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INTEGRATION AND SYNERGY BETWEEN INFORMATION AND COMMUNICATION TECHNOLOGIES AND MODERN BANKING

A V T O R E F E R A T

FOR DISSERTATION

For the award of the educational and scientific degree of 'Doctor'

Doctoral program Computer Systems, Complexes, and Networks

Professional field 5.3. Communication and Computer Technic

Research Supervisor: Prof. Dr. Dimitar Karastoyanov

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The dissertation has been discussed and approved for defense at an extended meeting of the "Computer Systems and Services" section of the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences, held on …….. in 2023.

The dissertation consists of …… pages, including ……. figures, ……. tables, appendices, and a literature section containing ……. titles.

The dissertation defense will take place on ……… 2024, starting at ………., in Room ……. at Block 2 of the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences. The defense will be conducted in an open session before a scientific jury composed of:

1. Prof.

2. Prof.

3. Prof.

4. Prof.

5. Associate Prof.

Substitute Members:

6. Prof.

7. Associate Prof.

The materials for the defense are available to interested parties at the Institute of Information and Communication Technologies office at the Bulgarian Academy of Sciences, located at "Akad. G. Bonchev" Str., Block 2.

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Title*: **Integration and Synergy between Information and Communication Technologies and Modern Banking***

Objective and Tasks

The objective of the dissertation, Integrating Information and Communication Technologies (ICT) in Modern Banking, is to achieve synergy between innovative methods and tools for digitization in the banking environment.

To accomplish this objective, the following Tasks will be addressed:

1. Research and analyze innovative methods and tools for digitization in the banking environment.

2. Propose an approach for integrating modern banking technologies to create a new comprehensive banking service. This service should reduce transaction execution time, be accessible to all users, and demonstrate improved financial aspects.

3. Propose improvements to regulations in the payment industry.

4. Validate the synthesized new banking service by conducting experimental studies and simulations of the proposed solutions. Verify and analyze the results.

Publications of the doctoral student on the topic of the dissertation

1.   Terzieva, M., Karastoyanov, D. Advanced Banking for Digitalization in Animal Husbandry., Sixth Int. Conf. BUSINESS AND REGIONAL DEVELOPMENT 2021, SHS Web of Conferences, vol. 120, 2021, ISSN:2261-2424, paper No 03006, DOI: https://doi.org/10.1051/shsconf/202112003006

2.   Karastoyanov D., Terzieva M., ICT for Innovation in Advanced Banking. problems of engineering cybernetics and robotics, 73, Prof. Marin Drinov" Publishing House of Bulgarian Academy of Sciences, 2020, ISSN:2738-7356, 47-54

3.   М. Терзиева, Д. Карастоянов, Информационно-комуникационни технологии в съвременното банкиране., XXIX Международна научно-техническа конференция – АДП 29.6- 2.7 2020, бр. 2, Издателство на ТУ-София 2020, ISSN:2682-9584, стр. 155-161

4.   Terzieva, M., Karastoyanov, D. Иновации в мобилното и онлайн банкиране. XXX Международна научно-техническа конференция – АДП, Автоматизация на дискретното производство 2021, бр. 3, Издателство на ТУ-София, 2021, ISSN:ISSN 2682-9584, 209-204

5.   М. Терзиева, Д. Карастоянов, Банкови услуги чрез платформа IDEAL в Интелигентното Животновъдство, XXXI Международна научно-техническа конференция – АДП 2022, бр. 4, Издателство на ТУ-София, 2022, ISSN: ISSN 2682-9584, 223-226

6.   М. Терзиева., Интеграция и синергия между ИКТ и съвременното банкиране., ROBOTICS, AUTOMATION AND MECHATRONICS ' 21 RAM 2021, Prof. Marin Drinov Publishing House of Bulgarian Academy of Sciences, 2021, ISSN: 1314-4634, 112-115

7.   М. Терзиева., ИНОВАТИВНИ МЕТОДИ И СРЕДСТВА ЗА ДИГИТАЛИЗИРАНЕ В БАНКОВА СРЕДА., ROBOTICS, AUTOMATION AND MECHATRONICS ' 20 RAM 2020, Prof. Marin Drinov Publishing House of Bulgarian Academy of Sciences, 2020, ISSN:1314-4634, 34-38

8.   M. Terzieva, D. Karastoyanov., Information Communication Technologies, Animal Husbandry, and the Ideal System: A New Comprehensive Banking Service in Real Time., GUICAF 2023 - 2nd Gulf University International Conference in Accounting and Finance, Kingdom of Bahrain, December 12-13, 2023

Chapter 1: Overview, Analysis, and Systematization of Existing Information and Communication Technologies (ICT) in Banking.

Over the past two decades, we have witnessed significant technological advancements in telecommunications and banking. This has led to a convergence of these industries. Telecommunication companies now offer financial services, while many banking institutions provide telecommunication services. Telecommunication operators extend traditional banking products, such as issuing and supporting credit and debit cards. Banks are allocating a portion of their communication line capacity to other users and actively utilizing telecommunication systems to provide Automated Teller Machines (ATMs) in locations remote from bank branches.

The result is increased competition in offering services such as financial, leasing, issuing, and supporting credit cards, traditionally dominated by banks. New competitors to banks, namely telecommunications companies, can diversify their business processes, whereas conservative rules and regulations constrain banks.

The convergence of computer services and telecommunications is significant for the competition between banks and telecommunications companies. Technological progress has made it possible to provide computer services over networks, where data can be transferred and processed in locations separate from their collection or production.

These technical references have consequently drawn attention to the escalation of specialized value-added networks (VANs) providers, which deviate from standard models. VANs are communication networks that add value to transmitted data, usually by providing processing services. These providers utilize existing networks or create new ones to offer clients information services overlooked by the traditional telecommunications industry.

Electronic Data Interchange (EDI) provides trading partners with an efficient means of conducting business, designed to automatically transmit commercial data from one computer system directly to another.

1.1. Existing traditional banking products and services

A banking product is any service or mechanism for managing money, including accounts, cards, deposits, and loans.
- ➢ The most frequently used accounts offered by banks are:
  - current account – suitable for users (individuals) who want to receive funds from salary, honorarium, pension, or other payments that go to their account. Payments can also be made through this account, for example, paying utility bills or transferring funds to accounts of individuals and legal entities.
  - payment account for basic operations - among its services are depositing and withdrawing cash, receiving and ordering payments, and operations performed by payment card.
  - deposit account - used when a person has available funds and wants to leave them in a bank for a certain period against receiving interest.
  - A savings account is used to collect funds for an unlimited period. In most cases, current withdrawals and deposits to these accounts are allowed.
- ➢ Types of cards and their purpose:
  - debit card. With it, you can:
- ➢ to pay in the commercial network, as well as in online stores;
- ➢ withdraw and deposit cash from/to an ATM;
- ➢ to make utility payments;

➢   to perform other operations, for example, account balance inquiries, etc.
- credit card. With it, you can:

➢   to pay in the commercial network, as well as on the Internet;
➢   to withdraw cash from an ATM;
➢   to make utility payments;
➢   to make reservations.
- prepaid card. Depending on the type of prepaid card, one or more of the following operations can be performed with it:

➢   to pay in the commercial network;
➢   to withdraw cash from an ATM;
➢   to make utility payments;
➢   to carry out reference and other operations, such as online payment.
➢   Types of deposits and their purpose - there is a wide variety and modifications of deposits, but the main types that are most common on the market are the following:

- standard term deposit.
- flexible deposit schemes:

➢   Deposit with advance interest.
➢   Deposit with partially free funds.
➢   Deposit with increasing interest.
➢   Savings deposit - the product is suitable for saving funds indefinitely with regular allocation of funds.
➢   Types of loans and their purpose - the main types of loans offered by banks and financial institutions for individuals are:

- overdraft.
- consumer credit.
- consumer real estate loans (housing/mortgage loans).

1.2. Existing information and communication technologies (ICT) used in banking

Banks and financial services companies have been key players in the telecommunications sector for many years. In the banking sector, information technologies have revolutionized the industry, changing how people live and work. The banking industry is transforming from paper-based to digitized and networked banking services, enhancing productivity through improved efficiency.

Despite regulatory constraints, banking institutions continue offering new services and features to improve the efficiency and convenience of their business processes. Banking is no longer defined by individual customers conducting transactions through tellers but is characterized by electronic transactions conducted through computer networks worldwide.

The use of information technologies in the banking industry provides benefits for both customers and banks, as well as their employees.

Today, 57% of banking transactions occur outside of traditional bank branches. According to the First Manhattan Consulting Group, the future will shift from traditional bank branches towards more electronic systems. They also predict that one in five bank branches will close by the decade's end.

With the implementation of information technologies, banks can handle multiple tasks simultaneously. Transactions are updated in real-time, and many banks make decisions based on information gathered about customer behavior. This information is collected through

computers, analyzing transaction types and frequencies. All of this is possible thanks to information technologies.

Despite the likelihood that banks will offer new services in the future, they already utilize telecommunication technology in four critical areas: leased lines, ATMs (Automated Teller Machines), POS (Point of Sale) terminals, and home banking.

1.2.1. Lease lines

The leased telecommunication line, or Level Three, provides crucial network connectivity that has grown significantly over the past years. With guaranteed speed, it offers bidirectional data transmission between points within a city, country, or internationally through a digital synchronous channel. The product supports data, voice, and video transmission for various end-user devices, with reserved frequency resources and guaranteed line capacity. An internet service provider provides this network connectivity and typically connects two corporate offices, data centers, or other locations through a secure and personalized line. The leased line offers a direct connection to the internet, using high-speed transmission lines, ensuring uninterrupted online access 24/7.

Leased lines are "Dedicated," as this network connectivity allocates the entire bandwidth exclusively for one client, preventing speed drops during peak moments. Additionally, they feature symmetric data transfer, allowing for consistent uploading and downloading of information. This connectivity benefits employees engaging in various online activities, including remote work, sending large files, and using VoIP phones.

The most common lines include fiber-leased lines, which transmit signals through optical cables. Digital Subscriber Line (DSL) Leased Lines use copper conductors. Multi-Protocol Label Switching Leased Lines (MPLS) provide prioritized data transmission and support various applications such as VPN, traffic engineering, and Quality of Service.

1.2.2. Automated Teller Machines/ATMs – types

ATMs have become a primary channel for banks to communicate with customers, and the well-known electronic financial service provides 24/7 money management through the telecommunication network. Offering features such as cash withdrawals, language selection, and deposits, ATMs provide functionalities like balance inquiries, accounts transfers, and utility service payments.

1.2.3. Point-of-Sale Terminal

The Point of Sale (POS) terminal is a hardware system with embedded software for reading magnetic stripes or chips. This terminal processes payments on-site and establishes a connection with the bank card linked to the respective account. A POS terminal involves entering a PIN code to confirm the payment transaction. These devices enable card payments and are designed to conduct transactions for goods and services or cash withdrawals conveniently.

1.2.4. Home banking or Internet banking

The banking industry utilizes telecommunication technologies for home banking, allowing customers to perform routine operations from remote locations using public or private networks. Central banks provide comprehensive home banking systems, including balance

checks, fund withdrawals, and bank transfers. Home banking can be online, using the internet and offering various conveniences such as bill payments and bank transfers. Alternatively, it can be done over the phone, where customers can conduct operations by calling a bank branch or call center and providing the necessary identification details.

1.2.5. Computer applications for operating deposits and loans

Online loans provide fast financial solutions through web-based platforms offered by non-banking institutions. These services are characterized by innovations and automated processes that comply with financial institutions' legislation. Applicants can obtain short-term loans by filling out an online form, where the process is expedited through partial human intervention, including checks and clarification calls.

1.2.6. Electronic/Virtual Term Deposit

The Electronic or Virtual Term Deposit is a savings service providing the opportunity to deposit funds for 1, 3, 6, or 12 months.

1.2.7. Online loans

In principle, online or quick loans are products non-banking institutions offer through a web-based platform. These companies constantly invest in innovative innovations and automated processes to meet today's digital world. This guarantees the identification and protection of the personal data of the customers of these companies according to the applicable legislation for the activity of financial institutions. These platforms are constantly emerging, and many are off-the-shelf solutions that can be adapted according to the supplier's needs and regulatory norms. Loans granted are short-term. The applicant for a loan applies online, fills in certain information according to the established algorithm, and, within a few minutes, finds out if he has been approved. However, the process is not fully automatic because there is partial human intervention in the processing of the data – a company employee must contact the potential client by phone, make an inquiry at the National Insurance Institute, the Central Credit Register, and the Police, and if he meets the criteria, contact again with the customer or the CRM (Customer Relationship Management) system used to send an SMS.

1.2.8. Peer-to-Peer платформи (P2P)

Peer-to-peer lending and investment platforms are based on the sharing economy principle, where participants directly provide and consume resources without a central authority. Two main business models exist direct lending between individuals and a system where credit companies (originators) provide loans that consumers (investors) can invest in. Platforms often act as intermediaries, assessing risk, ensuring transparency, and providing opportunities for automated investing based on predefined parameters.

Chapter 2. Innovative methods and means of digitization in the banking environment

2.1. Digitization in banking and applied ICT technologies

In the banking sector during the Internet era, there has been a convergence between the banking and telecommunications sectors, involving Internet service providers and online portals. The trend toward consolidation continues, with unconventional partnerships creating new forms of competition. Banking innovations include financial breakthroughs to create new products, services, and processes. IT services are crucial for banking processes, and digitization emphasizes the need for effective customer interaction both online and offline. Digitization leads to new services provided more affordably, quickly, and conveniently for customers, including previously impossible situations, such as express smartphone transfers in unforeseen circumstances.

2.2. ICT banking service through payment cards

Bank cards provide various opportunities, including cash withdrawals, payment for goods and services, account transfers, and other transactions. The cards can have a magnetic stripe, chip, magnetic stripe, or chip. There are two main ways to use bank cards: contact (inserting into terminals) and contactless (using RFID or NFC technologies). Contactless cards contain embedded chips and antennas that enable touchless payments on devices while providing security and personal data protection through encrypted codes.

In addition to bank cards, contactless payments can also be made with several devices:
- mobile phones, but you can also use
- Fitness bracelets
- Clocks
- Bracelets
- Keychains
- Stickers

2.3. ICT banking service "Pay with mobile devices"

2011 Google and Android introduced their NFC-based payment systems, followed by Apple in 2014 with Apple Pay. Apple Pay utilizes NFC technology and enables physical and online payments through the iPhone and iWatch. Users can send money to each other via iMessage using a virtual Apple card.

Google Pay lets users make physical and online payments through an encrypted number linked to their bank details. Like Apple Pay, Google Pay facilitates sending and receiving money between users.

On the other hand, Samsung Pay operates with NFC, magnetic stripe, and EMV terminals, simulating the card's magnetic stripe. It also provides the option for in-app and website purchases, utilizing MST technology for broader compatibility with terminals.

All mobile payment systems use tokenization to protect card data. Payments are processed by sending the tokenized card number and cryptogram, safeguarding the card number. These technologies signify a shift from traditional card payments to mobile devices.

2.4. Modern Banking – Online Banking Vs. Mobile banking

Online and mobile banking represent two aspects of modern financial management, offering additional capabilities. Online banking provides constant access to bank accounts from anywhere through the bank's website and gives options for bank transfers. Mobile banking offers freedom and flexibility, enabling financial management on the go. Fund transfers are made possible through technologies such as Electronic Fund Transfer (EFT), Real-time Gross Settlement (RTGS), and Trans-European Automated Real-time Gross Settlement Express Transfer system (TARGET2).

EFT is an electronic transfer from one account to another, conducted through a computer network, with processing time depending on the payment type and the EFT provider. RTGS is a real-time fund transfer system where money moves instantly between banks. TARGET2 provides real-time gross settlement for euro payments. The new RTGS system in Bulgaria, RINGS, ensures the final settlement of payments in the national currency in real-time, with the Bulgarian National Bank acting as the settlement agent.

In all cases, payments are influenced by technological advancements and regulatory requirements, offering improved and modernized services.

2.5. Interactive methods and tools for remote and autonomous banking

In the modern financial context, there is a growing interest in studying and implementing various methods and technologies to transform and enrich active and remote banking. This process requires dynamism in the banking sector, improving efficiency and enhancing the customer experience as critical criteria for integrating innovations into banking practices.

2.5.1. Token

A token is a self-powered device that generates one-time passwords for identification in remote banking. There are two types of tokens: hardware, which is compact, easy to use, and creates one-time passwords through a complex algorithm, and digital, installed on mobile devices, supports two-factor authentication, and does not require carrying an additional device. Integrating tokens into the banking environment can provide additional login and transaction confirmation security. The choice between hardware and digital tokens depends on the balance between security and convenience, with hardware tokens providing physical protection and digital tokens being more easily integrated into mobile devices. This choice can ensure a more secure and flexible authentication process.

2.5.2. Qualified electronic signature (QES)

An electronic signature is a means of signing electronic documents to identify the signer and protect the information from possible alterations. A qualified electronic signature holds the same legal value as a handwritten signature. It is created through a particular device connected to a physical medium, preventing unauthorized signing by other parties. The electronic signature, a digital signature, is a cryptographic credential designed to avoid forgery. It is used in electronic documents to verify the sender's identity and ensure that the information has not been altered between sending and receiving.

The electronic signature employs asymmetric cryptography with two keys – private and public. The electronic or digital signature certificate links the subscriber to the corresponding

public key, recorded on a smart card. This method is applied in various fields, including software distribution, financial transactions, and other cases where it is essential to safeguard information from forgery.

2.5.3. Artificial Intelligence – Chatbot

Banks are increasingly applying artificial intelligence, primarily through chatbot technologies. The AI-powered chatbot is available 24/7 and provides quick responses to standardized questions, offering structured information about banking products across various platforms such as Facebook, Viber, WhatsApp, or banking applications. This software tool enables users to communicate directly without disrupting comfort and can operate with text, voice, images, and other elements. The chatbot is an electronic virtual assistant that provides remote consultations, analyzes clients' credit history, and suggests suitable banking products. They are easy to set up, requiring training and consistent development of topics. Compared to humans, chatbots lack emotions, follow set rules, and can handle multiple conversations simultaneously. Their advantages include cost reduction, increased revenue, and customer satisfaction. However, virtual reality has not yet found widespread application in the financial sector.

2.5.4. Blockchain Technology

Blockchain technology transforms banking and financial services by decentralizing governance and providing cryptographic security for financial transactions. Transactions are grouped into blocks, added to the computer code chain, and encrypted. Each block includes a hash pointer linking it to the previous block, a timestamp, and transaction data. This process makes the data highly resistant to modification. Blockchain technology is often likened to "email for money" and can potentially improve various aspects of banking. Despite the challenges associated with decentralization, blockchain attracts significant interest in other industries, such as logistics, where automation with intelligent contracts has already enhanced efficiency. Smart contracts are programmable and use blockchain for verification and automatic execution of conditions. This not only reduces processing time but also ensures transparency in processes.

2.6. Trends in synergies between ICT and banking

In the digital era, technological progress is transforming various industries, including banking, which is transitioning toward a more autonomous customer process. The trend is the shift from using physical cash to non-cash transactions with credit and debit cards. Information and communication technologies are revolutionizing banking transactions, facilitating access to money through mobile banking. Technological innovations direct banking to a broader audience, competing with flexible and innovative services. Banks enhance customer satisfaction and prevent fraud by combining online security measures like mobile notifications. The financial management process is simplified, as online transactions and automated payments provide convenience and flexibility. In the modern era, businesses can operate online, expanding their presence and accepting payments through various online services. Mobile payments and digital wallets have become integral to active consumers' daily lives. The evolving fintech sector challenges the financial industry to implement innovations at the fastest pace possible. With the onset of the new decade, financial institutions face challenges such as changes in customer expectations, new technologies, and alternative business models.

However, the industry can respond to these challenges by seeking solutions in cloud computing – a technology that revolutionized the tech industry over a decade ago.

In 2020, regulations continued to shape legislation and oversee financial institutions, putting pressure on central banks. However, customers demand faster and more responsive interactions, inspired by examples from tech giants, prompting banks to focus on the front office and move away from traditional banking operations.

Chapter 3. Synthesis of a new comprehensive real-time banking service

This chapter will analyze strategies to improve Complex Banking Products and Services and propose a new real-time banking service.

3.1. Contemporary challenges facing banking institutions

Central banks are undergoing massive digital transformations, investing hundreds of millions to meet growing IT requirements and enhance customer services. Financial institutions are rapidly adopting cloud platforms as they become essential for quick market launches, increased flexibility, and improved customer experiences. In the context of rapidly growing mobile and internet payments, the European Commission is reviewing the Electronic Money Payment Services Directive (PSD) and introducing PSD2, which promotes competition, provides profitable opportunities, and enhances customer security.

In addition to traditional banks, non-financial brands like PayPal, Venmo, Mint, and Rocket Mortgage offer customers convenient payment methods, financial analysis, and mortgage loans. Companies specializing in mobile payments and e-commerce are actively seeking banking licenses or partnering with existing banks, opening up a new area of services beyond the traditional banking sector. These non-financial companies, focused on electronic payments and financial management, provide their customers with options typically associated with banking services, including easy payment methods, financial analysis, and an optimized mortgage loan process.

Open banking, although a catalyst for innovation in the banking sector and other industries, exposes companies to significant cyber risks, providing opportunities for potential attacks. API security is crucial, as even a single breach can lead to severe financial and reputational losses, potentially prompting the halt of open banking early on.

3.1.1. Open banking models

Open banking in Europe is a growing trend, playing a significant role in the dialogue on financial services. Based on the exchange of banking data, this model is changing how services are delivered to the market. Open banking initiatives that have emerged worldwide over the past decade are geared towards the industry's future, offering advantages to banks and FinTech companies such as Monzo and Revolut. This progress necessitates banks' adaptation, exposing them to various open banking models, including internal, platform-based, and distribution-based models. With cost optimization and a focus on customer experience, financial institutions are deriving revenue from these trends and responding to the need for international fund movement in light of globalization and increasing migration.

3.2. An Approach to Creating a New Real-Time Money Transfer Service

The dissertation introduces a new service for fast real-time money transfers, combining existing technologies to provide innovative advantages. The proposed solution integrates technologies into a comprehensive approach called Account-Based Money Transfer (ABMT). The goal is to offer secure, fast, and globally comprehensive real-time fund transfers. To reach end customers at competitive prices, the company can integrate the ABMT solution into its existing Point of Sale (POS) system and digital infrastructure. This approach facilitates quick and secure real-time money transfers, providing an additional service that attracts and retains customers. Integrating ABMT into POS and the digital channel makes it easier for customers to use the services by integrating them into their familiar payment and transaction methods. This approach can improve customer satisfaction by providing convenience, speed, and reliability in financial operations.

ABMT provides services through various channels for financial institutions (FIs):

Online (web) – The service is accessible through the FI's online portal.

Mobile (app) - The service is provided through the FI's mobile portal and is used on mobile phones.

ATMs - The service is physically available at the bank's ATMs.

Self-Service Kiosks - The service is accessible through FI's self-service kiosks.

Retail – Customers can visit a physical location to perform a personal transaction, receiving assistance from an employee (e.g., FI bank teller). The banking system is integrated with the partner's API, providing the service.

A global Money Transfer Provider (MTP) network can effectively complement or replace the existing correspondent banking network. This network provides locations that allow customers to send and receive money globally and is supported by various companies such as Western Union, MoneyGram, RIA, and MoneyTree.

MTPs offer integration solutions, including APIs and hosting options, making it easy for banks and financial institutions to embed them into their systems. This provides customers with a broader range of services, fast and efficient money movement, reduced costs, and better service. For banks and financial institutions, MTPs lead to greater efficiency, reduced costs, and improved customer service. However, businesses need to meet customer expectations, comply with regulations, and address challenges in marketing and advertising. In conclusion, MTPs represent a valuable tool for enhancing international money transfers.

3.3. The Ideal System. Functional characteristics of the developed new money service

The dissertation introduces a new banking service by integrating the fast money transfer platform "Ideal" into the core banking system. "Ideal" represents an innovative platform for express money transfers, available in a vast network of partner locations – fig. 1. The transfer initiator visits a physical location to execute the transfer, ensuring security and speed. The platform allows precise configuration of transfer parameters and generates a unique reference number for verification. The recipient can instantly receive the funds in cash from partner locations worldwide, optimizing customer satisfaction and the efficiency of financial
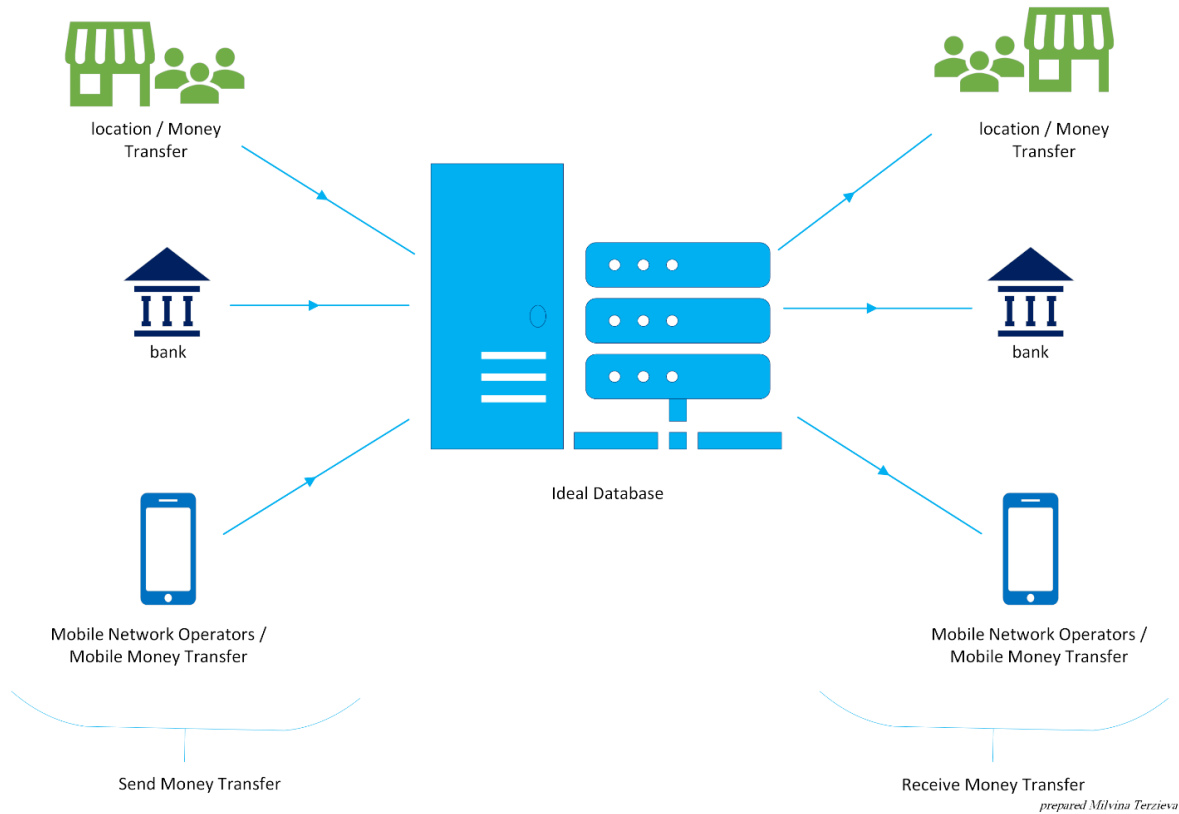
transactions.

Fig. 1. Ideal Database for money transfers

ABMT, or Account-Based Money Transfer, is a method of transferring money using bank accounts or other financial accounts. This process involves moving funds between different bank accounts or financial instruments. It is commonly used for transfers within a single bank or between different banks, including investment accounts and pension funds. ABMT provides greater security and safety by requiring identification of the recipient through their bank account or account information.

Partners control the customer experience with transfers through the Ideal platform and network. Customers can easily send funds from their bank accounts, and the bank controls the cash flow, providing convenient transfers through Ideal locations. Partners can manage the customer experience for transfers through the Ideal platform and network, allowing customers to send funds directly from their bank accounts.

Ideal's technological innovation enables automated real-time transfers with low fees and global coverage 24/7 – fig. 2.
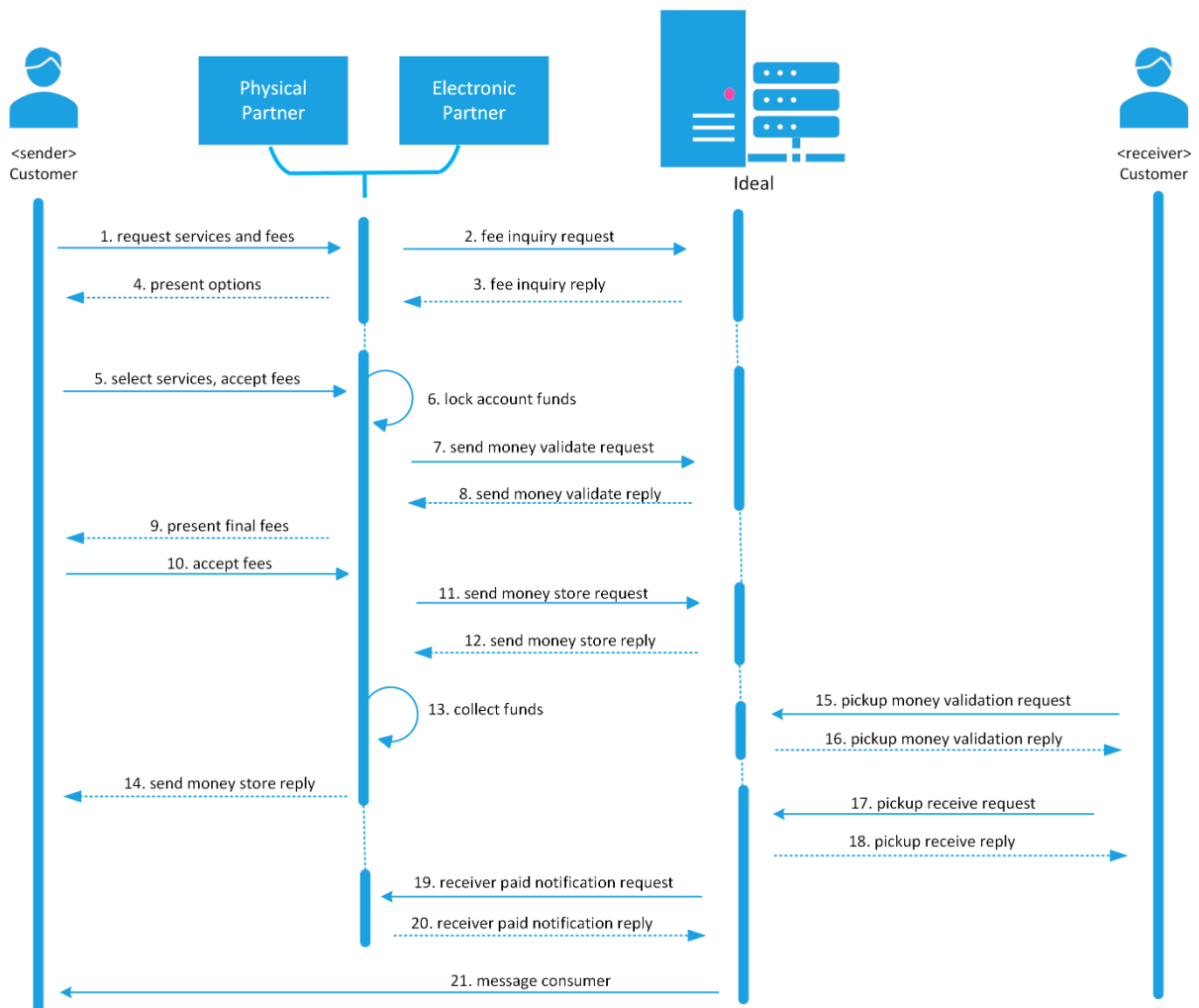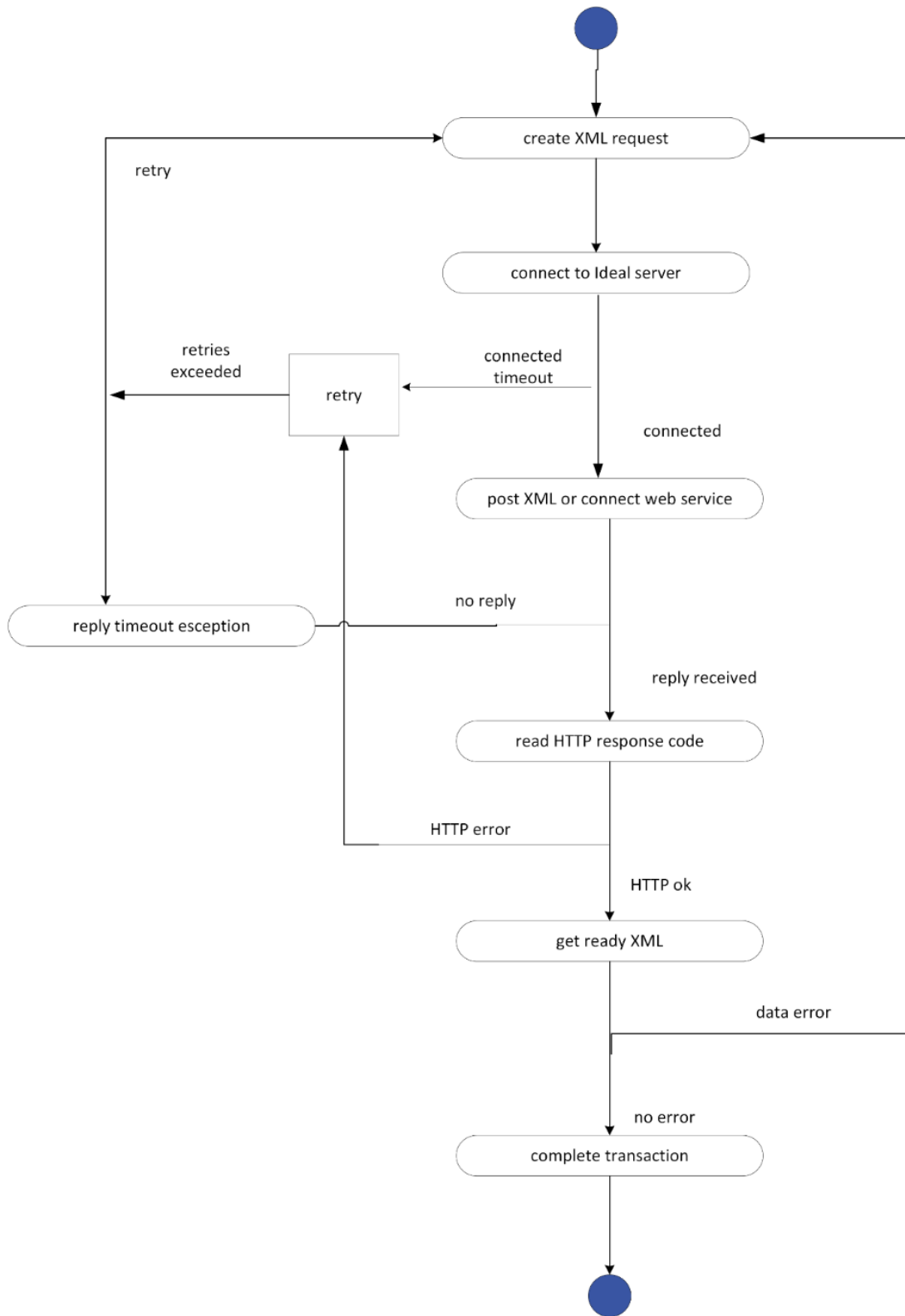
Fig. 2. Architecture of Ideal

3.3.1 Use of the Ideal service by third parties (Gateway). Application development. Integration process.

Ideal provides an ABMT solution through the Ideal Gateway, ensuring high-security standards such as SOAP 1.1, XML, and TLS 1.2. The system comprises a 4-layer security model: VPN for encrypted network, digital certificate identification, session encryption, and message verification.

The Ideal Gateway accepts transactions and forwards them to the Money Transfer Engine for processing. This engine connects the system to settlement and the universal money transfer database. The regulatory system manages financial regulations between Ideal and financial institutions.

The Universal Money Transfer Database maintains data for all transactions. The Ideal Gateway allows third parties to extend Ideal's money transfer service to bank customers and cashiers, enabling sending and receiving money through a website, ATM, mobile offering, or tellers in branches. Customers, both account holders and non-account holders, can easily access flexible money transfer methods using Ideal's extensive network – fig. 3.

create XML request

connect to Ideal server

retry

retries exceeded

connected timeout

connected

post XML or connect web service

reply timeout esception

no reply

reply received

read HTTP response code

HTTP error

HTTP ok

get ready XML

data error

no error

complete transaction

Send transaction to Ideal

prepared by Milvina Terzieva

Fig. 3. Sending a transaction to Ideal.

Ideal Gateway services include three main components: Physical Partner, Electronic Partner, and Customer Service.

Ideal stores all transactions in the Universal Data Transfer database, which remain "Pending" until payout or expiration after 365 days. Pending transactions can be paid out through Ideal's existing systems or services.

For example, a customer can initiate a money transfer from a mobile device to another customer, who may choose to receive the funds in cash from an Ideal representative, even though the initial transaction was intended for mobile payment.

The two primary processes in the banking system are "Sending Money" and "Receiving Money," with all money transfers managed and stored in a single database - fig. 4.
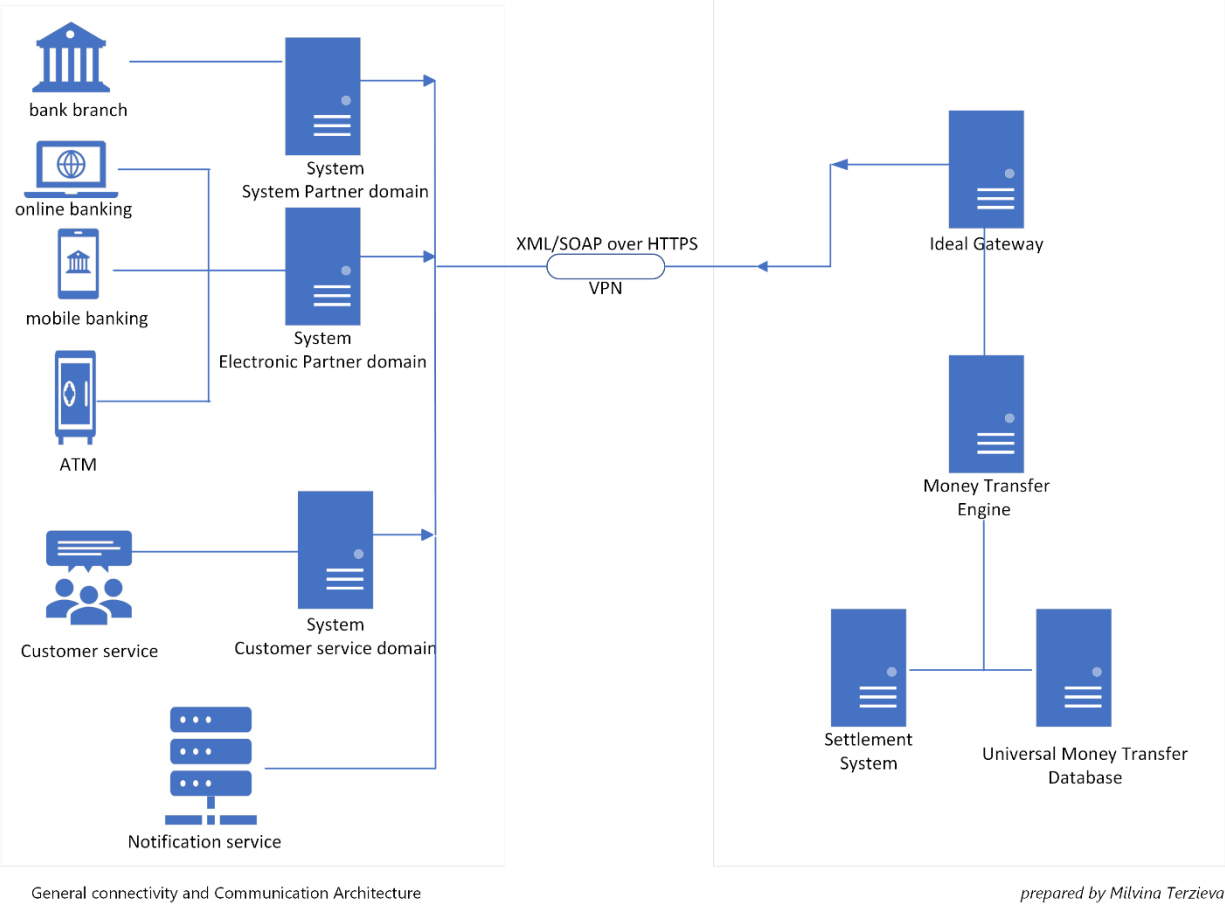

General connectivity and Communication Architecture   prepared by Milvina Terzieva

Fig. 4. General connectivity and communication architecture of Ideal gateway

3.3.2. Communication protocol

The Ideal Gateway utilizes standard SOAP and HTTPS protocols for communication. The system transmits an XML document containing all necessary transaction elements. Communication between parties is conducted through an XML request using the SOAP protocol and sent via HTTPS with the POST method. The designated client SSL certificate must be included in this request. Responses to requests are returned synchronously or asynchronously to the user identified from where the request was sent. The response is a new XML document compliant with the request and follows the communication conditions of the internet protocols.

To differentiate transactions between physical and electronic clients or customer service, the XML tag <device> is used. The value of this marker indicates the client (Client) from which the message was sent.

Table of clients and their associated device type values:

Domain	Possible Values for Device Type
Physical	AGENT, RETAIL
CSR	CSR
Electronic	ATM, WEB, IVR, MOBILE

Below is an example of the device tag used in an email message:
<device>
<id>WEB001</id>
<type>WEB</type>
</device>

3.3.3 Partner integration

The partner utilizes the Partner Integration Environment setup that Ideal provided to develop and test the interaction with the platform. After connecting to the Ideal Gateway, the partner executes basic transactions, ensuring the proper functioning of the Request-Response platform. Use case tests are conducted in the partner's environment, where they connect to Ideal's Partner Integration Platform and ensure that the format of requests and responses aligns with the partner's expectations, including checks and error messages.

Partner Integration connectivity - Depending on the interface protocol, the following URLs should be used by a partner to test integration with Ideal Gateway:
- XML / POST: **igateway1pi.ideal.net**
- SOAP: **igateway2pi.ideal.net**

These URLs are test environments and should only be used by partners during the development/integration phase. Further details will be provided for subsequent phases.

Upon completion of development, partners test the interface in the partner integration environment, executing test cases. An SSL certificate from Ideal is required to access the pre-production environment, where official testing occurs. The partner conducts self-checks, ensuring the new service meets requirements and undergoes testing in a test environment. The tests aim to identify and rectify errors, validate functionality, and assess performance before introducing the service into production. Test accounts are created and loaded with funds to test the money transfer service with Ideal. Test transfers are executed, followed by verifying the success of transfers in the test environment. The result indicates a successful integration and transmission of information for both sender and recipient.

3.4. Comparison between Bank Transaction, Ideal Transaction, and the innovative new Ideal Bank Transaction

The new banking service provided by Ideal is compared to two existing options - Bank Transaction and Ideal Transaction. The Bank Transaction is an international transfer conducted by a bank branch, subject to banking and regulatory procedures and fees, with varying execution times. Ideal Transaction offers fast international transfers with fees and currency exchange rates in real time or within a few hours.

The comparison was made using seven criteria:
1. Time to create a sent transaction

2. Shipment Fulfillment Time

3. Time to send a transaction

4. Users who can use the service in a different location from the servicing bank

5. Entities other than the servicing bank from which a transaction can be sent on a global scale

6. Entities other than the servicing bank in which a transaction can be received on a global scale

7. Service Fee

The comparison was made using a test environment. Test accounts have been created: sender and recipient who are not bank customers and sender and recipient who have a bank account; bank test customers' accounts are loaded with money. The results of the comparison are presented in Fig. 5.

	секунди			милиони			евро
	време за създаване на изпраща трансакция	време за изпълнение на изпращането	време за изплащане на трсансакция	хора, които могат да използват услугата в различна локация от обслужващата ги банка**	обекти, от които може да се изпраща различни от обслужващата банка в глобален мащаб*	обекти, в които може да се получава различни от обслужващат а банка в глобален мащаб*	такса
банкова трансакция	480	28800	180	0	0	0	30
Айдил трансакция	420	60	120	150	0.600	0.600	25
банкова трансакция използваща Айдил	120	60	100	3950	0.678	0.678	10
* според Световната банка на 100 000 човека има по 1 банков клон или 7.8 милиарда население 78 000 клона							
** според световната банка 69% от населението на възраст от 18г до 100г има банкови сметки или 3.8 милиарда							

Fig. 5. Comparison between bank transfer, Ideal transfer, and bank transfer using integration with Ideal

The comparison shows that the created new service is superior in all indicators to the existing two; as in indicators 4, 5, and 6, it has a significant advantage. The graphical interpretation of the data is given in Fig. 6.
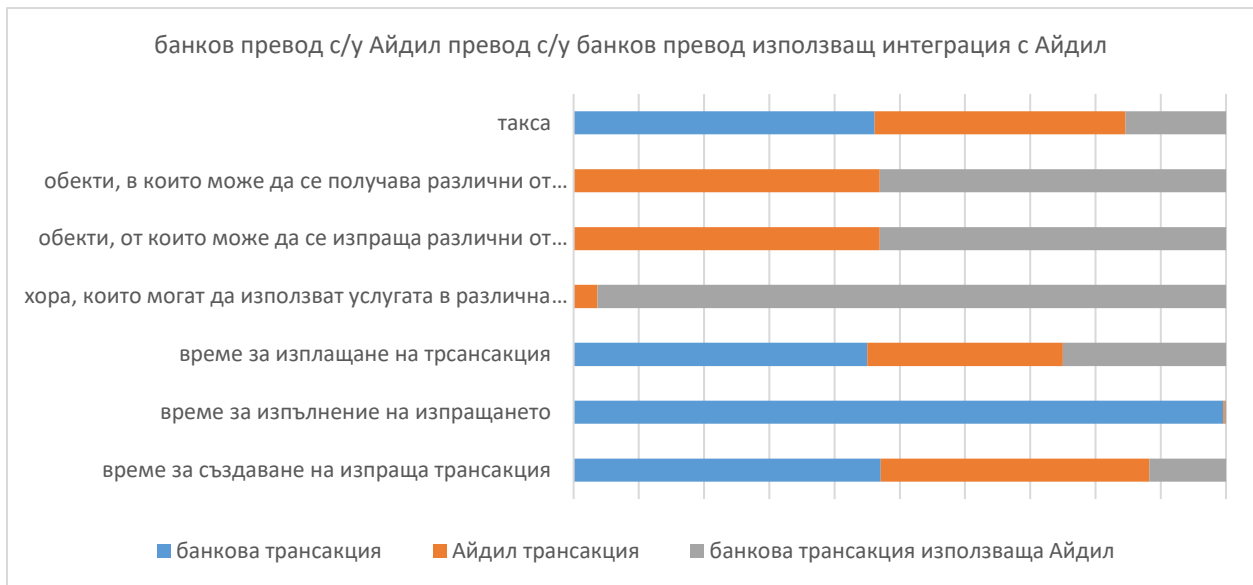
Fig. 6. Comparison between bank transfer, Ideal transfer, and bank transfer using integration with Ideal (new service)

3.5. Conclusions

Traditional international bank transactions often require 1-3 business days for the transfer, a mandatory bank account for the recipient, and the use of correspondent banks, which can worsen the time and costs involved. In the Eurozone, maximum transaction fees are defined, but outside of it, fees are often high, reaching 100-200 euros, and recipients often incur additional incoming transfer fees.

Advantages of the new financial service:

1. Transfer and Banking Time: the time required to successfully send and receive international money transfers, usually between 1 and 3 business days. In addition, the importance of mandatory bank customership of the recipient as a requirement for executing the transfer is emphasized.

2. Bank correspondents and their impact: the number of bank correspondents affects the speed and costs of international money transfers. It is expressly noted that an increase in the number of correspondents may lead to delays and increased costs due to multiple transitions and related fees.

3. Fees outside the Eurozone: In the Eurozone or the so-called SEPA countries, there is a maximum limit for the fees associated with transfers in euros, but outside of it, the costs can be extremely high. Also highlighted is that recipients are often required to pay input fees associated with non-SEPA countries or transfers in a non-euro currency from a SEPA country, further increasing the cost of transferring funds.

In addition to the above, the implemented integration of banking technologies allows:

o the translation is completed in seconds,

Do you have the flexibility to be or not be a bank customer,

o even if you are a bank customer, you can withdraw it in the money transfer in cash from a commercial establishment (for example, a pharmacy, as long as it is in the Ideal partner network)

o the sender pays a much lower shipping fee

If the recipient does not pay an incoming fee for an international transfer

o a "space profile" is created in the Ideal server, which is automatically saved in the banking system, and there will be no need to enter the data of the sender and/or recipient every time, regardless of the chosen method of sending and/or receiving

o with biometric identification, there will be no need for employee confirmation of sender and/or recipient data

Throughout this process, there will be an opportunity to interact with an artificial intelligence chatbot available to assist if needed.

Chapter 4. Improvement of the developed new banking service with modern ICT

The integration of the designed fast money transfer system Ideal with the banking system allows the use of the physical network of the prompt money service provider to receive and send money transfers, as well as the branch network of the bank without the need for the recipient and sender to is a client of the financial institution – fig. 7. This allows transfers to be made in seconds, a low service fee to be paid, and money to be received and/or sent from anywhere in the world 24/7.

As an essential additional feature, after the one-time use of Ideal's services, both the sender and the recipient, a "space profile" is established, the information of which is actively entered and stored in the banking system. This profile provides deep integration between the platform and financial institutions, allowing users to maintain consolidated information and facilitate future transactions. Users access the information through a Biometric Recognition method where artificial intelligence performs analysis of biometric data such as fingerprints, face, voice, and other physical characteristics.
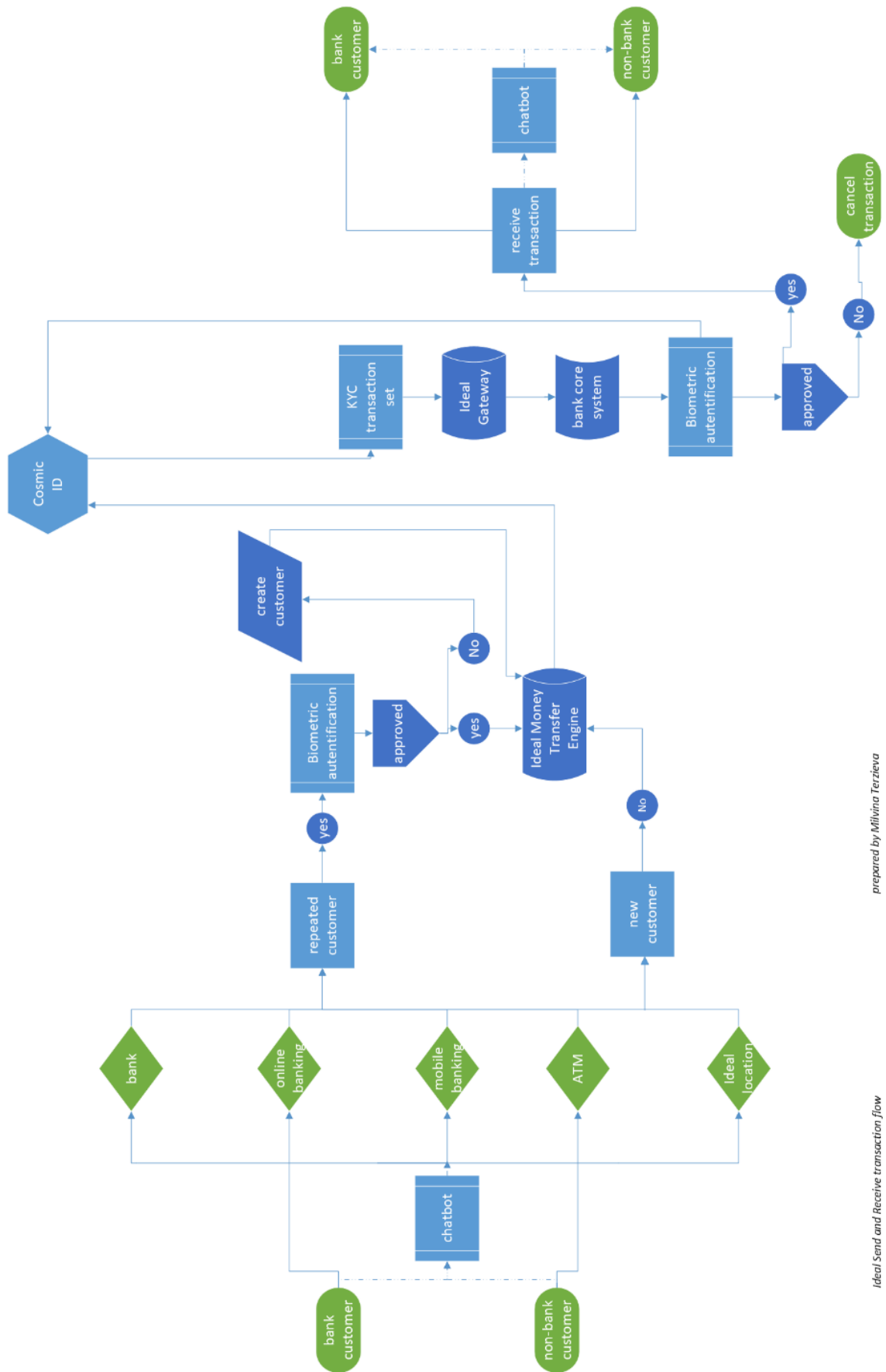
fig. 7. Ideal process of sending and receiving money transfer

4.1. Integration of artificial intelligence elements into the new service

To improve the customer's satisfaction with the new service, this dissertation proposes integrating an aspect of artificial intelligence, such as a chatbot.

Artificial Intelligence (AI) chatbots will significantly benefit consumers and financial service providers.

Combining fast money transfers with an AI chatbot will offer convenience and security for customers and streamline processes for financial service providers.

The comparison was made using three criteria:
1. Time to create a sent transaction
2. Shipment Fulfillment Time
3. Customer satisfaction

The comparison was made using a test environment. The graphical interpretation of the data is given in Fig. 8.
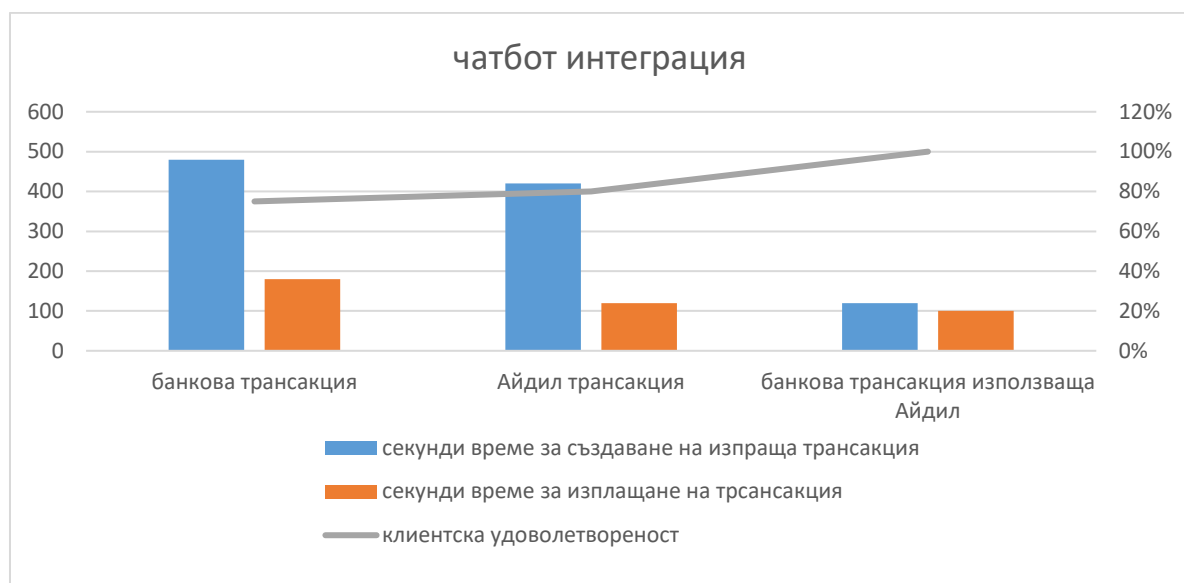

Fig. 8. Chatbot integration influence

The conclusion is that chatbot-assisted Ideal bank transfers are better than traditional methods in several ways. It is faster, more reliable, and more convenient for customers. Banking institutions implementing this product can expect efficiency, customer satisfaction, and competitiveness improvements.

4.2. Integration of the so-called "space profile" in the new service

Integrating the "cosmic profile" provides an enhanced financial service, ensuring convenience and speed in customer service when interacting with various locations of Ideal and partner platforms. This profile integrates user personal data while maintaining high standards of security and protection of personal information. Creating the "cosmic profile" facilitates interaction with different partners and enhances the personalized customer experience within the Ideal system.

An experiment compared three services: bank transfer, fast money transfer through Ideal, and bank transfer integrated with Ideal using AI and the Cosmic profile. The experiment aims to prove that the improved new service is superior to the others. The experiment employs

six different indicators to demonstrate the advantages of the enhanced service compared to existing ones.

• Transaction Time: How long does the customer take to complete a transaction?

• Who can use the service: Which customers can transact?

• Number of errors: How often do errors occur when performing a transaction?

• Facilities where the transaction can be carried out: Which offices and locations can customers use to carry out the transaction?

• Customer satisfaction: How satisfied are customers with the service?

The experiment was conducted with six customers divided into three groups:

• Group 1: Will use bank transfer

• Group 2: Will use the new fast translation service Ideal

• Group 3: Will use the improved new service: bank transfer integrated with Ideal using space profile and chatbot.

The indicators for each group are tracked over a specific time. After the experiment, the data is analyzed to determine which service is the best.

The expected result - the improved new service integrated with Ideal using space profile and chatbot achieves the best results in all indicators – fig. 9.

The diagram shows that according to the criterion "People using the service in a different location from the bank serving them," there is a significant advantage compared to the other two transactions. The new service has an advantage in the criteria of "Time to create a sent transaction," "Time to pay out the transaction," and "Customer satisfaction." The requirements "Entities from which non-serving bank can send globally" and "Entities where a non-serving bank can receive globally" show dominance of the new service.

Fig. 9. Space profile of money transfer sender and recipient

The Cosmic profile significantly speeds up transactions, eliminating the need for re-entering information and allowing customers, even if they are not banking clients, to be identified in the database.

The chatbot provides instructions and support, easing customers through the transaction process. Increased satisfaction leads to more frequent service use, ultimately boosting revenues.

In summary, the tandem of the Cosmic profile and AI chatbots greatly enhances international money transfers, providing greater convenience, efficiency, and security for both senders and beneficiaries. This improved service is advantageous for both consumers and the partner bank.

Chapter 5. Validation of the new financial service. Experiments, simulations, and results

Testing the new Ideal service for fast international money transfers with the help of a chatbot, biometric identification, and a space user profile includes various scenarios to ensure a smooth and secure operation.

5.1. Space User Profile:

1. Create Account. The space user profile creation process has been tested during user registration. Testing also includes verifying that users can successfully enter and save their personal information, including name, contact details, and identification documents.

2. Edit profile – The ability to edit and update information in the space user profile has been tested. The check shows that the changes are reflected correctly.

3. Saving the space profile in the banking system - it has been tested that users can be successfully registered in the system of the partner financial institution, and data fields are transferred successfully

5.1.1. Analysis of the probability of problems and errors in the functioning of the new service and ways to overcome them

Transfer failures can be caused by technical issues in the integration between the Cosmic user profile and the money transfer system and errors in data mapping and transformation. Problems in the server infrastructure or communication between system components can also contribute to failures. Errors and inaccuracies in the information stored in the Cosmic user profile and data synchronization issues can also lead to transfer problems.

Corrective actions:

To improve transfers, the following measures are recommended:

Technical Analysis: Conduct a detailed technical analysis of the integration between the Cosmic user profile and the transfer system to identify and resolve potential technical issues.

Data Updates: Enhance the accuracy and currency of information in the universal user profile by updating or automating the process of collecting and refreshing data.

Synchronization Tests: Perform data synchronization tests and update systems to ensure proper integration and transfer of information.

Monitoring and Feedback: Implement monitoring and feedback systems to track and respond to potential issues in real time.

5.2. Biometric identification

Biometric identification is done to improve the security and reliability of the identification process. It uses a person's unique physical or behavioral characteristics, such as

fingerprints, face, or voice, to identify them. The advantage is that it is harder to fake, more convenient to use, and harder to forget. Biometric identification requires specialized software and hardware. The software is used to collect and process the biometric data, and the hardware is used to scan the biometric data. Biometric identification is not built into the space profile.

1. Registration of biometric data - We are testing the process of registering biometric data (fingerprint, face, etc.) in the space user profile. We verify that users can successfully register their biometrics without errors.

2. Biometric Identification – We test biometric identification when accessing the space user profile. We make sure users can securely access their profiles via biometrics.

3. Fallback mechanism - We test what happens when biometric identification fails (for example, due to sensor problems). We check that there is a secure backup mechanism for alternative identification methods.

5.2.1. Analysis of the probability of problems and errors in the functioning of the new service and a way to overcome them

Causes of failure in biometric identification include:

Hardware or Sensor Issues: Problems with the hardware or sensors used for biometric recognition can lead to identification failures.

Algorithm Issues: Errors or shortcomings in the algorithms used for identification can result in failures, affecting the accuracy of biometric identification.

Server Infrastructure Problems: Issues with the server infrastructure or communication with it can contribute to failures in the biometric identification process.

Additionally, even after successful biometric identification, problems with access rights or other obstacles may prevent the user from gaining successful access to the system.

Corrective actions:

To address the issues related to biometric identification failures, the following measures are recommended:

Technical Review: Conduct a detailed technical analysis of the components involved in biometric identification to detect and rectify any problems.

Resource Access: Ensure that the user has the correct access to the resources or services granted to them after successful identification.

User Notification: In case of problems, inform users about the reasons for the failure and the steps they need to take.

By implementing these measures, you can improve the reliability and effectiveness of the biometric identification system.

5.3. Chatbot integration in the new service

1. Profile integration with chatbot. Testing has been done to integrate the chatbot successfully with the space user profile. It has been found that the chatbot can access users' relevant information to provide personalized assistance.

2. Profile-Based Recommendations. - Checked if the chatbot can provide personalized recommendations based on user profile data. Scenarios were tested where the chatbot suggested suitable transfer options.

5.3.1. Functionality analysis of chatbot integration

The reasons for failure include Incorrectly understood user queries or incorrect instructions from the chatbot; Errors in user communication, where the chatbot may not interpret the user's query correctly or provide incomplete or inaccurate instructions; Lack of context, where errors are due to insufficient context for understanding the user's question or transfer scenario; System problems, such as technical issues in the chatbot system, including service outages or database problems.

Corrective actions:

To improve the chatbot, the following initiatives are undertaken:

Bot Training: Optimizing models for enhanced recognition of user queries and providing more accurate responses.

Enhancing Context: Expanding the database with information and transfer scenarios to provide better instructions and advice.

Monitoring and Error Handling: Regularly monitor and detect errors and technical issues by the support team for quick and efficient resolution.

User Feedback: Utilizing user feedback enhances the chatbot and continuously addresses communication and functionality issues.

5.4. Money transfer scenarios:

1. Profile Data Transfer - We test money transfers using space user profile data. We make sure the recipient information is pre-populated and accurate.

2. Recipient Verification - We test the chatbot's ability to verify recipient information using space user profile data. We check whether it prompts users to fill in missing or incorrect recipient details.

5.4.1. Analysis of the functional possibilities of the bank transfer

Reason for failure: The failure may result from a lack of integration between the space user profile and the money transfer system, data processing errors, or communication problems.

Failure may be due to incorrect use of profile data in the recipient verification process, lack of validation, or data matching errors.

Corrective actions:

Review the code and configurations related to the integration between the account and the transfer system to identify and fix errors.

Perform extensive integration testing, including simulating various transfer scenarios to ensure proper functionality of account data.

Implement monitoring systems and automatic error notifications to ensure quick response in case of problems.

Review the recipient confirmation process and validation tests to ensure that profile data is used correctly and matches the entered data.

We implement additional data validation and verification steps to prevent recipient confirmation errors and inaccuracies.

They educate users on the importance of updating their account information and correctly entering recipient information when making transfers.

5.5. Usability and integration:

1. Mobile and Web Compatibility - We test the compatibility of the service with different devices and browsers. We make sure that the space user profile can be accessed smoothly.

2. Money transfer API integration - We check that the service integrates seamlessly with external payment systems and banks. We are testing transfers to different banks and payment providers using the account.

5.5.1. Analysis of the integration and functioning of the new service in real-time

Reason for failure: Failure can be due to insufficient testing on different devices and browsers, an unoptimized interface, or incorrect use of web standards.

Also, failure can be due to factors such as poor technical integration, data incompatibility, or communication problems between systems.

Corrective actions:

Compatibility Optimization: Optimize the interface and functionality of the Service to ensure compatibility with different devices and browsers.

Technical integration: Review of technical integration with external systems and corrections of potential problems or incompatibilities.

Testing and Optimization: Perform tests of transfers to different banks and payment providers to ensure correct functionality and speed of transfers.

Integration Monitoring: Implement integration monitoring and management systems to prevent future incidents and ensure continuous functionality.

5.6. Security of the use of biometric data in the new service

1. Security of Biometric Data - We ensure that the biometric data stored in the space user profile is securely protected. We test the service's response to unauthorized access to the biometric data.

2. Profile Data Security - We check that personal and sensitive information in the space user profile is encrypted and secure. We test for possible cases of data breach or unauthorized access.

3. Data protection and compliance with data privacy regulations - We ensure that the service complies with data privacy regulations (for example, GDPR). We check that user data, especially in the space user profile, is processed securely and by rules.

5.6.1. Analysis of the functionality of the new service for biometric data

Reason for the failure. Failure can be due to several factors:

Non-compliance with data privacy rules such as GDPR or other regulations.

Improper processing of user data.

Failure of the system to comply with data privacy regulations.

Need for more data protection in the space user profile.

The system is unable to detect and prevent unauthorized access.

Problems with the server infrastructure or communication between system components.

Corrective actions:

Regulatory Compliance: Review and update the system to comply with data privacy regulations such as GDPR.

Improving data processing: Improving data processing processes, including enhanced data protection and staff training to comply with data privacy rules.

System Compliance: Ensuring that the system is set up to comply with data privacy regulations and prevent improper processing of user data.

Improving data protection: Introducing more stringent data protection measures, including data encryption, restriction, and monitoring of unauthorized access.

Strengthening system response: Reviewing the system for detecting and preventing unauthorized access and implementing more effective measures to prevent security breaches.

Technical review: Perform a technical review of the system to detect and fix possible vulnerabilities or issues that can be exploited to breach security.

These test scenarios cover critical aspects of an Ideal fast money transfer service using a chatbot, biometric identification, and space user profile.

Considering the synergies gained from the partnership and the general threat of alternative solutions or providers, telecom operators and banks should look for opportunities to partner and fully exploit these areas of convergence.

Conclusion

In the study, testing the new Ideal service for fast international money transfers was successful, and an innovative approach was presented by integrating chatbot technology, biometric identification, and cosmic user profiles. Testing included diverse scenarios aimed at ensuring the smooth and secure operation of the service.

Key findings from the testing:

Innovative Chatbot Technology: The implementation of chatbot technology provided a faster and more efficient way for international money transfers, offering interactive and intuitive customer interactions.

Biometric Identification for Security: Using biometric identification improved the security and reliability of the process, providing a solution that is more difficult to forge and convenient to use.

Cosmic User Profile Integration: Integrating the cosmic user profile improved the management of customer financial information and provided comprehensive and flexible access to resources.

Scenarios to Ensure Functionality:

Testing involved various scenarios highlighting the need for detailed planning and control of the service stages.

Conclusions from the Testing:

Innovative Solution for Financial Transactions: Ideal represents an innovative and user-friendly solution that can change how international money transfers are conducted.

Suitable for a Broad Range of Users: With ease of use and no requirement for special technical knowledge, Ideal is suitable for a broad range of users.

Secure and Reliable Service: The service is secure and offers reliability in executing fast and accurate money transfers.

Meets the Requirements of Modern Markets: With proper planning and implementation, Ideal can provide seamless and secure customer service, meeting the growing demands of financial markets.

According to the testing conclusions, Ideal has the potential to be successfully embraced by users and establish itself as a preferred choice for international money transfers.

Dissertation Contributions

1. A new approach has been created to integrate modern financial information and communication technologies to create a new financial service.

2. A new real-time banking service was synthesized with three main components: physical customer, electronic customer, and customer service. The service uses information banking technologies and modern web communication standards.

3. The service has advantages compared to existing solutions regarding transfer time, bank correspondents, non-euro area fees, global coverage, etc.

4. An improvement of the new service has been developed with modern information and communication technologies, in which the space user profile technology has been integrated, providing convenience, personalized experience, and speed of service for the customer when he interacts with various partner locations of Idil platforms, including partner bank branches while at the same time maintaining the security and protection of the user's data.

5. Elements of artificial intelligence and biometric data are integrated into the service. The results of the testing confirm the usefulness of the new service.

6. The new service has been validated by performing tests with multiple scenarios on different indicators. The advantages of the service, alleged gaps, and methods to overcome them are proposed. The results of experiments and simulations confirm the benefits and usefulness of the service.

Acknowledgments