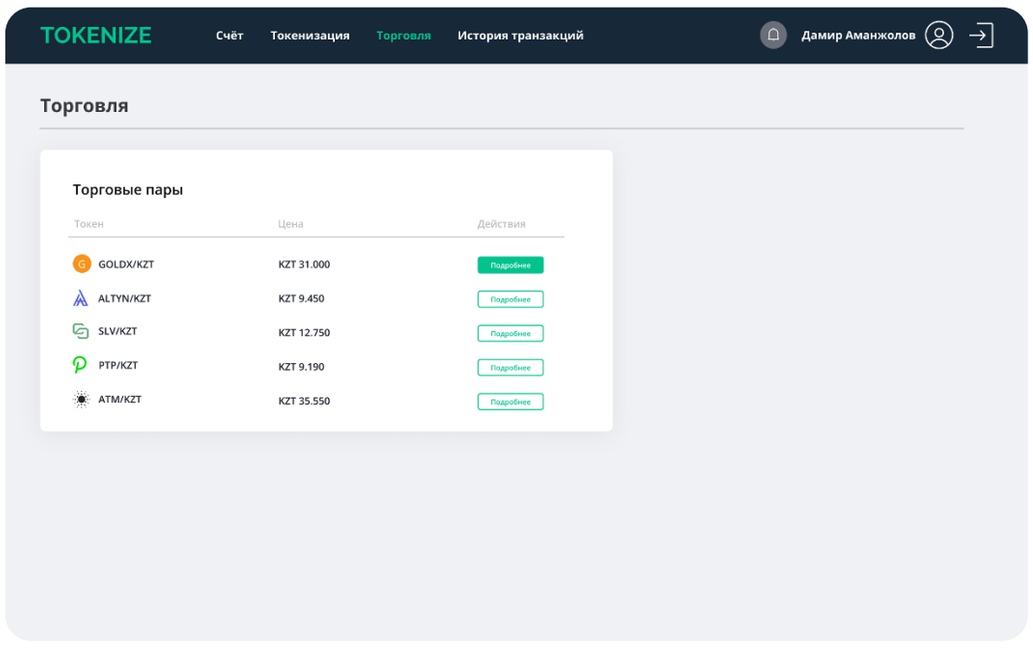
On the tokenized asset platform, the ownership verification and tokenization of the asset was performed. After that, it was possible to sell and buy tokenized assets in real time with the use of DT. During the implementation of the scenario, tokenization of gold was demonstrated as an example.

Demonstration:

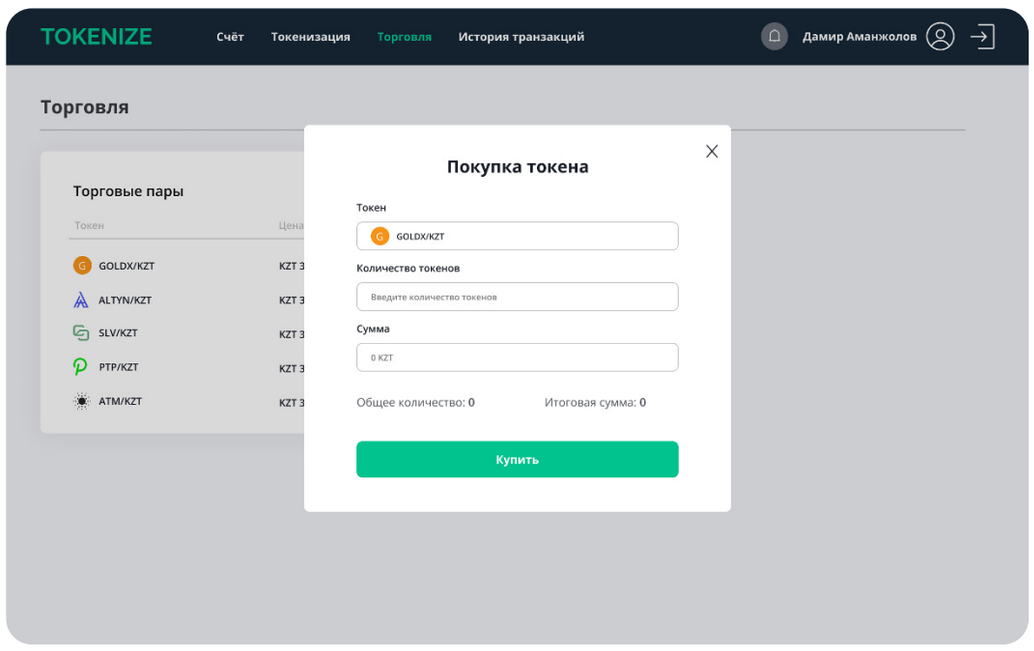
The screenshots below show developed app and customer journey



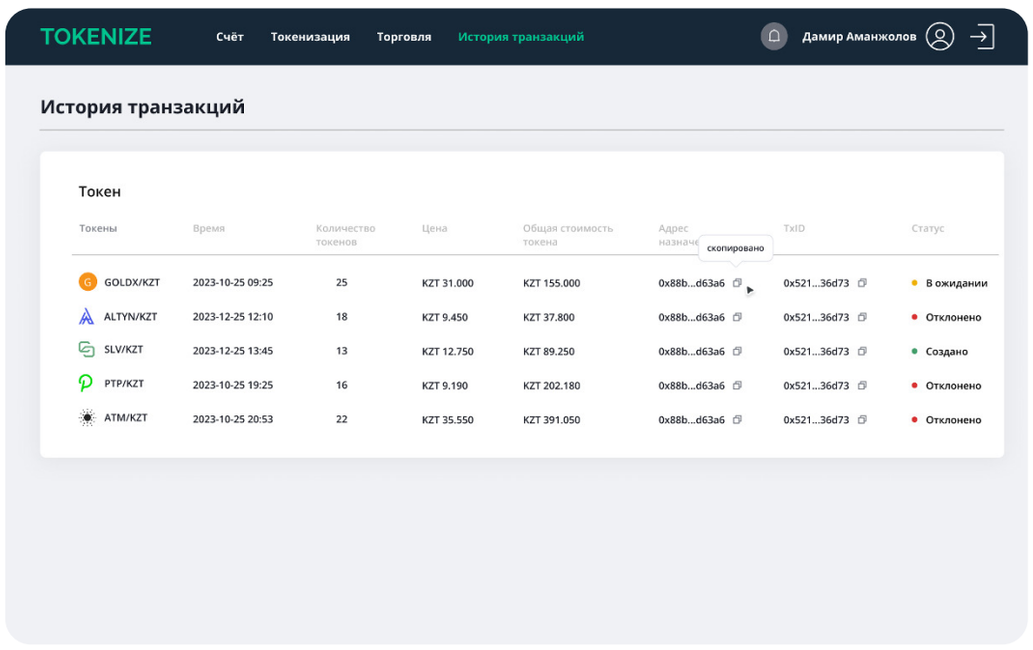
The user (**buyer of tokenized assets**) logs in in the application



The user goes to the **"Trading"** section, which displays the available tokenized assets



The user selects a tokenized asset for purchase, enters required quantity and **makes the payment in DT**



The user can also see transaction history

Value:

The scenario facilitates the capability of payments between the seller and the buyer with potentially instant settlement.

Value of using DT:

Tech Company integrated their app with the DT platform for real-time payment for tokenized assets. The use of the DT platform guarantees reliable and transparent storage of transaction data while the programmability functionality will enable the creation of new innovative financial instruments.

Scalability:

Данный сценарий в дальнейшем может быть использован для токенизации различных видов активов и применим для любой платформы токенизации.

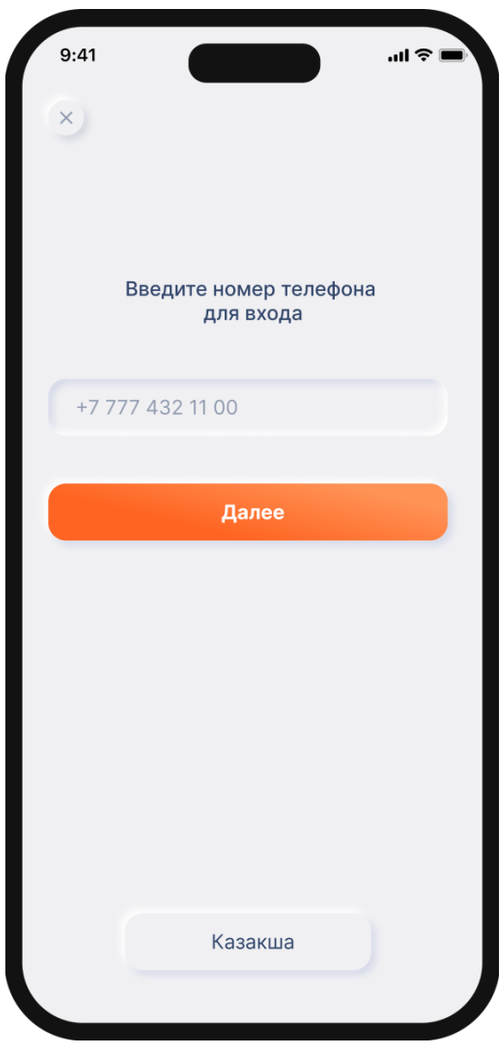
Pedometer scenario

Description:

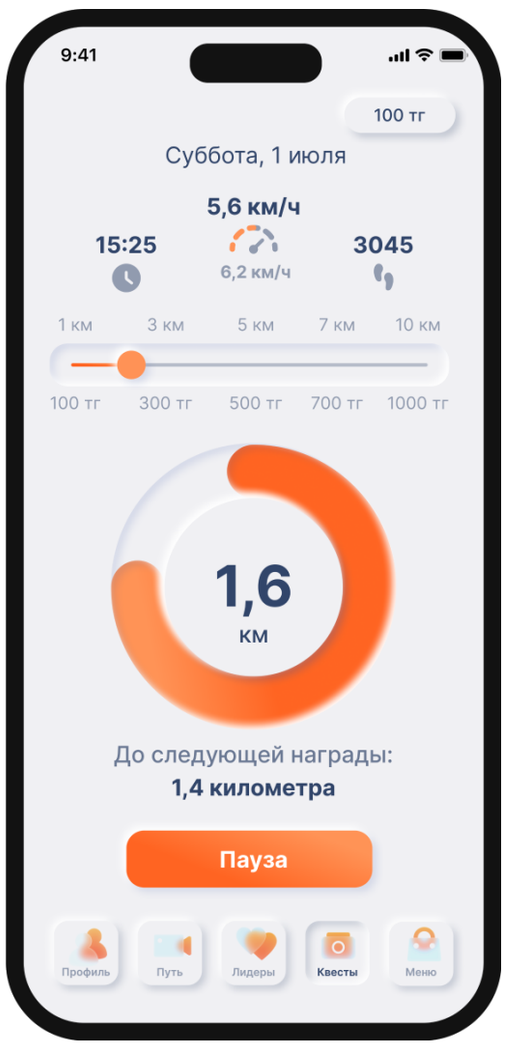
The main aim of this scenario was to test automatic accrual of bonuses in the form of DT for the physical activity. The number of steps taken was counted using devloped mobile application, and when certain thresholds of steps were reached, the user was automatically credited with rewards in the form of DTs to a digital account previously opened by the user. After that, the user could use the DTs as he or she saw fit (e.g., to make transfer transactions to other users). In the future, gamification in the application was also envisioned for additional attraction of new customers.

Demonstration:

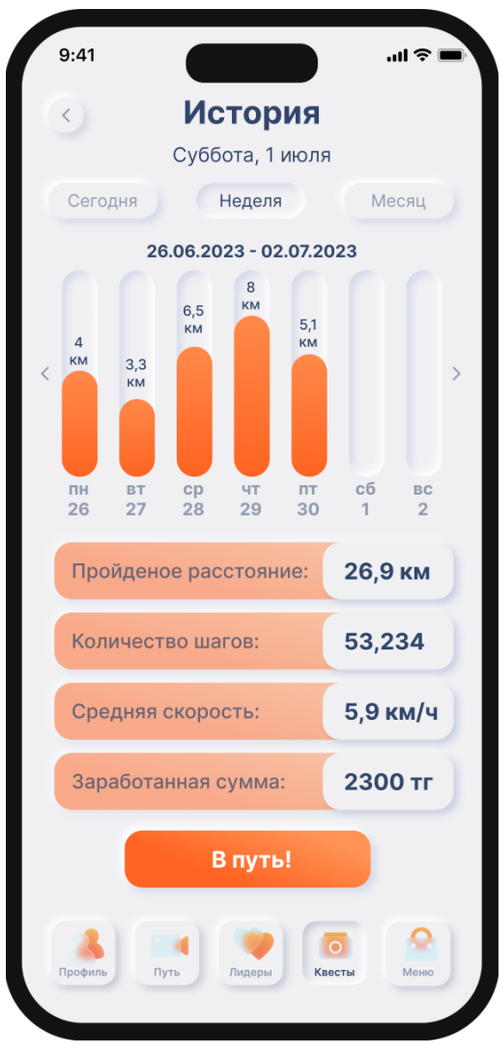
The screenshots below show developed app and customer journey.



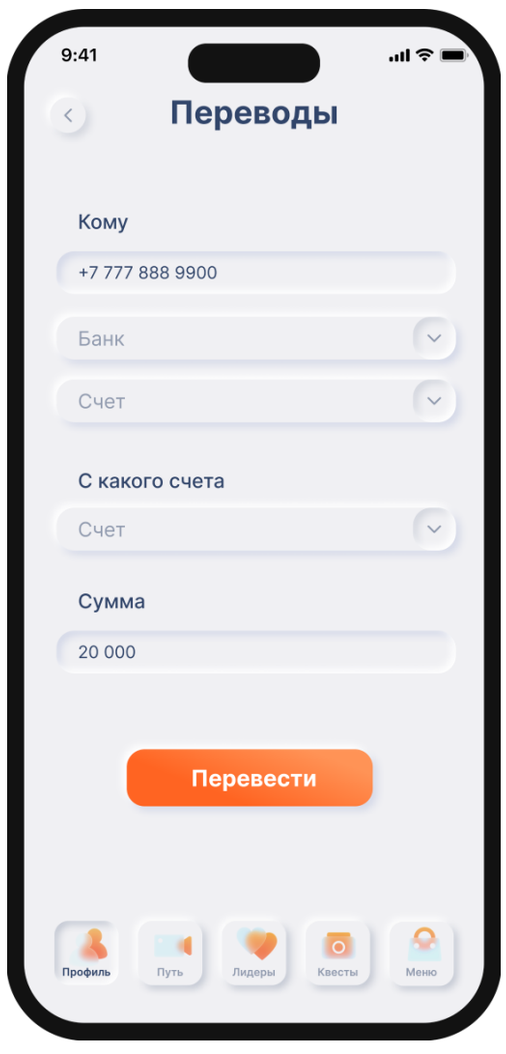
The user logs in the pedometer app



The user starts activity counting mode.



When certain thresholds are reached, the user is automatically rewarded with DTs.



The user can also transfer his or her bonuses to other users.

Value:

This experimental scenario is a vivid example of how the DT platform creates a foundation for innovative products. Potential realization of the scenario can promote an active lifestyle.

Value of using DT:

Metaforra integrated their app with the DT platform to have capability to give their users DT as a reward for physical activity. The use of the DT platform guarantees reliable and transparent payments for all users.

Scalability:

This scenario can be further used for various mechanisms of rewarding people with bonuses including payments from the state.

VAT Deduction scenario

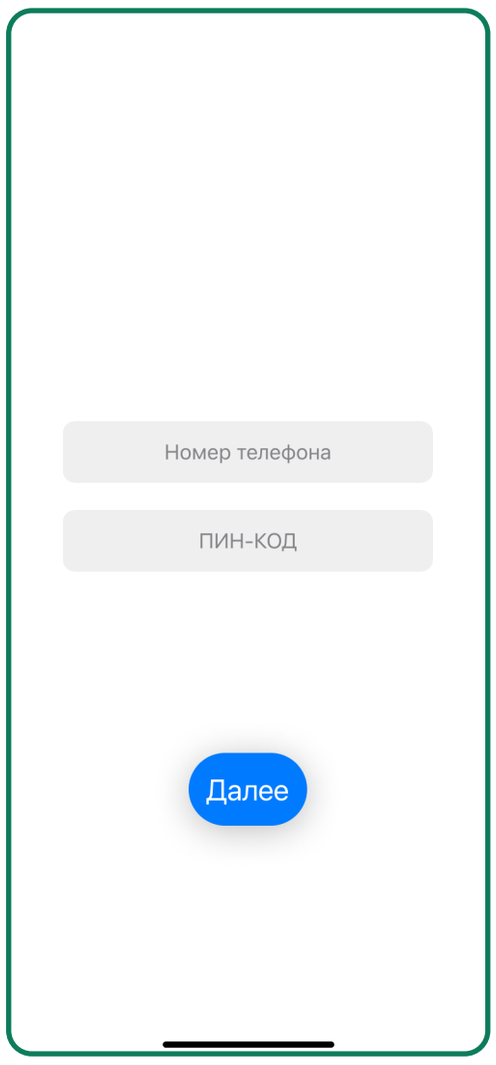
Open Business

Description:

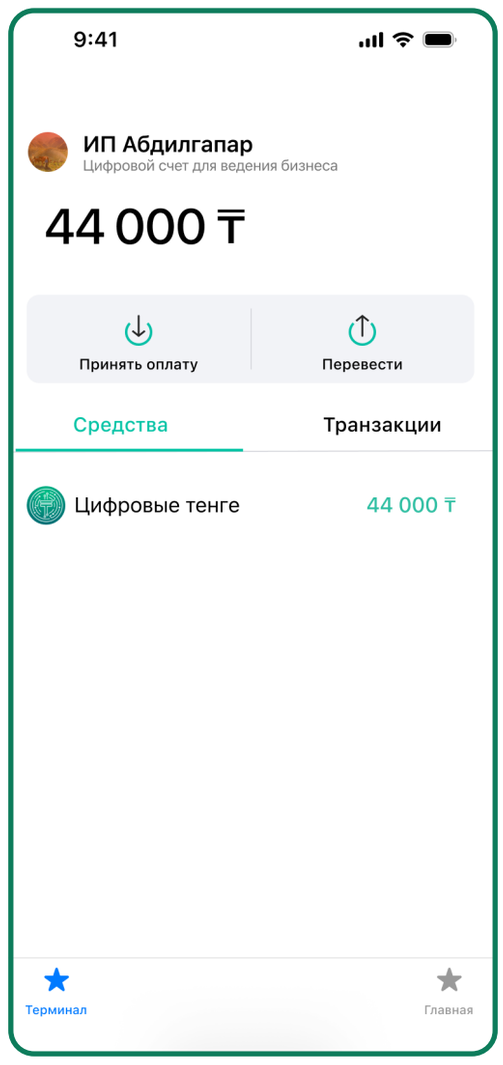
This scenario was aimed at the implementation of automated deduction of VAT from the transaction of purchasing goods at a merchant using a smart contract. Special QR-code for payment is generated by the merchant, the user reads the QR-code and confirms the payment transaction. The VAT amount is automatically calculated and two transactions are performed: the first one is the payment from the customer to the merchant and the second one is transfer of the VAT amount to the tax authority. The information about the tax payment can be seen in the history of transactions of the TSP.

Demonstration:

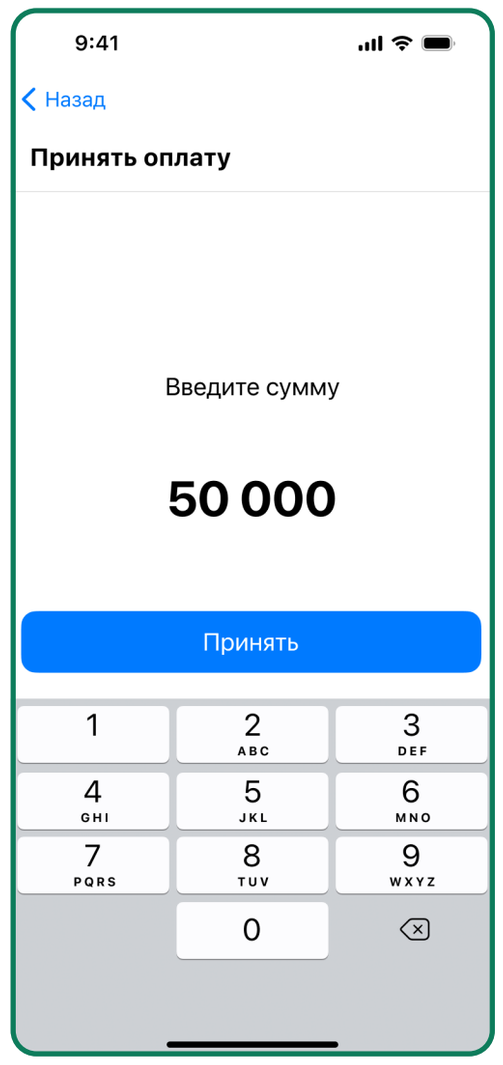
The screenshots below show developed app and customer journey.



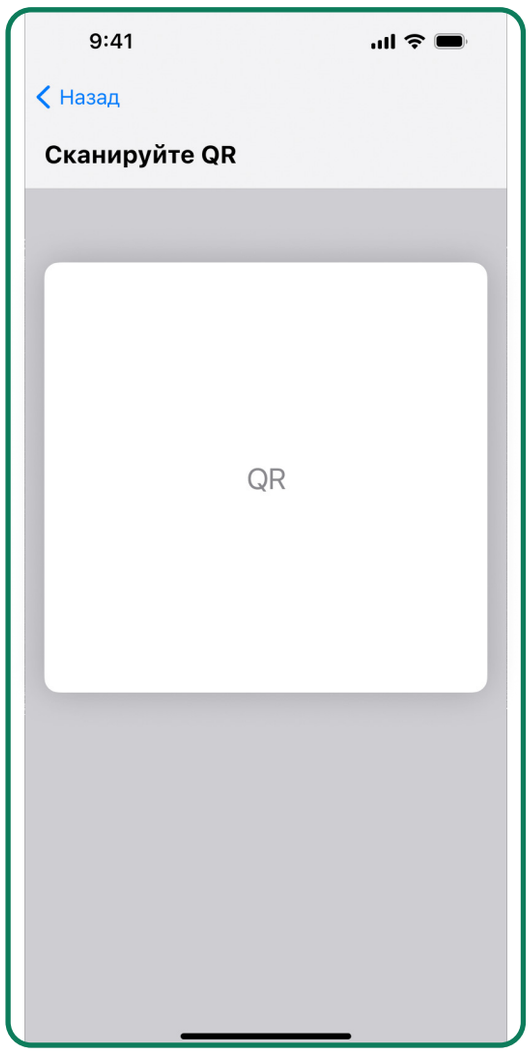
The merchant's employee is authorized in the application.



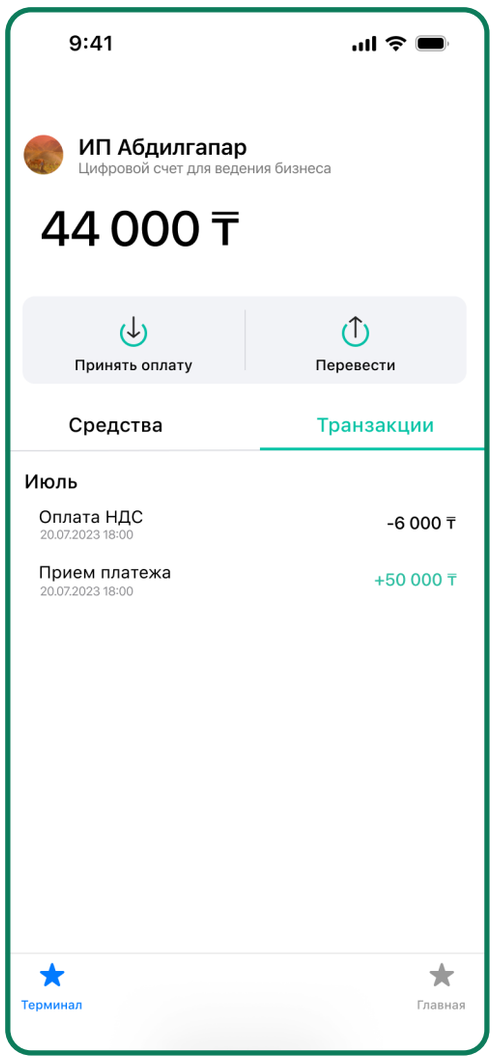
The merchant's employee sees the main menu where the balance and transaction history are displayed.



The merchant's employee enters the number of DT to be paid by the customer and confirms the VAT deduction.



Special QR code for the transaction is displayed on the screen, the customer uses to pay for goods in DT



At the moment of payment, VAT is deducted from total amount of DT. VAT deductions are displayed in the transaction history.

Value:

The scenario automates one of the most wide-spread economic processes - tax payments.

Value of using DT:

The scenario realized by Open Business had demonstrated the use of smart contracts for paying taxes in DT. The smart contract logic is implemented on the DT platform which in its turn makes tax deductions fast, transparent and secure .

Scalability:

Other types of taxes can also be paid automatically by using a smart contract. Possible use of this scenario will automate and speed up interaction with tax authorities; it may be also utilized for automated generation of tax reports.

Plans for 2024

Further development of the Digital Tenge project will follow three main directions: **business processes**, **regulation** and **technology**. The information below describes plans for all of these areas.

The following work and activities are planned as part of the **business process improvement**:

1. **Increase in the number of participting banks**. The launch of DT in retail and the experience gained within the CBDC Cards scenario makes it possible to expand the availability of DT to a wider range of consumers. The first step to achieve this goal will be to connect new banks to the DT platform;
2. **Development of the mechanism of social payments and public procurement**. The Digital Vouchers scenario can be utilized for other areas and tasks - for example, they van be used to automate the process of payment for education services. As part of the 2024 work, public procurement on the DT platform will also be investigated together with authorized government agencies to ensure greater transparency of expenditures and increase their efficieny;
3. **Conducting a pilot project on issuance of stablecoins and integrations with DeFi**. Realization of the pilot loop scenarios with KASE and Binance are the first steps in this direction. In 2024, the work on the application of the DT platform as a bridge between the worlds of traditional and decentralized finance will be risen to a new level;
4. **Implementation of smart contracts created in collaboration with market participants**. In 2023, three scenarios of market participants were designed and tested. In the future, this practice will be continued with a larger number of companies and organizations and within the industrial loop. The programmability of DT will be used to create fundamentally new products and services;
5. **Launch of the cross-border payment mechanism in limited production mode**. The ongoing research in the area of cross-border payments using CBDC will continue not only within the framework of the CBDC Connector and mBridge projects mentioned above, but also in the context of other initiatives. This will simplify and automate cross-border transactions for all stakeholders and may become a driver for the development of better mechanisms of international trade;
6. **Conducting a pilot project on offline-transactions**. The ability to make payments and transfers without access to the Internet is an important and unique feature of DT that can provide access to modern financial instruments even in the most remote regions of the country. In 2024, offline transactions will be tested for the first time with market participants as a full-fledged payment mechanism.

The following work will be carried out under the **Regulatory** direction:

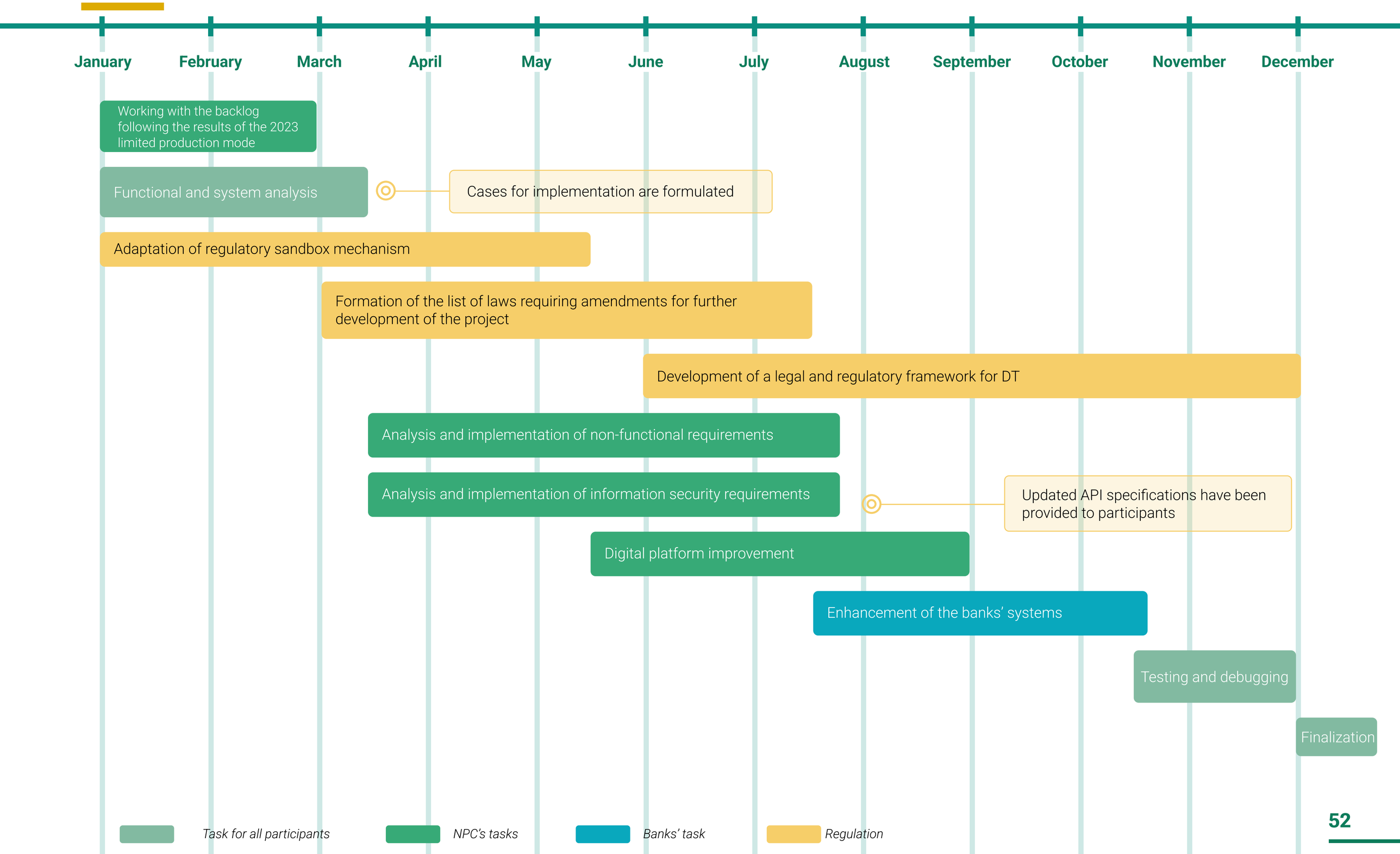
1. **Determination of the legal status of DT.** The most important condition for the transition from limited production mode to industrial operation is the full legal status of the national digital currency as a third form of payment. For this purpose, a number of activities will be carried out in 2023 including the use of the regulatory sandbox mechanism;
2. **Development of a legal and regulatory framework for DT**. In addition to the legal status, new regulations are also needed to govern participants' interaction with the DT platform. In 2022 and 2023, the foundation for the regulation of DT circulation was laid, and in 2024 it will be used to begin the creation of a full-fledged regulatory framework;
3. **Identification of laws and sublaws to be changed via collaboration with governement agencies**. The implementation of DT affects not only the financial sphere, but also others. The above-mentioned public procurement can be cited as the most vivid example. In order to ensure the legal status of DT, it is necessary to amend a large number of legal acts, at first glance not directly related to finance, and therefore in 2024, the relevant work will be carried out together with the authorized government agencies;
4. **Work on digital financial assets**. The DT platform is the foundation for new services and products, some of which will be related to digital financial assets. In order to use them properly, appropriate regulation is required which will begin its development in 2024

The following **technological aspects** of the DT platform will be explored in 2024:

1. **Target architecture model**. The distributed architecture model described above will be implemented in 2024 and 2025. In 2024, a phased process of building this architecture will be initiated with the involvement of banks;
2. **Information security**. The number of crimes related to digital financial products is steadily increasing all over the globe. New technologies and threats are emerging, therefore the improvement of the DT security platform will continue in 2024;
3. **Improvement of the DT platform's non-functional characteristics**. As a critical component of the national financial infrastructure, the DT platform must meet the criteria of continuity and high speed of transaction processing. In 2024, work will be carried out to improve the non-functional characteristics of the national digital currency

All the above-mentioned works will be carried in accordance with the Roadmap of the Digital Tenge project for 2024 (see below).

ROADMAP FOR 2024



Frequently asked questions

What is DT?

Today, the financial sphere of Kazakhstan uses both cash and non-cash money. Cash includes banknotes and coins, while non-cash money includes money in bank accounts. The NBK is developing a third form of the national currency, the DT. The decision to launch the DT was made at the end of 2022.

The DT will be universally accepted as a legal tender and fulfill all the functions of classical money for all subjects of the economy. The DT will be issued as a unique digital sequence (tokens) or electronic records stored on special electronic wallets. Regarding payment technologies, the usual transaction options will remain available. Still, a fundamentally new payment solution will be implemented - offline payment, i.e., payment by mobile phone or other similar device without an internet connection. With the launch of the DT, cash or non-cash money will remain in circulation, and digital currency will coexist with them.

What will the implementation of DT give?

The NBK is building and developing the National Payment System so that all Republic's payment market participants can access inexpensive, fast, convenient, and secure payments. The DT infrastructure will become an additional tool for financial market participants, using which they can create innovative services.

The DT will also ensure further growth in the penetration of non-cash payments in the regions and increase the availability of financial services. In the long term, implementing the DT will also increase the efficiency of cross-border payments. The DT platform also provides the ability to program national currencies at the token level, opening up a wide range of opportunities to improve the efficiency, speed, and transparency of settlements involving the state.

A detailed description of the potential benefits and risks of implementation is available in the NBK report.

How can financial market participants participate in the project? What new opportunities will they get in this regard?

One of the leading hypotheses is the possibility for market participants to create innovative services and products on the platform provided by the NBK. Participants develop customer-driven scenarios in the 2023 pilot project by integrating projects into the digital platform. It enables participants to assess the potential of new technologies and build customer-centric products. At the same time, the NBK conducts training for market participants to realize their scenarios on the DT platform.

What prospects and opportunities does the DT offer?

The existing forms of settlements have advantages and work successfully in the existing system. However, implementing the DT opens up new perspectives and opportunities that serve not only efficiency but also the long-term development of the economy.

Innovation. The DT promotes new technology thus facilitating access to financial services and creating new opportunities for entrepreneurship and business.

Security. The DT provides high transaction security by using modern cryptographic technologies,.

Availability. The DT can make financial services accessible to a broad population segment including remote and hard-to-reach regions.

Efficiency. Accelerating and facilitating settlement through the DT can reduce costs and increase the speed of financial transactions.

The DT offers unique opportunities and has advantages over other forms of settlement. It contributes to increased speed, security, and accessibility, thus enriching the financial system. The DT does not replace existing methods but offers additional options and flexibility for ordinary citizens and business entities. The implementation of the DT is being conducted considering national and the existing financial structure's participants' interests to work together for the long-term and sustainable development of the Kazakhstani economy.

Will the NBK be able to change the rules of using DT at any time?

No, the primary objective of NBK regulation is to ensure macroeconomic stability, safety and equality for all financial system participants and users. The NBK will not change the rules of using the DT arbitrarily and unilaterally.

Any potential changes will be carefully considered, investigated, and widely discussed with stakeholders. The NBK will continue to act with maximum transparency and accountability to serve the interests of all participants in the economic process.

At the same time, it is worth noting that other modes of payment (both cash and non-cash) will always be available with the DT. Consumers will be free to choose any payment method that is convenient for them.

In the DT-related context, what is the role and status of the BIS, IMF, and WB? What are the mechanisms for interaction with these organizations? And to what extent is this in line with national interests and needs?

International organizations act as independent advisors whose expertise is considered alongside independent expertise or representatives of other CBs. The interaction mechanisms with these organizations are based on transparency, cooperation, and compliance with international norms and standards.

It is important to emphasize that all decisions regarding the DT are made by the NBK, considering national interests and needs. Interaction with international organizations upholds our independence and ability to act in the interests of our people and economy.

Will the DT solve the corruption problem since corruption is about people on the ground first and foremost?

Corruption is a complex and multifaceted phenomenon with human factors at its core. However, implementing of the DT can be part of a comprehensive approach to fighting corruption. The DT's transparency, traceability, and security compliance can facilitate monitoring and prevent fraudulent behavior. It is not a replacement but a complement to broader measures to strengthen the rule of law, education, and a culture of transparency.

Despite the possible benefits, it is essential to emphasize that the DT is, first and foremost, a payment instrument. The DT can complement existing financial instruments and support long-term goals like fighting corruption. Still, the DT aims to improve and simplify financial transactions for citizens and businesses in Kazakhstan. Its main objective is to ensure efficiency, security, and accessibility in payment transactions.

Will the DT enable the NBK or other government agencies to monitor all transactions of citizens?

Data privacy and confidentiality are critical issues related to the DT. The NBK recognizes the significance of this issue and strictly complies with personal data protection laws.

The DT will have the necessary security measures in place to prevent unauthorized access or monitoring of transactions of individual consumers. Access to such information will be restricted, and the legislation in force will carry out all transactions.

It should be emphasized that the primary objective of the DT is to simplify and improve payments, not to monitor the transactions of individuals. The NBK is constantly working to improve security and reliability to ensure that the interests of all participants in the financial process are trusted and protected.

Does DT have cybersecurity advantages over e-money and cryptocurrencies? Will additional work be required on the part of banks to enhance security? Should citizens be educated on certain specific security rules when using DT?

Fundamental principles for implementing digital currency, particularly the DT, include data protection, operational resilience, and cybersecurity. A review of cyber-attack tests of existing central bank digital currency platforms was conducted. It should be noted that many risks depend on the design of the digital currency technology infrastructure and the configuration of different properties depending on the system requirements. The distributed ledger technology of the Corda platform was chosen for implementing the DT pilot project and for security and privacy reasons. This solution allows the management anonymity, privacy, and traceability of transactions.

One of the hypotheses successfully tested within the project is transaction security. Using tokens makes it possible to identify the issuer unambiguously, thus guaranteeing the authenticity. At the same time, the consensus mechanism excludes the possibility of double spending of tokens in the presence of an Internet connection on the participants' devices. Nevertheless, the requirements and criteria for protecting users' data containing banking secrecy and the distribution of responsibility between participants will have to be worked out in the future.

Are there common objective reasons that encourage different countries to introduce CBDC? If so, what are they?

The strategic objectives of implementing CBDC in different countries may vary depending on local specifics. Still, according to the BIS study, most countries have the following objectives:

- Diversification and increased sustainability of payment mechanisms.
- Increased financial inclusion.
- Increased efficiency of cross-border payments.
- Improved security and confidentiality of payments.
- Increased sovereignty of monetary policy at the global level.

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