Implications for financial market infrastructures of a wholesale central bank digital currency based on distributed ledger technology

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IMPLICATIONS FOR FINANCIAL MARKET INFRASTRUCTURES OF A WHOLESALE CENTRAL BANK DIGITAL CURRENCY BASED ON DISTRIBUTED LEDGER TECHNOLOGY

Abstract

An ongoing debate is raging about the possible issuance of a sovereign digital currency by national central banks. This article focuses on one part of this debate, specifically the impact that the issuance of a wholesale central bank digital currency based on distributed ledger technology (DLT)[1] could have on financial market infrastructures (FMIs). A sovereign digital currency issued within the network could harness the potential of DLT as an exchange mechanism that, by its very design, mitigates liquidity and credit risks. The article identifies the main areas where this would affect the existing FMIs, classified according to the potential significance of this impact compared with the services these infrastructures currently provide, to allow them to offer enhanced services that would be difficult to achieve with present technology.

1 Introduction

The debate on the advisability of the issuance of a digital currency by national central banks, generally known as a sovereign or central bank digital currency (CBDC) has recently intensified. This is a broad debate that covers the issuance both of a retail and a wholesale central bank digital currency. Issuance of a retail CBDC, as a supplement to cash and deposits, and accessible to all kinds of users, poses a huge challenge for national central banks. They would face a complex process, with a high number of potential users and a multitude of aspects and implications across a broad range of spheres. In addition, to assess a retail CBDC issuance it is essential to consider the specific characteristics of each region and their cash use patterns (to date, in most countries, the only way that individuals have access to central bank money). In this respect, the Eurosystem has begun to study the possibility of issuing a digital euro,[2] as part of its commitment to supply the public with a risk-free means of payment that meets their needs.

This debate also encompasses the possible issuance of a wholesale central bank digital currency (WCBDC), confined to a limited group of financial counterparties. This is a more limited debate: it may share some aspects, such as the technology issues, but it is less complex and has more limited implications. Indeed, there are

1 A database of which there are multiple identical copies distributed among several participants and which are updated in a synchronised manner by consensus of the parties.

2 ECB (2020c).

currently numerous digital currency initiatives developing, and many of the parties concerned are wondering what role central banks should play in these developments.

The potential issuance of a WCBDC would have implications for the direct competences of the Eurosystem, in terms of its responsibility for monetary policy, for the purposes of supervision of financial institutions and, lastly and possibly most directly, as regards its responsibility for promoting the smooth operation of payment systems.[3] This analysis aims to identify precisely those aspects of a WCBDC that would affect the existing FMIs and, therefore, concentrates on this third competence. It is important to note, in this respect, that FMIs are constantly evolving, on account of developments in technology that entail efficiency gains for these infrastructures.

Recently, some new private initiatives aim to offer wholesale means of payment based on tokens, that is, units of value issued and backed by private institutions (wholesale stablecoins),[4] as opposed to other projects that have public sector backing. In this respect, the European Commission's legislative initiative to create a pilot regime for FMIs based on DLT, as part of the Digital Finance Package,[5] deserves a special mention. This initiative expressly advises that – whenever possible within the DLT infrastructures – payments should be made in central bank money (potentially a WCBDC).

When we refer to the issuance of a new WCBDC, it is important to note that bank reserves held at central banks already constitute a form of WCBDC.[6] Moreover, TARGET[7] services already operate electronically with this wholesale central bank currency. Accordingly, this article seeks to analyse the specific case of issuance of a WCBDC within a DLT network. Distributed technology is certainly not a necessary condition for the existence of a WCBDC, but the combination would offer a series of advantages that would be difficult to achieve with FMIs' current technology. Wholesale interbank transactions are a use case that would allow all the potential of distributed technology to be harnessed, to operate a network of participants with different interests but which share information. In addition, a WCBDC issued directly within the distributed network seems to be the most appropriate solution for exchanges inside the network, as it would provide a perfectly liquid and credit risk-free payment solution (the CBDC represents a claim on a central bank deposit and is, therefore, a risk-free asset).

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3 One of the Banco de España's functions is to promote the smooth operation and stability of the financial system and, specifically, of the payment systems (including TARGET2).

4 Digital assets designed to minimise their price volatility relative to a "stable" asset or basket of assets, maintaining price stability. They may be collateralised (backed by legal tender or other cryptocurrencies to ensure their stability) or algorithmic (based on algorithms and smart contracts that administer the supply of the tokens issued to ensure their stability). See Arner et al. (2020).

5 https://ec.europa.eu/info/publications/200924-digital-finance-proposals_en.

6 A centralised WCBDC based on entries in accounts open at the central bank.

7 Trans-European Automated Real-time Gross settlement Express Transfer system (see Annex).

In general, having all the necessary instruments to carry out exchanges within a single network or platform – i.e. end-to-end transactions – provides added value to any infrastructure. To perform this kind of end-to-end transactions within a DLT network, all participants must have access to a liquid and safe asset with which to settle transactions. This does not mean that it is technically impossible to deploy an alternative without a WCBDC issued within the network;[8] in that case, clearing and settlement would be carried out through the distributed network, but there would have to be an external link, as these settlements would be backed by funds held in a fiduciary account open in the conventional infrastructure. This option is, a priori, more complex and is not credit risk-free, whereas credit risk is mitigated if the WCBDC is issued within the network. In addition, a WCBDC mitigates the potential liquidity risk present in the private initiatives in the event of a possible unexpected surge in demand.

2 Role of the Eurosystem's existing FMIs

A financial market infrastructure is a multilateral system among participating institutions, including the operator of the system, used for the purposes of clearing, settling or recording payments, securities, derivatives or other financial transactions.[9] The Eurosystem is the monetary authority of the euro area, comprising the European Central Bank (ECB) and the national central banks of the Member States whose currency is the euro. Its primary objective is to maintain price stability. Within the Eurosystem, the TARGET services play a key role. Developed and managed by the Eurosystem, they ensure the free flow of cash, securities and collateral across Europe. All these transactions are settled – finally and irrevocably – in central bank money. The TARGET services comprise: TARGET2 (the real-time gross settlement (RTGS) system), TARGET2-Securities (the securities settlement platform) and TIPS (the instant payment settlement service).

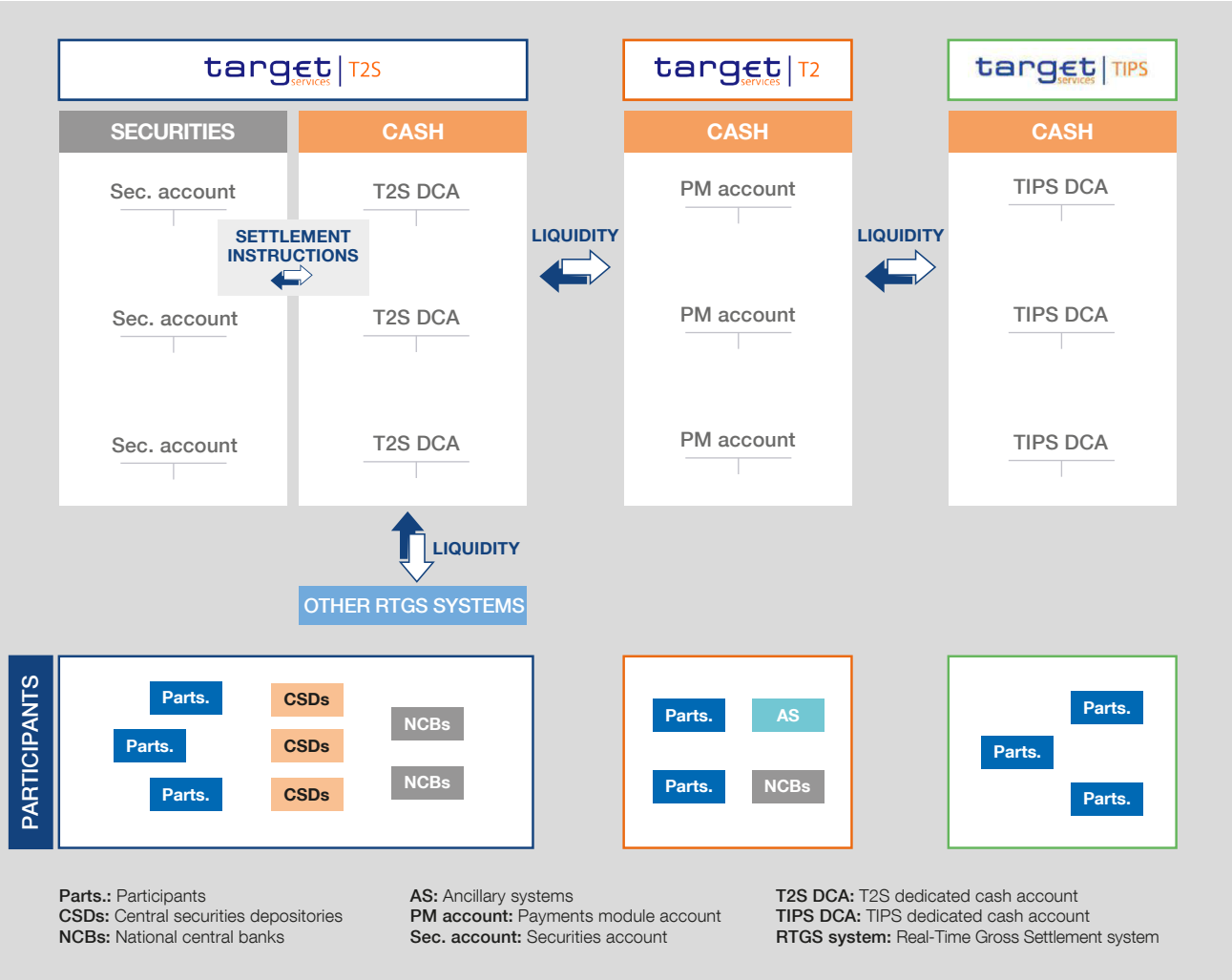
TARGET2 is a payment system managed by the Eurosystem that allows for the exchange of transactions between the participating financial institutions. It is a single shared platform (SSP) that offers the same level of service to all participants. From a legal standpoint, TARGET2 comprises the different national components of the euro area countries (or of other European Union countries whose central banks have decided to join the system). Thus, TARGET2-BE is a payment system managed by the Banco de España[10] and the Spanish component of the TARGET2 large-value payment system in euro. In general terms, transactions are settled one-by-one (gross) and in real time, i.e. as soon as they enter the system. If there are queued

8 Project Helvetia.

9 Committee on Payment and Settlement Systems and Technical Committee of the International Organization of Securities Commissions (2012).

10 Article 8 of Law 41/1999 of 12 November 1999 on payment and securities settlement systems (Spanish version only).

Figure 1
TARGET SERVICES AND PARTICIPANTS



SOURCE: Devised by authors.

transactions owing to a lack of funds, the system activates certain liquidity optimisation routines that allow them to be netted, thus settling transactions that would otherwise have remained in the queue awaiting funds. The platform permits execution of euro area monetary policy and processes both interbank and customer transactions (generally large-value transactions) through the cash accounts opened by the participating institutions.

TARGET2-Securities (T2S) is a pan-European single platform, owned by the Eurosystem, which provides for centralised settlement in central bank money of securities transactions in euro or in other currencies (multi-currency settlement). By grouping securities accounts and cash accounts together on one platform, it is able to provide an integrated, neutral and borderless settlement service. T2S offers central securities depositories (CSDs) a shared, technical solution for settlement of securities transactions. The CSDs maintain their business and contractual relations

with their participants and continue to provide securities custody and administration services (such as managing corporate actions), as well as other added-value services. T2S offers real-time gross settlement of securities (for delivery free of payment and delivery versus payment), together with night-time batch settlement, using sophisticated algorithms. It also includes various optimisation routines, which are used to improve system liquidity and increase settlement efficiency (auto-collateralisation, prioritisation and partial settlement of instructions, settlement algorithms, optimisation and recycling of unmatched transactions, en bloc settlement instruction chains, etc.), and the domain responsible for liquidity management in the dedicated cash accounts.

TARGET Instant Payment Settlement (TIPS)[11] is a Eurosystem service that enables payment service providers to offer instant credit transfers in the retail sphere around the clock. TIPS was developed as an extension of TARGET2 and has been used to settle payments in central bank money since November 2018. At present, TIPS only settles payments in euro, but as from May 2022 it will start to settle instant payments in Swedish kronor.

The Eurosystem participates in a series of initiatives that primarily seek to promote efficiency and innovation and, ultimately, to achieve greater integration of Europe's financial markets. Consistent with this strategy, the Eurosystem is investigating ways to improve its FMIs, to allow them to continue to meet market needs, anticipate cybersecurity challenges and keep up to date with advances in technology.

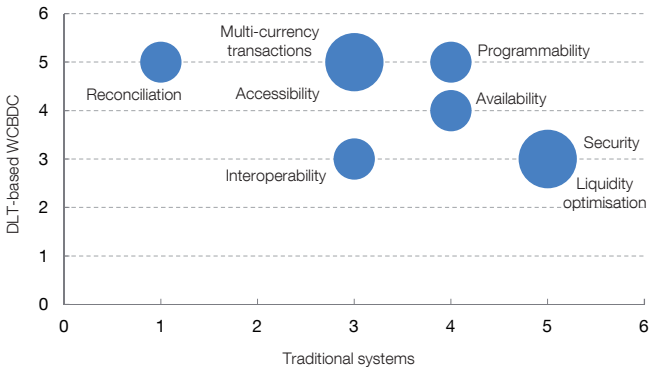
In addition to these services, other projects are being developed. T2-T2S consolidation is a project to replace TARGET2 with a new real-time gross settlement system to enhance optimised liquidity management across all TARGET services. The Eurosystem Collateral Management System (ECMS) will be a single, standardised and harmonised system to manage assets used as collateral in Eurosystem credit operations.

3 Possible improvements within existing FMIs

Among the possible improvements, introducing a WCBDC issued within a DLT network entails a different framework which could potentially optimise the services offered by existing FMIs. Below we analyse the implications that such issuance could have, taking as reference the systems described in the previous section. The aspects identified are classified according to their greater or lesser potential impact for today's payment and securities settlement systems. The aim is to determine whether such a change is essential in order for certain improvements to be achieved (i.e. they would be difficult to achieve at the existing FMIs), or whether, on the

11 https://www.ecb.europa.eu/paym/target/tips/html/index.en.html.

Chart 1
AREAS OF IMPACT IDENTIFIED



SOURCE: Devised by authors.

contrary, these are areas where the existing FMIs already offer satisfactory services, or have sufficient potential to do so.

i) **Reconciliation of transactions** entails a high cost for institutions, both in terms of time and resources. Currently, external data sources must be used which are managed on a centralised basis and must be integrated into the institutions' own systems in order to make the reconciliation. DLT networks can simplify these processes,[12] since as they operate with a single database shared by all the participants, the data used will be complete, real-time and identical. This means that **reconciliation would be more efficient,** to the point that it may be made in real time or may even become unnecessary.[13] In any event, although issuing a WCBDC within a DLT network could accelerate the innovation process, integration processes with institutions' internal systems would be required.

   Complementary technologies, such as artificial intelligence (AI), may also contribute to achieving large-scale efficiency gains for automation of reconciliation processes in the existing systems.[14] These technologies are compatible with – but not exclusive to – DLT networks.

12 World Bank Group (2017)

13 Project Ubin Phase 3. See Deloitte 2018.

14 At present, FMI participating institutions' data management systems must include reconciliation rules for all the data on account statements and entries in accounts that are sent from a centralised platform. Using AI-based IT solutions and algorithms based on historical data patterns, these reconciliation processes could be fully automated.

ii) Efficiency, transparency and traceability gains for multi-currency international transactions[15] is precisely the area where most initiatives have emerged in recent years, both in the private sphere and involving central banks and authorities. Multi-currency international transactions have traditionally been manual processes, involving high costs and difficulties to trace the transactions and to ascertain their exact amount and the actual date of availability of funds at destination. These initiatives[16] have demonstrated the technical viability of DLT networks for such transactions, and also their ability to improve the user experience, speed up the transactions, reduce their complexity and their cost and enhance their transparency.[17] DLT networks would also improve data integrity and allow for the transaction status to be known in real time.[18] Lastly, they would represent an opportunity to lower the counterparty risk, as transactions could be settled directly in central bank money, and also to lower cross-border transaction costs. Accordingly, in general, the **potential issuance of a WCBDC integrated into a DLT network could enhance the efficiency, transparency and traceability of multi-currency transactions.**

iii) Regarding the number of direct participants in the TARGET services, aside from the regulatory and strategic considerations, there is currently a barrier to entry given the access requirements and the high connection costs that only banks with a high volume of activity can assume. **A decentralised platform could lower these barriers and enable direct access to settlement services to a larger number of participants.** This would make it possible to lower the "tiering",[19] or in other words, to reduce the number of indirect participants that settle through direct participants (which are institutions that hold a payments module account, a T2S dedicated cash account or a TIPS dedicated cash account[20] with a Eurosystem central bank).[21] This could mitigate the associated risks

15 CLS (Continuous Linked Settlement) is currently the world leader in multi-currency transaction settlement. It provides a payment versus payment (PvP) settlement service, thus mitigating settlement risk, and optimises the use of liquidity by means of a multilateral position netting system. However, it has certain limitations, in that transactions are only settled within a two-hour window and there is a window of only five hours for allocation of funds, both very distant from availability 24/7.

16 Among others, Project Inthanon-LionRock, launched by the Hong Kong Monetary Authority and the Bank of Thailand. See Bank of Thailand and Hong Kong Monetary Authority (2020).

17 Project Jasper Phases 1 and 2. See Payments Canada, Bank of Canada and R3 (2017).

18 Project Ubin Phase 1. See Deloitte (2017).

19 In a payment system, "tiering" refers to the proportion of institutions that participate indirectly in the system through access to accounts held by direct system participants, which offer settlement services. Tiering is limited in TARGET2 and amounts to around 6% in terms of value and 21% in terms of volume.

20 The following may be direct participants in TARGET2: credit institutions established in the European Union or the European Economic Area (EEA), including when they act through a branch established in the European Union or the EEA; credit institutions established outside the EEA, provided they act through a branch established in the European Union or the EEA; and the ECB and the national central banks of the EU Member States.

21 Guideline of the European Central Bank of 5 December 2012 on a Trans-European Automated Real-time Gross settlement Express Transfer system (TARGET2).

(credit, liquidity, operational and legal risk) both for the direct and the indirect participants.

iv) In large-value payments, most traffic is channelled through real-time gross settlement (RTGS) systems. These are generally specialised electronic fund transfer systems that transfer money and securities from one bank to another in real time (i.e. there is no waiting period, with transactions being settled as soon as they are processed) and on a gross basis (i.e. they are processed one-to-one, with no need for prior netting). Once processed, payments are final and irrevocable. However, these systems have limitations as regards to availability, largely imposed by technical restrictions. There are indications of a possible shift in traffic in large-value payments from these systems to instant payment platforms,[22] which provide for transfers of funds between users in real time, around the clock. In the not-too-distant future, the need for availability 24/7 could extend to all other settlement platforms.[23]

By integrating a WCBDC into a DLT network, RTGS systems could operate 24/7. These are highly resilient infrastructures that do not depend on a single validating authority. In addition, as they are decentralised,[24] maintenance tasks being performed on one part of the network would not halt operations on the rest of the network. Although there are operational hurdles to achieving availability 24/7 with existing technology, it would certainly be possible to increase the present level of availability. However, it is important to note that some TARGET service users have reported technical limitations on their ability to further increase availability. This casts **doubt over the real need to extend the availability of these services in the wholesale sphere.**

v) **Interoperability between wholesale payment and securities settlement systems** in the different economic areas worldwide is possibly one aspect where there is most room for improvement. However, this is not necessarily owing to technology-related reasons,[25] but may be for

22 This is already happening in the Netherlands, where credit institutions used to use an application to direct critical customer payments to TARGET2. Many of them no longer do so, and now direct such payments towards instant payment solutions. This has not yet happened in Spain, although it is true that as a result of the pandemic, the fall in the volume of customer payments is above the EU average.

23 In addition to availability, there are other factors that make instant payments more convenient: substantially lower costs than for T2 transfers, the increased limit for instant transfers (the SCT Inst scheme) that may encourage inter-company payments, real-time payments to customers, flexibility for making payments outside regular working hours and an improved user experience.

24 Although in the case of a wholesale system, there would be fewer participants than in a retail system.

25 Some of the technology-related reasons are: the use of different technical standards, differences in the development and implementation of APIs, the existence of legacy IT systems that cannot be easily adapted to the new requirements, and limited operating hours. An ongoing international initiative led by the FSB with the participation of the CPMI seeks to improve cross-border payments; see Committee on Payments and Market Infrastructures (2020).

strategic or cost-benefit reasons. In consequence, the volumes currently settled through multi-currency interoperable systems are quite low. Issuing a WCBDC integrated into a DLT platform could be an appropriate way to address some of these aspects, as the experience of central banks and authorities has shown, both in terms of connecting DLT systems with centralised systems and interconnecting different DLT platforms.[26]

As to the possibility of connecting different **securities settlement platforms to RTGS systems,** the conceptual analysis and experiments carried out[27] have shown that delivery versus payment (DvP) securities settlement is possible between different DLT platforms and even through connections with centralised platforms.[28] Indeed, in Europe, there is already an interconnection between RTGS systems (e.g. TARGET2 and Kronos2[29]) and a securities settlement platform (TARGET2-Securities).

Securities settlement services on the TARGET platform are currently connected to two RTGS systems,[30] and connections to a larger number of infrastructures would be technically possible. The securities are held and administered by Central Securities Depositories (CSDs), which perform this service on behalf of others by providing or holding securities accounts. In the case of transactions settled between participants of different CSDs (inter-CSD settlements), these services have evolved, with the integration of the national securities settlement services in Europe into a single infrastructure. As a result, securities settlement at the pan-European level is harmonised and simple, with a significant cut in costs and in central bank money. The TARGET services also permit settlement of transactions of external CSDs, that is, CSDs that are not direct platform participants,[31] even if there is no direct connection with other securities settlement platforms.

Accordingly, in general **the introduction of a WCBDC, either alone or as part of a DLT network, would not per se resolve the problem of international interconnectivity.** There are, however, other alternatives that could be studied in this respect.[32]

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26 Project Ubin Phase 4. See Accenture (2019).

27 Project Stella, an ECB/BOJ joint research project.

28 Project Stella Phase 3. See ECB and Bank of Japan (2018 and 2020).

29 Danmarks Nationalbank's real-time gross settlement system for payments in Danish kroner and collateral management system.

30 TARGET2 and Kronos2.

31 For this purpose, a T2S participating CSD must register the external CSD as its participant and configure the necessary statistical data (i.e. links and the corresponding accounts). T2S thus provides the tools for interoperability between different securities settlement systems worldwide, even if the platforms are not directly interconnected.

32 There are some examples of system interconnectivity with no need for a WCBDC or for DLT technology, for instance, in the European sphere, the technical interconnection between RTGS systems (e.g. TARGET2 and

vi) Recently, discussions abound on the different applications of programmable money, and how this could enhance the efficiency of the institutions connected to FMIs (contributing to complete automatic processing of transactions), to make payment systems more efficient. If this were introduced into a distributed network, it would grant access, through the use of smart contracts, to automatic execution of operations such as payment of interest. Essentially, these contracts are based on an IT protocol that automatically verifies and executes the underlying agreement, with no need for intermediaries. Although this level of **programmability** does not exist in today's RTGS systems, in general terms **automatic execution of operations could be achieved using other technologies,** specifically an application programming interface (API)[33] that connects external participants to the system. This could, however, entail greater exposure to these participants.[34]

vii) Regarding **liquidity optimisation routines,** although some conceptual tests and experiments using DLT networks in which central banks and authorities have participated have shown that they are technically viable,[35] they are not new, as the TARGET services have used such routines for years.[36] As for execution times at the existing FMIs,[37] there may be room for improvement, but there appears to be no urgent need to reduce these times for the services they currently provide. In consequence, **it seems that neither liquidity optimisation routines nor a possible improvement in execution times are determinant in the case for issuance of a WCBDC on a DLT platform.**

viii) **As regards the security, resilience and integrity of the FMIs, the TARGET services currently enjoy a high level of security.** The large

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Kronos2) and a securities settlement platform (TARGET2-Securities). In addition, in May 2022 the Swedish instant payment settlement service (RIX-INST) is expected to be connected to the TIPS platform for the settlement of instant payments in Swedish kronor, and a project for instant settlement of multi-currency (EUR-SEK) payments is at the research stage. Lastly, the euroSIC system processes all cross-border payments in euro from/to Switzerland, channelled through the Swiss Euro Clearing Bank, which acts as a link between the Swiss RTGS system and TARGET2.

One example outside Europe is the East African Payment System (EAPS), which connects the RTGS systems of Kenya, Uganda, Tanzania, Rwanda and Burundi. In this system, each national central bank holds an account at the other central banks and payments are settled in the local currencies of the participating countries.

33 A set of definitions and protocols used to develop and integrate software from different applications.

34 The "trigger solution", which would allow the settlement of smart contract-based transactions to be integrated into conventional payment systems, as in the case of TARGET2. See Deutsche Bundesbank (2020).

35 More specifically, Project Ubin Phase 2, in which the Monetary Authority of Singapore and 11 financial institutions have demonstrated that it is possible to implement measures of this kind in different types of DLT networks to perform RTGS functions. See Accenture (2017).

36 In addition, various initiatives are under way to design more advanced mathematical models to formulate algorithms that may be applied to the existing FMIs. In the case of securities settlement, T2S has a broad range of tools to optimise liquidity and securities settlement: auto-collateralisation, advanced settlement algorithms, optimisation and recycling of unmatched transactions, partial settlement of transactions and prioritisation of instructions.

37 See Annex.

volume of investment in this sphere[38] is acting as a major boost to security and to alignment with the stricter standards required to date. However, business continuity and contingency mechanisms in centralised systems require high investment and entail high maintenance costs.

Despite the numerous conceptual tests and experiments carried out, there are no published details on the cost that a DLT infrastructure of the size of the existing FMIs would entail, and no production-level experience that allows us to assess the investment required. In consequence, although DLT networks are intrinsically highly resilient – decentralised database technology which thus eliminates the risk of the single point of compromise – to date this does not appear sufficient, from a security standpoint, to warrant either a radical change in technology in the TARGET services, or the issuance of a WCBDC associated with that technology.

4 Final considerations

An overall analysis of the different areas that would be affected by the potential issuance of a WCBDC as part of a DLT network reveals that the gains identified do not, a priori, appear to warrant such a substantial change in FMIs in the short term. Especially considering that these infrastructures are currently undergoing changes, with a view to making gains in terms of innovation, efficiency and cyber resilience.

The proliferation of private initiatives and the interest shown in some jurisdictions could be a result of strategic positioning in light of the technological revolution in which we are immersed. However, it is difficult to imagine there will be a radical change in technology. Rather, we foresee a scenario in which the FMIs will gradually evolve, incorporating new functionalities and offering new possibilities to their participants, adopting solutions based on new technologies such as the DLT networks and with APIs playing a key role. In consequence, the Eurosystem as a whole should anticipate and lead the changes in payment systems, without losing sight of the private initiatives that have emerged and of the importance of time-to-market.

38 Cyber security enhancements: software integrity (recovery), data integrity (recovery), security testing (TIBER-EU, penetration testing) and security services (Security Operations Center, Incident Detection and Response).

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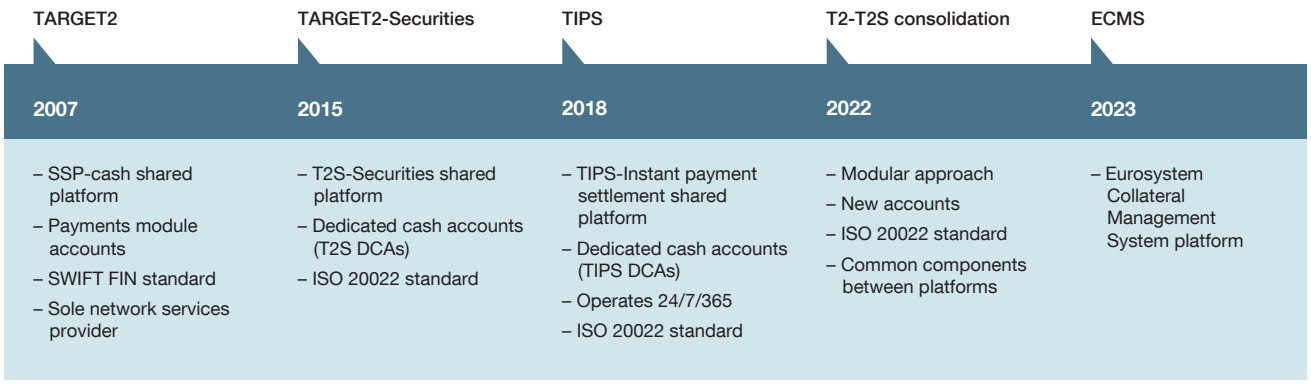
Figure A.1
TARGET SERVICES TIMELINE



SOURCE: Devised by authors.

TARGET2

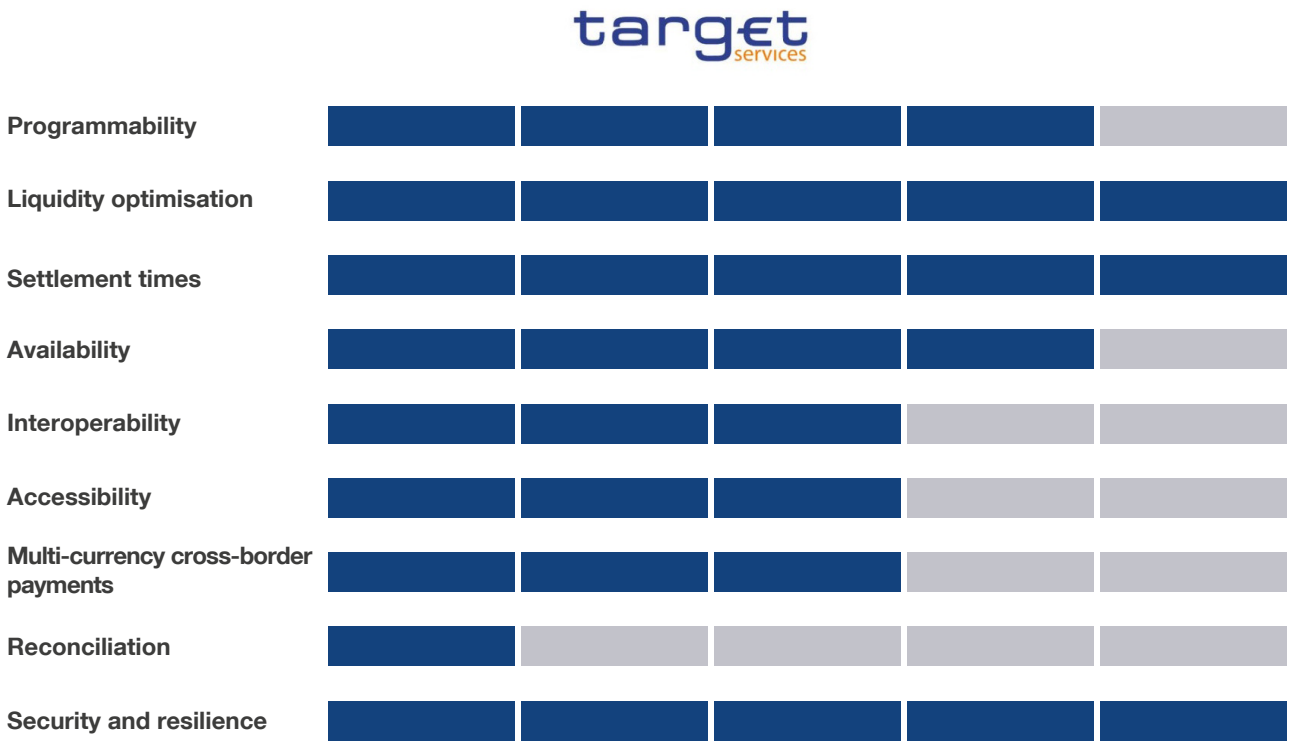
According to data published by the ECB (2020a), TARGET2 processes 88% of the value and 62% of the volume settled by large-value payment systems in euro. When settling transactions, participants can use priority options to optimise their liquidity management. They can also reserve liquidity and establish bilateral or multilateral limits with other participants. Moreover, various algorithms are used to resolve payment queues swiftly and efficiently and with significant liquidity savings.

The number of non-settled payments in TARGET2 is very low; this reflects the fact that liquidity is appropriately distributed across all TARGET2 participants. Overall, non-settled payments in TARGET2 in 2019 amounted to 0.1% of the total daily volume. There are various reasons for non-settled payments: insufficient funds in the account to be debited, transaction errors by participants, or breach of the limits established on the liquidity position between one or more participants.

Liquidity levels in TARGET2 cash accounts are very high. This contributes to the smooth operation of the payment systems, as it reduces the use of intraday credit and facilitates early payment settlement.

In 2019, all payments settled in the TARGET2 payments module were processed in under five minutes. On the peak day for payments settled (525,075 payments in total), 50% of the transactions were settled within 26 seconds and 90% within 39 seconds.

Figure A.2
TARGET SERVICES



SOURCE: Devised by authors.

The technical architecture of the business continuity model follows the concept of "four sites in two regions". In addition, cyber resilience enhancements are constantly being made, in accordance with the strictest standards. TARGET2 uses the SWIFT FIN standard for customer and interbank payments. From November 2022, with the launch of the T2-T2S consolidation project, the ISO 20022 standard will be used.

TARGET2-Securities

According to the T2S Annual Report, in 2019 T2S settled a daily average of 606,938 transactions, with a daily average of €1,106.13 billion. At the end of the day, all instructions that have not been settled remain in the system for future settlement.

One of the indicators used to measure the efficiency of the T2S platform's settlement system is the platform settlement efficiency indicator (PSEI). It measures the platform's ability to settle transactions and is calculated at the end of each business day. In 2019 the indicator stood at 97.63% in terms of value and at 96.93% in terms of volume as a proportion of total transactions.

One example of a liquidity optimisation routine is auto-collateralisation, which is a credit operation that is triggered when a participant does not have sufficient funds to purchase certain securities. It is an automatic process aimed at facilitating smooth real-time DvP securities settlement with central bank money. In 2019 the daily average value of auto-collateralisation on the T2S platform amounted to €103.91 billion.

T2S uses the ISO 20022 messaging standard for its communications with users (CSDs, central banks and directly connected participants).

TIPS

TIPS uses the ISO 20022 messaging standard. TIPS is based on the SEPA Instant Credit Transfer (SCT Inst) scheme, which is the pan-European scheme defined by the European Payments Council (EPC) for instant payments. It processes transactions in real time, 24/7, with a maximum amount per transaction of €100,000. The maximum end-to-end processing time is 10 seconds, i.e. the funds will be available in the payee's payment account within 10 seconds (99% of instant payments processed by TIPS are processed within 5 seconds).