The payments ecosystem: where do we start?

"The story of payments is the story of how trust becomes technology".
A paraphrase of the ideas of Neha Narula, Director of the Digital Currency Initiative at the MIT Media Lab..

The origin of the payments ecosystem can be traced back to the emergence of trade in its most primitive form, when human beings began to exchange surplus agricultural production for necessary goods or services. It was in this context that the concept of payment was born, understood as the consideration associated with a transaction or exchange between two parties.

Since then, the payments ecosystem has undergone a progressive evolution, adapting and becoming more sophisticated to meet the changing needs of its participants. It encompasses a complex web of actors, infrastructures, regulations and technologies that facilitate the transfer of economic value between end users. This system includes both retail and wholesale payments, involving central banks, commercial banks, non-bank payment service providers, infrastructure operators and end users, as defined by the Bank for International Settlements (BIS[23]).

To understand the starting point that marks the most recent changes in the payments ecosystem, it is necessary to analyze its historical evolution, from its origins to the present day.

Barter Era - The first payments ecosystem

The most basic payments ecosystem consisted of two fundamental players: the sender (payer) and the receiver (payee). The transaction was materialized through a physical means of payment, which acted as consideration for the economic value agreed between both parties for the exchange of goods or services. (see figure 3).

Metal Age - Coin as a standardized means of payment

The appearance of the first coins, which occurred in Lydia (in the west of present-day Turkey) in the middle of the 7th century B.C., represented a real revolution in the history of payments, giving rise to the so-called "Metal Age"[24] represented a real revolution in the history of payments, giving rise to the so-called "Metal Age". This period is characterized by two fundamental milestones: (see figure 4):

- For the first time, the three essential functions of money are unified in a single instrument: unit of account, medium of exchange and store of value[25].
- A new central player was incorporated into the payments ecosystem: the coin-issuing entity - known as the Mint - whose main function was to produce coins accepted as legal tender, guaranteed by a sovereign authority that ensured their authenticity, security and resistance to counterfeiting.

Mint

Although the first monetary issues arose as private initiatives, the backing of value provided by the coins minted by sovereigns progressively led to the issuance of currency, which became the exclusive prerogative of public authorities who, initially, used coins as a means of financing their own spending needs. Over time, coinage evolved into a monetary policy tool. The first interventions of the authorities on the alloy of coins constitute the historical background of the progressive decoupling of the nominal value of coins from their intrinsic value.

[23] BIS *Committee on Payments and Market Infrastructures - Fast payments – Enhancing the speed and availability of retail payments* (https://www.bis.org/cpmi/publ/d154.pdf).
[24] Glyn Davies (1919 - 2003: Professor of Economics at the University of Wales and economic advisor to the British government), *A History of Money: From Ancient Times to the Present Day* –2002.
[25] Pavlek, D. Wintersy, J. Morin, O. (2019) *Journal of Anthropological Archaeology Ancient coin designs encoded increasing amounts of economic information over centuries* https://doi.org/10.1016/j.jaa.2019.10110.

Figure 3. Basic payment through barter.

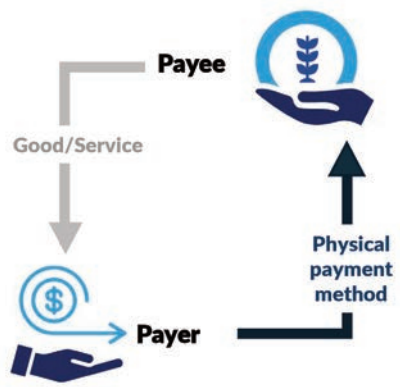
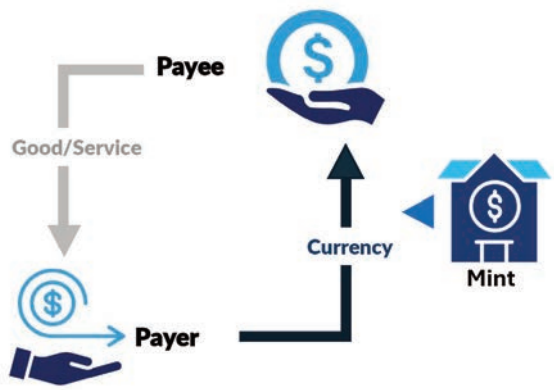


Figure 4. Payment through mint-issued currency.



Paper Era - Financial system dominates the payments ecosystem

Although paper money's earliest consolidated use occurred during the Song dynasty in the 11th century, it appeared in the 7th century during the Tang dynasty. This, coupled with the subsequent creation of central banks, constituted a second revolution in the history of payments, giving rise to the so-called "Paper Era". This period is characterized by several fundamental elements:

- Beginning of fiat money: The use of coins whose value no longer depends on their intrinsic composition, but on the trust placed in the issuing authority is introduced. Central banks begin to issue banknotes backed by gold or silver reserves, establishing the basis of the modern monetary system.

- Birth of contemporary payment services, aimed at providing users with capabilities such as:

  - Deposit and withdrawal of cash in bank accounts.
  - Sending funds through transfers between accounts.
  - Initiation of payment transactions by ordering entities instructed by payers.
  - Execution of payment operations in favor of debt collectors.
  - Issuance of payment instruments (bills, coins, cards, among others).
  - Aggregation and management of financial information.

- Consolidation of commercial banking: Beginning in the 17th and 18th centuries, commercial banking emerged as a centralizing agent in the execution of payment transactions. During this period, key innovations such as wire transfers were developed, and new correspondent banks and clearing and settlement houses emerged. Likewise, the payments ecosystem came to be regulated by rules established and supervised by central banks, with the aim of guaranteeing the security of transactions and the stability of the financial system as a whole. (see figure 5).

Correspondent bank

A correspondent bank is a financial institution that provides services in its own market to a foreign bank that is not headquartered in that country, or to any bank that lacks direct access to certain clearing or settlement houses. For this purpose, the bank requiring these services opens an account at the correspondent bank, called a "nostro account", from which payments and collections in the target market are centralized.

Clearing and Settlement Houses

Clearing and settlement houses are institutions in charge of processing payment transactions between financial institutions.

- Payment netting involves the netting of multiple collection and payment transactions, where the clearing house assumes the role of a central counterparty to reduce the risk of non-payment and simplify obligations between participants.

Figure 5. Payment by transfer.

History of means of payment: from barter to smart payments.

Throughout history, societies have adopted various means of payment to facilitate transactions and improve the quality of life. Reflecting the dominant business models and underlying mechanisms used to facilitate exchanges, the payments ecosystem has evolved through several stages: the Barter Era, the Metal Era, the Paper Era, the Plastic Era, the Account Era, and the current Decoupled Era (see Figure 6).

In its initial phase, the exchange of goods and services was carried out through barter, a system based on reciprocity and the coincidence of needs between the parties. However, the inherent limitations of this model - such as the difficulty of finding a counterpart with complementary needs - led to the appearance of the first coins with intrinsic value in Anatolia (modern-day Turkey) around the 7th century BC. This marked the beginning of the Metal Age. Initially minted in precious metals, coins gradually spread across various regions and, over time, began to be manufactured from materials of lesser value to meet the growing demand.

One of the most significant milestones in the evolution of payments was the creation of paper money in China around the 7th century, during the Tang dynasty, marking the beginning of the Paper Age. This instrument, with its value backed by a specific amount of precious metals, overcame some of the disadvantages of metallic coins, especially in terms of transportation and storage. Following the emergence of the first central banks in the 17th century, and with growing importance during the 18th century, paper money became the primary means of payment, giving rise to the fiduciary system, where banknotes were issued by banks and backed by gold or silver reserves. At this stage, payments were mainly made with cash and paper documents, such as checks and money orders. In 1872, the Western Union company innovated with the first money transfer service via telegraph, allowing funds to be sent remotely using code books and passwords, marking a significant advancement in payment services.

Some 1,300 years after the introduction of paper money, a new instrument emerged: the payment card, ushering in the Plastic Age. The first card was issued in 1914, when Western Union[1] offered its customers a no-fee line of credit. Later, in the 1950s, Diners Club cards were introduced[2] , acting as an intermediary between restaurants and customers to defer payment for consumption, charging a fee for the service. This is considered the origin of the modern credit card.

The Plastic Era was marked by the widespread use of debit and credit cards, which introduced three major innovations: the possibility of making cashless payments, the option of accessing credit for deferred purchases, and, decades later, the ability to make purchases online. This development played a key role in the internationalization of retail trade. On the technical front, advances such as the magnetic stripe (1969) were introduced, followed by additional security features such as the personal identification number (PIN) and embedded chips to protect users' funds.

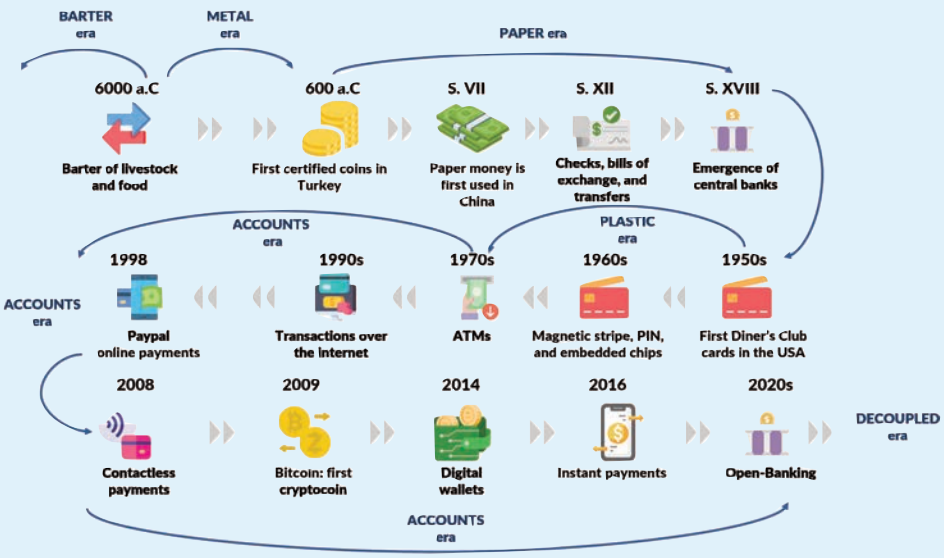
Beginning in the 1990s, the expansion of the Internet and digital technologies gave rise to online banking and electronic payments, ushering in the Accounts era. Users could now make payments and purchases without physically visiting a point of sale, reducing their reliance on physical cards. A pivotal development during this period was the founding of PayPal in 1998, considered the first major modern fintech. Initially conceived to facilitate transfers between PDA devices[3] , the company evolved into a platform for payments between individuals and businesses over the Internet, radically transforming the global payments ecosystem.

Currently, the payments ecosystem is transitioning into a new phase, often referred to as the Decoupled Era. This stage is characterized by the increasing decoupling of payments from traditional bank accounts. Emerging technologies such as artificial intelligence, blockchain and tokenization have redefined the payments infrastructure, enabling innovations such as digital wallets and standalone applications, largely driven by technology companies outside the banking sector.

In the future, a greater decentralization of means of payment is expected, driven by the expansion of cryptocurrencies and digital currencies issued by central banks (Central Bank Digital Currencies, CBDCs). These developments are set to structurally transform how financial transactions are carried out, validated and managed on a global level.

[1] 6 fascinating things about Western Union's history - Blog | Western Union.
[2] History and Legacy | Diners Club International.
[3] PDAs (Personal Digital Assistants) were portable electronic devices designed to function as digital personal organizers. They were popular before the rise of smartphones, especially during the 1990s and early 2000s.

Figure 6. Summary of the historical evolution of monetary transactions.



- Settlement consists of the actual execution of the movement of funds between bank accounts.

Over time, clearing and settlement houses have expanded their functions to include the provision of collateral and liquidity facilities, thus strengthening the stability of the financial system.

Plastic Era - A new means of payment is born: the card

In the mid-20th century, the appearance of the first payment cards marked the beginning of the so-called "Plastic Era", constituting the third major revolution in the payments ecosystem. This breakthrough introduced two fundamental transformations:

- For the first time, merchants were able to directly access the funds available in the customer's account, without the need to resort to checks, cash or bank transfers.

- Although the new model required the incorporation of new players into the ecosystem, the primacy of the financial system was maintained, articulated around the following actors (see figure 7):

    - Issuers.
    - Acquirers.
    - Card networks.
    - Payment processors.
    - Payment gateways.
    - Payment facilitators (Payfacs).

Issuers

Issuers are financial institutions that issue credit or debit cards on behalf of card networks. Their role includes verifying the cardholder's identity and guaranteeing sufficient funds to authorize the transaction, thereby assuming credit and operational risks.

Acquirers

Acquirers are financial institutions that process card payments at merchant locations. They act as intermediaries between the merchant and the issuer, accepting payment from the customer and then transferring the funds to the appropriate issuer. Some acquirers may also operate as payment processors or Independent Sales Organizations (ISOs), both international (e.g. Fiserv, Adyen) and domestic (e.g. Transbank in Chile, Cielo in Brazil).

Card networks

Credit card networks - such as Visa, Mastercard, American Express or Discover - are organizations that connect issuers, acquirers, merchants and consumers. Their role is to:

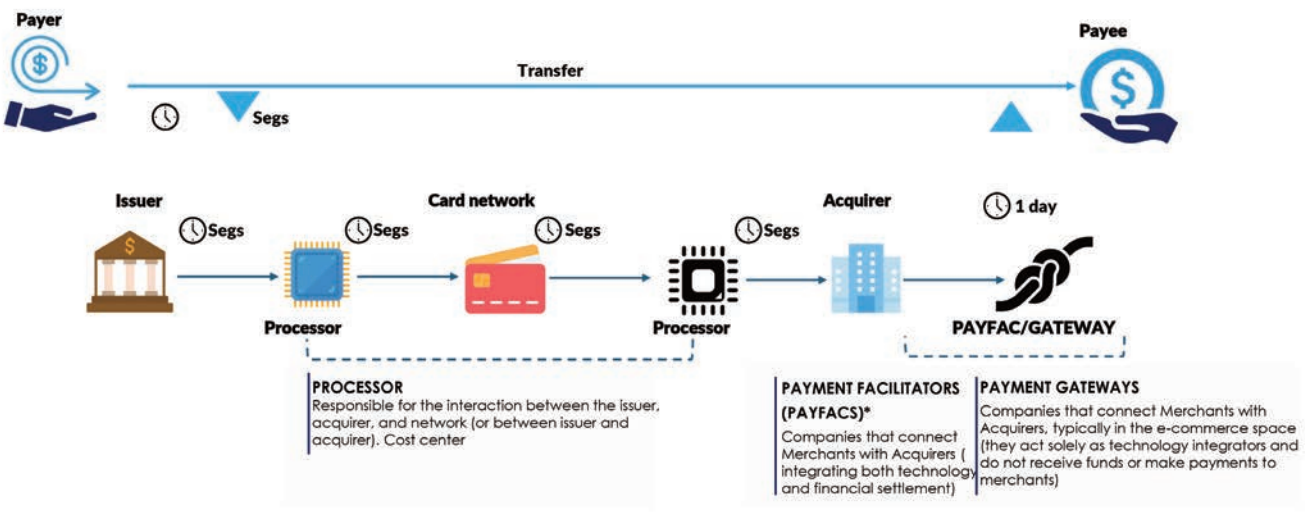
- Transmit transaction data between the parties involved.

- Supervise the settlement and clearing processes.

- Establish network operations and compliance policies.

These networks have contributed significantly to the international standardization of payments, allowing a previously fragmented ecosystem - where payment instruments were valid only in national contexts - to evolve into an interoperable environment on a global scale.

Figure 7. Card payments.



Payment processors

Payment processors are companies that provide electronic transaction processing services. Their functions include:

- Establishment of commercial accounts.
- Data transmission.
- Authorization of credit, debit and prepaid card transactions.
- Management of reimbursements.
- Application of fraud detection mechanisms.

There are two main types:

- Front-end processors, which route transactions to the issuing bank for authorization (e.g. Redsys in Spain, SIBS in Portugal).
- Back-end processors, which settle authorized transactions and transfer the funds to the merchant's bank (such as PayPal, Stripe or Adyen).

Payment gateways

Payment gateways are technology platforms that enable merchants to accept card payments - either online or at physical points of sale. Their function is to connect the merchant's website with the payment processor and issuer, encrypting the transaction information to ensure its security. Common examples include Stripe, PayPal and Flow.

Payment Facilitators (PayFacs)

Payment Facilitators or PayFacs are intermediaries between acquirers and merchants that simplify the onboarding process, especially for small and medium-sized businesses. Their model allows merchants to quickly integrate without the need to establish a direct relationship with an acquirer, thus optimizing the digital payment acceptance experience (see Figure 2). Common examples are Shopify Payments, Amazon Pay or Kushki (see Figure 8).

Definition of payment services.

Payment services encompass a range of financial products and services that enable individuals and companies to conduct the financial transactions necessary for their economic operations, as well as manage their liquidity and associated risks.

There are international regulations that cover both the payments ecosystem in general and payment services in particular. For example, the European PSD2 Directive[1] (Second Payment Services Directive) defines the following business activities as payment services:

- Services that allow the deposit and withdrawal of cash into or from a payment account, along with all operations necessary for managing these activities.
- Remittance of money and execution of payment transactions, whether or not the funds are covered by lines of credit, including:
  - Transfer of funds between different payment accounts.
  - Direct debits, whether recurring or non-recurring.
  - Payment transactions made by means of cards or similar devices.
- Issuance of payment instruments and/or acquisition of payment transactions.
- Payment initiation services.
- Account information services.

In Europe, the transposition of this directive into national legal systems has enabled the adoption of a uniform definition across all Member States. An example of this is Royal Decree-Law 19/2018[2] in Spain. Likewise, the regulation issued by the European Central Bank (ECB) on oversight requirements for systemically important payment systems[3] has helped align oversight criteria in this area.

Furthermore, other legislation from different regions maintains substantial consistency with this definition. This includes the United Kingdom´s Treasury regulations (Payment Services Regulations or PSRs)[4] , the regulations issued by the Federal Reserve Board in the United States[5] , as well as the regulations enacted by the main central banks in Latin America, such as the Payment System Law in Mexico[6] and the regulations applicable to the Brazilian Payment System[7].

[1]Directive 2015/2366 of the European Parliament and of the Council on payment services, art. 4 and Annex I.
[2]https://www.boe.es/eli/es/rdl/2018/11/23/19.
[3]European Central Bank: Regulation - 795/2014 - EN - EUR-Lex (europa.eu).
[4]The Payment Services Regulations 2017 (legislation.gov.uk).
[5]Federal Reserve Board - Policies: The Federal Reserve in the Payments System.
[6]Ley DOF 12-12-2002 de Sistemas de Pagos de México (https://www.diputados.gob.mx/LeyesBiblio/pdf/255.pdf).
[7]Rules of the Brazilian Payment System (SPB) created by Law No. 10 214/2001, Regulation No. 150/2021.

Era of Accounts - Disruption brought about by e-commerce

The emergence of the Internet at the end of the 20th century introduced a new disruptive factor - the fourth major milestone in the evolution of the payments ecosystem - by enabling the development of electronic commerce (e-commerce). This phenomenon quickly highlighted the inadequacy of traditional means of payment to meet the demands of the new digital environment, giving rise to what is known as the "Age of Accounts".

In September 1995, Canadian Mark Frazer made a historic purchase: a defective laser pointer acquired through a website called Auction Web. This transaction would become the first sale recorded by this platform, which years later would be renamed eBay. Founded just two months after Amazon, eBay would become one of the emblems of the e-commerce revolution that burst onto the scene at the end of the 1990s with the expansion of the World Wide Web.)

It is very likely that Frazer himself, like other early buyers, immediately experienced the limitations of existing payment methods. During the early years of e-commerce, most transactions were settled by sending checks or even cash by postal mail. Thus, the immediacy promised by the new digital environment was thwarted by slow, insecure and inefficient collection procedures that offered no guarantees either for the buyer (who had to pay before receiving the product) or for the seller (who had to ship the goods with no guarantee of collection).

Friction in the payment experience quickly became a major concern for large e-commerce platforms. In response, eBay sought to develop a solution of its own and, in 2000, launched Billpoint, a payment system powered by a start-up acquired the previous year, in a strategic alliance with Wells Fargo bank. This decision reflected the continued reliance on the traditional financial sector as a natural provider of payment services, given its hegemony over the previous two centuries.

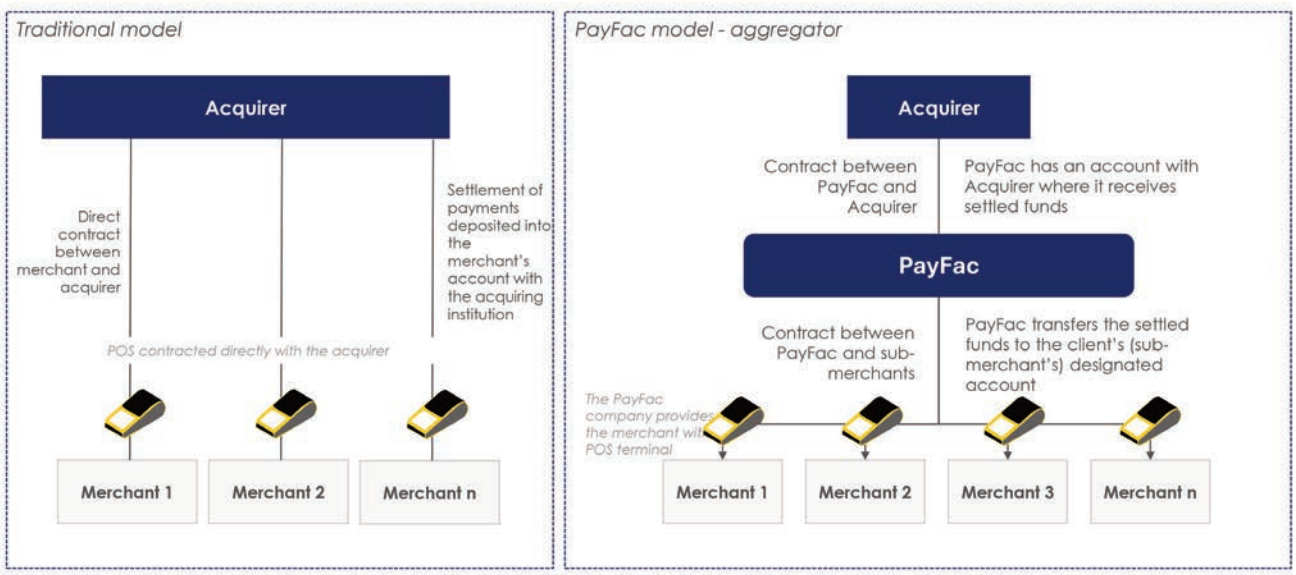
However, Billpoint failed to gain traction. Despite eBay's backing, users found an emerging technology solution outside the banking sector more convenient: PayPal[26], founded in 1998. PayPal's success marked a turning point in the history of the payments ecosystem by demonstrating that technology companies were in a position to compete with - and surpass - traditional players in the provisioning of innovative solutions.

Considered by many as the first modern fintech, PayPal symbolizes the moment when the financial system loses its monopoly over payments and begins to share the limelight with new players driven by digital transformation.

Over the last three decades, the payments industry has undergone a dizzying evolution. The rise of e-commerce and increasing digitalization generated expectations and needs among users that traditional financial institutions were only able to satisfy through profound organizational and technological transformations. This situation opened the way for the entry of new competitors, many of them from Silicon Valley, the epicenter of the contemporary technological revolution. As a result, the payments ecosystem has become one of the most innovative and dynamic sectors of the global financial system.

[26]PayPal's Place in FinTech: From Industry Pioneer to Modern Innovator, Jade Dagher Bentley University. Article available in the Social Science Research Network (SSRN).

Figure 8. Traditional relationship model between acquirers and merchants vs. relationship model using a PayFac.



Decoupled Era - Decentralization of financial services

Currently, several experts and monetary authorities agree that we are entering a new stage in the evolution of the payments ecosystem. This phase has been referred to by different names, such as "Decoupled Era", "Era of Digital Money", "Era of the Interoperable Ecosystem" or "Era of Programmable Accounts and Payments"[27]. In all cases, this stage represents a transformation that transcends the simple possession of a bank or digital account, and is characterized by automation, interoperability, the use of digital intelligence and the increasing decentralization of financial services.

In this new context, the very concept of currency is being redefined with the emergence of private cryptocurrencies - such as Bitcoin or Ethereum - and public digital currencies issued by central banks, such as the digital euro[28]. These innovations not only transform the way value is transferred, but also introduce new paradigms of monetary policy and financial supervision.

The fifth disruptive factor in the evolution of the payments ecosystem is considered to be precisely this decentralization of financial services. This structural change implies a profound transformation in the way financial services are designed, offered and consumed. Unlike traditional models based on centralized institutions - such as banks, stock exchanges or insurance companies - decentralization uses technologies such as blockchain and smart contracts to enable direct transactions between users, eliminating the need for intermediaries.

This new paradigm enables more agile, programmable and transparent financial structures, where the processes of validation and execution of payments, loans, investments or insurance can be carried out automatically and securely, through algorithms and distributed platforms. The following table shows a comparison between traditional finance and decentralized finance based on the most relevant parameters that define the functioning of the payments ecosystem (see figure 9).

[27] "We are transitioning to an ecosystem where money is not only digital, but also programmable, interoperable and smart. This is a new paradigm in the architecture of money." - BIS, Blueprint for the future monetary system, 2022 https://www.bis.org/publ/arpdf/ar2022e.pdf.

[28] "The digital euro, one of the main Central Bank Digital Currencies (CBDCs) envisioned, would be a digital currency of the European Central Bank. Designed as an electronic equivalent to cash and would thus complement banknotes and coins, it seeks to provide citizens with an additional choice on how to pay" - European Central Bank - Digital Euro: Frequently Asked Questions (https://www.ecb.europa.eu/paym/digital_euro/html/index.en.html).

Figure 9: Comparison between traditional and decentralized finance.

	Traditional finance	Decentralized Finance
Intermediaries	Banks, stock exchanges, insurance companies, regulated entities	Automated protocols in blockchain (smart contracts)
Infrastructure	Centralized and based on private servers	Decentralized and on public blockchain networks
Custody of assets	Generally in the hands of a financial institution or intermediary	Self-custody (non-custodial) and under the control of the individual
Transparency	Partial: depends on the regulator or audits	Complete: public code and transactions on blockchain for all agents with access
Regulation	Strong, issued by national and supranational authorities	Little to no direct regulation at present (evolving)
Operating speed	Subject to internal schedules and processes of both intermediaries and central clearing houses (e.g., cut-off times and working days)	24x7, global and with no time restrictions
Main risks	Operational failures, counterparty risk, stringent regulation	Code errors, cybersecurity and hacks, volatility, lack of legal backing
Governance	Governments, central banks and financial institutions	Users via governance tokens - Decentralized Autonomous Organization (DAOs)