

The future of European financial market infrastructure: A business case for distributed ledger technology?

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ABSTRACT

Technological innovation in general, and distributed ledger technology (DLT) in particular, could

become a game changer in the financial sector. Market infrastructures, which are the backbone of financial markets, need to adequately respond to technological advances and the resulting change in user needs and expectations. This paper discusses the potential impact of DLT on European financial markets and the potential scenarios of DLT adoption. Furthermore, it analyses the Eurosystem's strategic considerations for the future of its market infrastructure and how change is embraced. Finally, it examines whether DLT could prove to be an integral part of the Eurosystem's evolving market infrastructure and what other functions of the European Central Bank (ECB) could be affected by market actors adopting DLT.

Keywords: *distributed ledger technology, blockchain, smart contracts, technological innovation, disruptive potential, European financial markets, market infrastructure, T2S*

When the winds of change blow, some people build walls and others build windmills
(Chinese proverb)

INTRODUCTION

Technological innovation has moved our lives into the fast lane and innovative products and services are popping up more and more frequently. Often characterised by quick mass adoption, they change the way we communicate, store information and do business with each other. As this process accelerates even more, our expectations of new products and services also increase, and

providers respond by rapidly coming up with innovative ideas.

To give a tangible example of the astonishing rate of technological progress, we just need to take a look at our smartphones, which are more powerful than the NASA computers were for the Apollo 11 programme. And as if that was not enough, new smartphone releases are added to the market each year.

The financial sector, including its underlying market infrastructures, needs to adequately respond to fast change. It needs to adapt to technological advances and to the corresponding changes in user expectations. Just as a driver with a car full of petrol would not get very far without a network of roads, bridges and tunnels connecting it to a destination, financial markets require infrastructure to be able to move cash and assets around. What is true for the traffic network is true for the financial market infrastructure as well: it needs to be maintained and modernised as the number of users increases and their needs evolve. At the same time, it has to remain reliable and capable of accommodating technological change.

Among the technological innovations that have been emerging, distributed ledger technology (DLT) clearly has the largest disruptive potential in the field of market infrastructure. This paper first discusses the potential impact of DLT on European financial markets and the different scenarios of DLT adoption. Secondly, it analyses the Eurosystem's strategic considerations for the future of its market infrastructure and how it embraces change in line with the overarching goal of ensuring the provision of safe and efficient market infrastructure services. Thirdly, it examines whether DLT could become an integral part of the Eurosystem's evolving market infrastructure and which of the European Central Bank's (ECBs') functions could be affected by market actors adopting DLT.

DLT: REVOLUTION OR EVOLUTION?

DLT is essentially an innovation in database technology that is used to share the

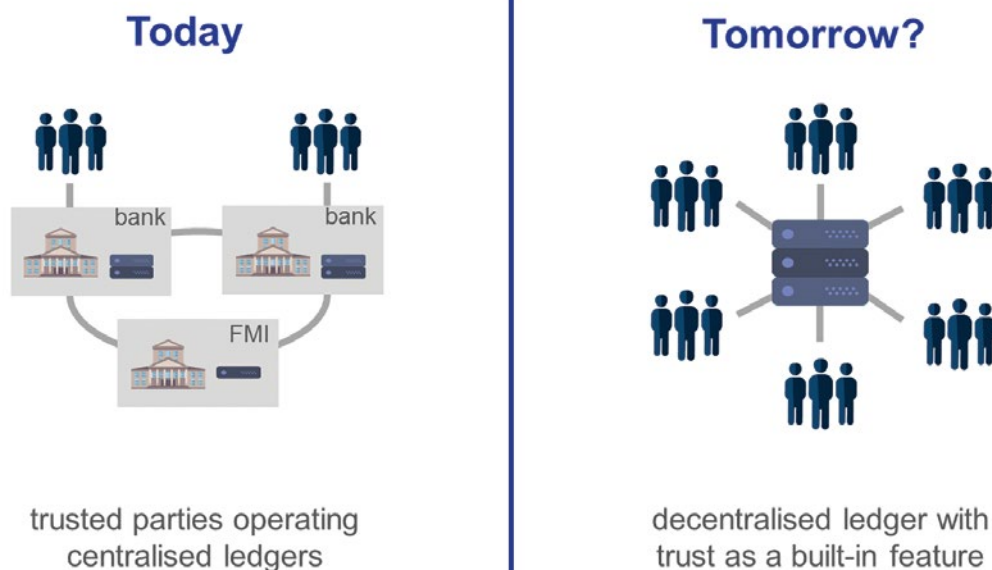
management of information among multiple participants in a network. In some types of DLT, groups of transactions are stored together in batches called 'blocks', which are 'chained' to each other via encrypted digital signatures. This is where the name 'blockchain' comes from, which is also colloquially used for other types of DLT where nodes of the network focus on finding consensus on the latest status of the ledger, but do not necessarily keep track of individual transactions.

From a market infrastructure perspective, the most interesting aspect of storing data in a shared way is that the validation of updates to the database (recording either transactions or account balances) can be managed in a decentralised way. This decentralised management can be undertaken by a number of interested participants who reach a consensus even if they may have conflicting incentives.¹ The consensus process used in DLT eliminates the need for a central management system that validates each update and takes care of storing data across multiple servers. This could increase the resilience of the system and its ability to recover from disruptions.

In addition to aspects of IT, DLT could change business processes and the organisation of financial markets. At present, using current technology, financial institutions mediate the process between the execution of a trade and its settlement in the records of market infrastructures that give legal validity to asset transfers. In future, the use of DLT could allow financial institutions to share a common set of data on a centralised ledger. Consequently, there may no longer be a need to reconcile information that is kept in a number of silo-like databases (see Figure 1).

Today, intermediaries are needed between investors and market infrastructures to overcome fragmentation in terms of laws and business processes in European national markets. They provide the range of protocols and expertise required for cross-border transactions before these can be settled *inter alia* in the

Figure 1 Financial market infrastructure: today and tomorrow



Note: FMI, financial market infrastructure

Source: ECB

pan-European market infrastructure provided by the Eurosystem.

The lack of a common repository of information that financial intermediaries can rely on before a trade reaches settlement obliges them to check consistency across their individual databases. Any change that occurs at different levels of the value chain has to be reconciled. This happens on a continuous basis and is a source of inefficiency and potential risks.

The main potential advantage of DLT is that it allows all intermediaries to rely on a common set of information that enables the automatic update of a participant's account if changes are made in other accounts. The impact of this feature could vary depending on the market architecture. DLT could potentially have the biggest efficiency gain in market segments with a high level of intermediation and relatively long settlement cycles.

POSSIBLE SCENARIOS FOR DLT ADOPTION

The impact of DLT adoption depends on how market players decide to embrace it.²

It is possible, for example, that individual market players will try to use DLT mainly to improve their internal efficiency, either individually or in a conglomerate of institutions. In such a scenario, there would be no, or limited, interaction between different in-house solutions. That could lead to new fragmentation in the market. The potential of DLT would not really be exploited and there would not be much of an effect on the financial ecosystem.

A second possibility, perhaps as a result of a group of core market players adopting DLT, is that the new technology could reach a critical mass that would enable whole market segments to shift to using distributed ledgers. To achieve this, standardisation of technological details and harmonisation of both business processes and regulations are key. Assuming the technology matures enough, this would make it possible to achieve the potential benefits mentioned above in terms of shared information and automated updates.

In a more revolutionary scenario, there could be direct interaction between issuers

and investors on a distributed ledger. This would mean cutting out all regulated intermediary institutions with drastic changes to the financial sector and to its players, but also with key questions arising regarding the safety and sustainability of such a market architecture.

Whatever the future may look like, it is unlikely that some specific functions will be rendered superfluous by DLT. In the settlement layer, for instance, there is still the need for an entity that exercises the notary function to ensure that there is no discrepancy between the amount of issued securities and the amount of traded securities. A similarly non-negotiable function is the central clearing of derivative transactions.

SMART CONTRACTS

In addition to decentralised database management, another promising innovation that DLT could enable is the use of algorithms that can be encoded in the distributed ledger: so-called 'smart contracts'. By creating these algorithms, different functionalities can be applied to the ledger. These functionalities can be customised and become active when they are accepted and signed by the participants, which is similar to what happens with a contract, but with verifiable encoding in the ledger. The term 'smart' refers to the fact that these contracts can be written to allow the seamless execution of terms agreed between two or more parties, with no need for further human intervention. They could be instructed, for instance, to allow automatic updates to take place in the ledger if certain conditions are fulfilled, either in the real world or in the ledger itself. Hence, if a DLT-based market infrastructure ever finds its way into financial markets, it could become something more than just a highway where transactions achieve settlement. It could also prove to be a more versatile tool allowing a range of services to be built with the possibility of sharing information seamlessly.

Nevertheless, there are many similarities between DLT and existing market infrastructures such as payments and securities settlement systems. This leads to the question of whether there is a future for DLT-based market infrastructure services.

EUROSYSTEM MARKET INFRASTRUCTURE: THE BACKBONE OF FINANCIAL MARKETS IN EUROPE

The Eurosystem is responsible for operating two of the systems that form the backbone of financial markets in Europe, namely TARGET2, the real-time gross settlement system for the euro, and TARGET2-Securities (T2S), a service for the integrated settlement in central bank money of securities transactions. The smooth operation of these services is crucial for maintaining confidence in the euro and to support monetary policy operations. Furthermore, it plays a central role in ensuring the stability of the European financial system and in boosting economic activity.

The Eurosystem market infrastructure is designed to meet the highest levels of safety and efficiency. Efficiency covers multiple dimensions: of course it means low costs for institutions that use the infrastructure, but it also implies the opportunity for them to benefit from a range of functionalities that bring added value to the services offered along the value chain.

Back in 1999, with the introduction of the euro, the euro area was in need of a system for settling payment transactions in the new currency across national borders as well as for serving the needs of the single monetary policy. Given the urgency, there was no time to create a new stand-alone platform. Instead, TARGET was established, a system linking all of the existing Eurosystem central banks' systems and putting some minimum standards in place for settling payments in euros across borders.

Subsequently, it was decided that TARGET would be replaced by a fully integrated,

and therefore less costly and more efficient, system that also offered more harmonised services. TARGET2 was launched in November 2007 and by May of the following year, it had become fully operational, with all members having successfully migrated to the new platform. TARGET2 has since become one of the largest payment systems in the world and the market's first choice for large-value payments in euros. Last year the system processed almost 88 million transactions, accounting for a total turnover of €494 trillion. This corresponds to a daily average of 343,822 transactions, with each transaction averaging around €5.6 million.

T2S is a more recent development. It went live in June 2015, bringing more integration into the European securities settlement market infrastructure, which was highly fragmented. With this platform, cross-border settlement of both debt securities and equities can now cost the same as domestic settlement. Central securities depositories (CSDs), which before T2S largely focussed on national markets with little or no competition, can now operate more easily in other European countries. Thus, T2S challenges the previous monopolistic set-up and opens up the post-trade landscape to more competition. Competition means more choice for investors and issuers, who now have access to the whole European market via a single service. Importantly, T2S also allows its users to manage their collateral and liquidity needs more easily, as they can hold a single pool of collateral in T2S rather than having it spread across several different systems. This makes it easier for T2S users to move collateral to where it is needed across Europe, thereby balancing out shortfalls in one market and surpluses in another, something which was time-consuming and costly before.

Since its launch in 2015, 12 CSDs have migrated to the T2S platform, with a further 11 scheduled to join by 2017.³ Today, T2S settles around 220,000 transactions per day

(see Figure 2), accounting for around 50 per cent of the total transaction volume expected once all 23 CSDs have migrated. It is therefore anticipated that T2S will process an average of more than 550,000 transactions per day once full migration is complete in 2017.

THE EUROSISTEM'S STRATEGY FOR ITS FUTURE MARKET INFRASTRUCTURE

The Eurosystem is continuously looking for ways to improve the efficiency and lower the costs of its market infrastructure (see Figure 3). It also considers how best to respond and take advantage of technical innovation and meet new user needs, while staying ahead of evolving risks such as cyber risk. Against this background, strategic reflections on the future of the Eurosystem's market infrastructure are ongoing. Work is conducted in close cooperation with the market and revolves around making liquidity management, within the fields of payment transfers, securities settlement and collateral management, more efficient. In this context, the Eurosystem has developed three key areas of investigation:

- (1) the consolidation of TARGET2 and T2S;
- (2) settlement services to support instant payments;
- (3) a Eurosystem collateral management system.

As stated earlier, TARGET2 and T2S are the cornerstones of the Eurosystem's market infrastructure for payments and securities settlement. But as they were developed at different points in time, they operate on separate platforms and use different technical solutions and environments. Hence, it is logical to seek to draw on the synergies between both systems. Modernising TARGET2, employing the possibilities already available in T2S and consolidating the technical and functional components of TARGET2 and

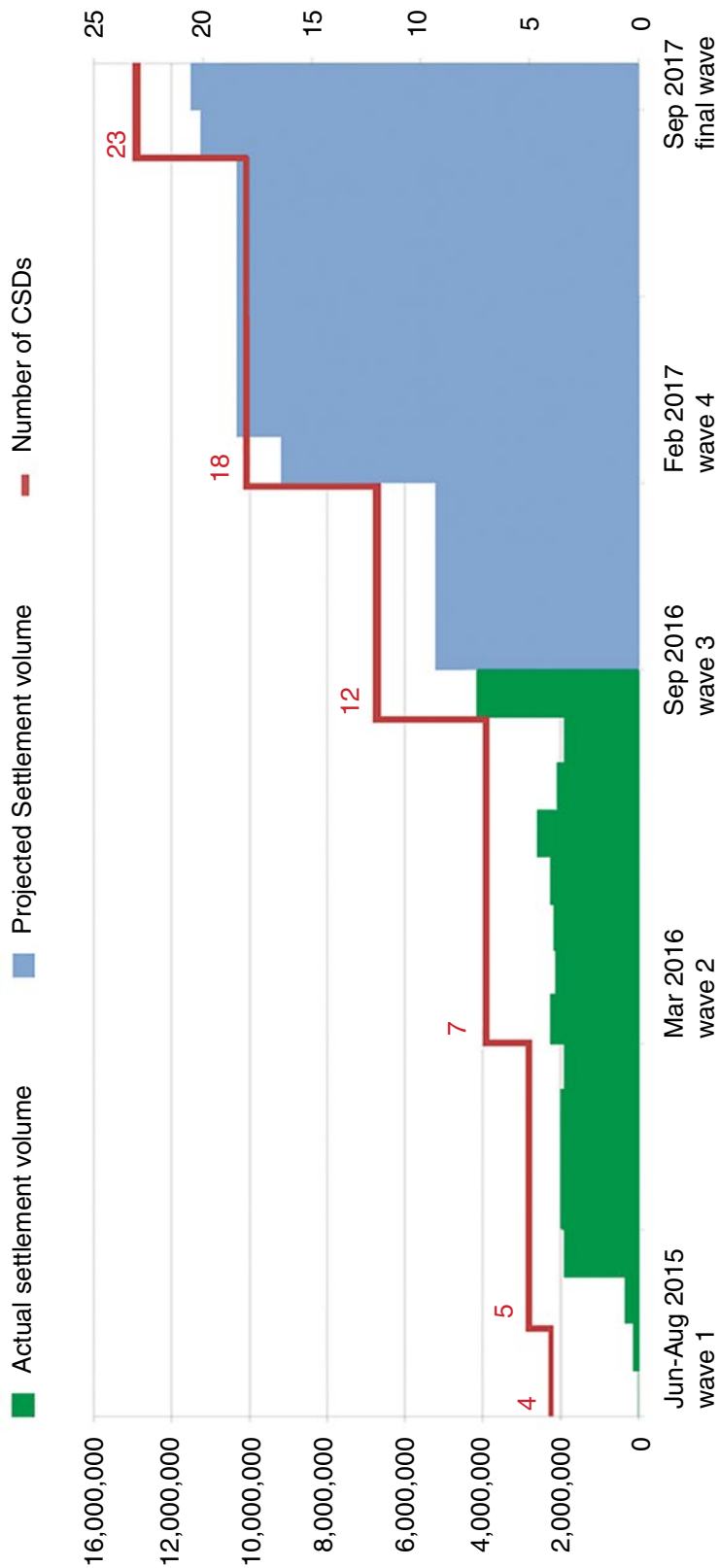
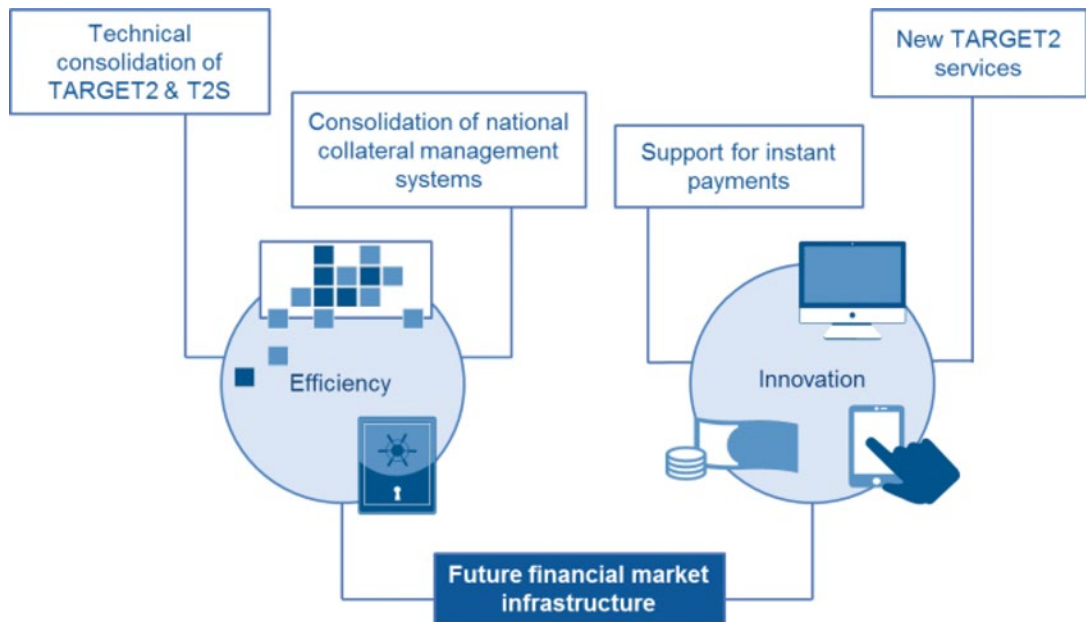


Figure 2 T2S migration plan and settlement volume

Note: CSDs, central securities depositories

Source: ECB

Figure 3 The future of Europe's financial market infrastructure



Source: ECB

T2S services are the primary objectives. In addition, consolidating TARGET2 and T2S provides an opportunity to further improve cyber resilience, to enhance the services offered to users and to establish a single access channel.

Instant payments are one of the most prominent innovative services in the retail payments industry. By November 2017, end-user solutions for instant payments in euros should be made available at a pan-European level by payment service providers. This means that by November 2017, the European financial market infrastructure has to be ready to clear and/or settle instant payments on a pan-European scale. Instant clearing will be supported by the delivery of an enhanced TARGET2 functionality for automated clearing houses (ACHs). Furthermore, the ECB will launch an investigation with market participants into the possibility of extending the availability of settlement in central bank money up to 24/7/365 to allow for real-time settlement of instant payments.

As regards collateral management within the Eurosystem central bank community, the Eurosystem will strive to drive harmonisation forwards, particularly regarding Eurosystem operations for mobilising marketable assets, as well as the handling procedures for non-marketable assets, which still vary across the central banks. Furthermore, the Eurosystem will investigate the business case for, and the scope and cost of, a possible common Eurosystem collateral management system for managing eligible assets used as collateral in the Eurosystem credit operations.

COULD DLT PROVE TO BE AN INTEGRAL PART OF THE FUTURE EUROSYSYTEM MARKET INFRASTRUCTURE?

In the context of its strategic reflections on the future of the Eurosystem market infrastructure, the ECB has been considering a range of DLT models that are currently under development. These differ in a number

of dimensions that include: (1) the way updates are validated; (2) the network architecture and permissions assigned to different nodes; (3) the level of data sharing and replication; and (4) the set of cryptographic tools used to ensure the integrity of the shared database. In this context, it is noted that work is ongoing to shape the design of DLT solutions according to the specific needs of the financial industry, including scalability and processing speed.

However, one has to acknowledge that there are still a number of question marks when it comes to the implementation of this technology. There are substantial functional, operational, governance and legal aspects that need to be carefully looked at before thinking about possible mass adoption in the field of market infrastructure services. Furthermore, DLT is a relatively new development and it is too early to conclude whether it could possibly change the financial ecosystem. Any technology-based market infrastructure service obviously needs to be mature enough to meet high requirements in terms of safety and efficiency. These requirements are taken very seriously by the ECB, not only in its role as an operator, but also as one of the European authorities overseeing the safety of financial markets. As a consequence, the ECB cannot, at this stage, consider using DLT in the evolution of its market infrastructure. However, the ECB remains open to consider any innovative solution in its role as the operator of TARGET2 and T2S — both in the field of DLT and beyond — if and when such technologies are proven to be safe and their adoption are required by the users of the Eurosystem infrastructure.⁴

Beyond its role as market infrastructure operator, the ECB is also involved in studying other aspects of DLT and their potential impact on financial markets. For example, DLT also needs to be analysed from a legal perspective, eg how to ensure finality of settlement and how to interpret smart contracts in court. Governance is another major issue,

ie it needs to be clear who is responsible for what in a DLT environment.

COULD DLT LEAD TO NEW MARKET FRAGMENTATION?

As discussed in the section on the possible scenarios for DLT adoption, individual market players and consortia are currently working on various DLT solutions. This potentially bears the risk of fragmentation through the establishment of new silos. Therefore, it is of great importance to ensure that any services developed are interoperable, not only by ensuring standardisation at the technical level but also by harmonising business and legal domains.

Against this background, the ECB has recently established a DLT task force as part of the post-trade harmonisation agenda within the T2S governance framework. The objective of this task force is to assess the potential impact of DLT on harmonisation, from both the T2S and the wider European perspective, with a view to supporting other T2S governance bodies advising the Eurosystem in this respect. It is important that such work takes place in the context of T2S to allow proactive collaboration with the market and to avoid having to take corrective action if DLT adoption leads to new market fragmentation.

CONCLUSION

Market infrastructure needs to keep up with technological advances and changing user needs. Strategic reflections are underway within the Eurosystem to find ways to make liquidity management, within the fields of payment transfers, securities settlement and collateral management, even more efficient by capitalising on technological developments.

DLT undoubtedly has potential and could ultimately disrupt the financial ecosystem, in particular through the possible disintermediation of some market players. However, its potential impact on financial markets

depends very much on how the technology possibly will be adopted. Although the technology is not yet sufficiently mature for mass adoption, and therefore not usable in the context of the Eurosystem's current strategic reflections on the future of market infrastructure services, there appears to be value in further exploring the potential benefits of DLT further down the line.

It is also important to follow technological innovation in collaboration with stakeholders across markets and jurisdictions to make sure that sound technological, legal and operational standards can support the safe provision of interoperable services intended to make financial markets more efficient. In doing so, one should bear the words of Roy Charles Amara in mind, a researcher and scientist who became known for what has been called 'Amara's law': we tend to overestimate the effect of technology in the short run and underestimate the effect in the long run.

NOTES AND REFERENCES

- (1) For instance, two validating participants could be counterparties in a trade that one party would like to repudiate, but which has benefited the other. Users of a DLT can verify, via cryptographic proof, that any change to the ledger is legitimate and its deletion would be detected as cheating.
- (2) See Pinna, A. and Ruttenberg, W. (April 2016) 'Distributed ledger technologies in securities post-trading: revolution or evolution?', *Occasional Paper Series*, No. 172, ECB, available at: <https://www.ecb.europa.eu/pub/pdf/scpops/ecbop172.en.pdf> (accessed 9th November, 2016).
- (3) See www.t2s.eu for further information.
- (4) See the speech by Yves Mersch, Member of the Executive Board of the ECB, entitled 'The next steps in the evolution of the Eurosystem's market infrastructure', given in Geneva on 26 September 2016 and available at: <http://www.ecb.europa.eu/press/key/date/2016/html/sp160926.en.html> (accessed 9th November, 2016).