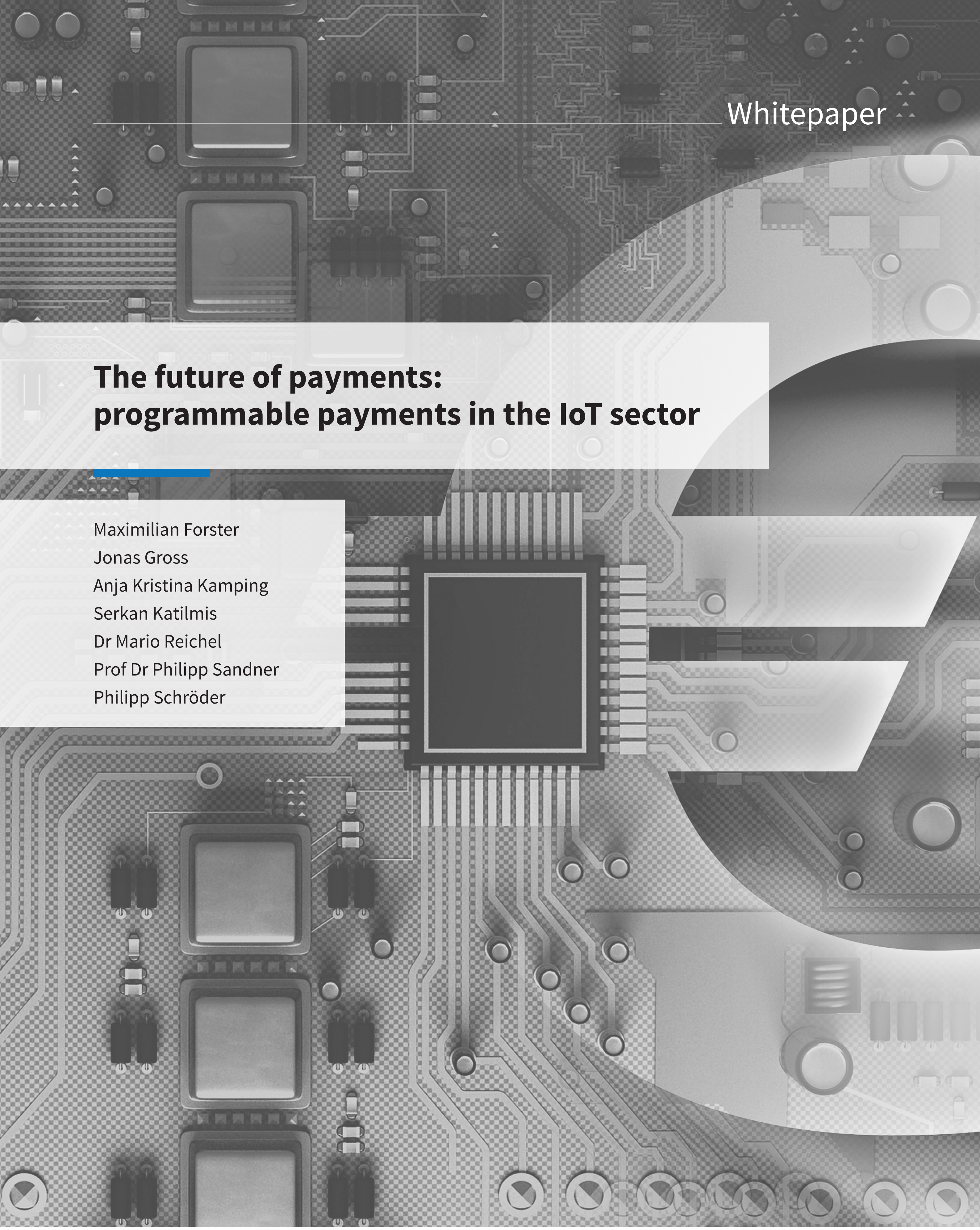


Whitepaper

The future of payments: programmable payments in the IoT sector

Maximilian Forster
Jonas Gross
Anja Kristina Kamping
Serkan Katilmis
Dr Mario Reichel
Prof Dr Philipp Sandner
Philipp Schröder

CashOnLedger
DEA Digital Euro Association
Frankfurt School Blockchain Center
ppi

CONTENT

Management summary II

1. The megatrend IoT 1

2. Payments today 3
   2.1. Payments as means of transport of value and information 3
   2.2. SEPA payments 3
   2.3. The limitations of the SEPA payment system 5

3. Next generation: possibilities of programmable payments 7
   3.1. The two types of digital euro 7
   3.2. The trigger solution for programmable payments 9
   3.3. Alternatives to the trigger solution 12

4. Innovative business models based on programmable payments 15
   4.1. Use case 1: automated payment processes in goods logistics 15
   4.2. Use case 2: asset-as-a-service/ pay-per-use 17

5. Conclusion 21

Content partners 23

Authors 25

Management Summary

- The German industry is increasingly being digitalised. The field of Internet of Things (IoT) in particular promises revolutionary, novel business models that can have a positive impact on the competitiveness of the German industry.
- Distributed ledger technology (DLT) will also play an important role for the digitalisation.
- In order to realise the full potential of the digitalisation of the industry, the entire payment process must be optimised and adapted to IoT payments, so that payments in connection with these new business models can also be processed efficiently, automatically and in real time.
- Due to the limitations of the current SEPA payment system, the processing of payments via a DLT offers such a payment solution.
- This paper analyses the status quo for IoT payments and shows how the industry benefits from innovative payment options, such as a European Central Bank (ECB) digital euro or a trigger solution that connects a DLT to the conventional SEPA system.
- Specific use cases regarding goods logistics and asset-as-a-service / pay-per-use are examined.

1. The megatrend IoT

The digital transformation of business processes

The digitalisation of the economy and society is progressing at a rapid pace. In particular, the Internet of Things (IoT) promises revolutionary business models with which the European industry can position itself as a global market leader. Here, the term IoT refers to the increasing connection of machines and devices with the internet and with each other. These devices are equipped with a digital identity, so that they can communicate with each other and execute processes autonomously without human intervention. This trend will become more and more relevant in the future. The total number of IoT devices is expected to rise to 75 billion by 2025.[1] These IoT devices include, for example, machines, robots, sensors or other digital assets. The megatrend IoT will transform the industry in the coming decades. The focus is not only on optimising and interconnecting production processes to increase efficiency, but also on a complete digital transformation that enables new, innovative business models.

The total number of IoT devices is expected to rise to 75 billion by 2025.

The networked industry transformation

Connected machines and devices will interact with each other in the future and replace manual intervention with intelligent, automated processes. However, the full potential of these IoT devices in the industry can only be realised if the entire end-to-end process line – from the performance of the service to the provisioning and to the payment processing – is considered. In this way, the services of an IoT device and the corresponding payment can be performed immediately via the same infrastructure, possibly based on a distributed ledger. However, human interactions, such as a payment execution, currently interrupt the process and lead to a system disruption as well as only limited efficiency gains. Typically, today's complex value chains, such as international trade finance, are very paper-based and analogous. However, if you realize the full potential of connected IoT devices, including the payment execution, new business models will emerge. Already today, it is no longer necessary to buy, rent or lease certain products. Instead, only the actual use is charged, which is called pay-per-use (see section 4.2.).

Human interactions, such as payment authorisations, lead to system disruptions.

Already today pay-per-use models exist, which will be common in the IoT in the future.

[1] PPI study: Internet of payments, 2020, www.ppi.de/en/studie-iop (accessed 26/05/2021).

Payments as an important element

Considering a pay-per-use and further innovative business models, it is noticeable that the integration of payments is often a particular challenge. As such, human interaction is currently required to execute payments. Interconnecting machines in networks considerably increase the requirements for the digitalisation of the payments infrastructure. Distributed ledger technology (DLT) can be used to fully exploit the potential of IoT devices. With the help of DLT, process logics can be automated by means of smart contracts. The aim must be to provide the industry with a seamless, efficient, immediate and scalable payment execution.

To realise the full potential of IoT, the use of distributed ledger technology is a good idea.

Potential analysis of a networked industry

Against the background of these challenges, this paper examines which payment solutions are available for the industry and which technologies are required to exploit the full potential of connected machines and devices. The remainder of the paper is structured as follows. Chapter 2 explains how payments are processed today. It also addresses the associated problems and inefficiencies of the current payment system. Chapter 3 describes various DLT-based payment solutions that can be used to realise the full potential of IoT through automated IoT-based payments. These include a bridge solution linking the current (SEPA) payment system to the DLT environment, tokenised commercial bank money, tokenised e-money, and a central bank digital currency (CBDC). Chapter 4 outlines and discusses exemplary IoT use cases that can benefit significantly from DLT-based Euro means of payment.

2. Payments today

2.1. Payments as means of transport of value and information

Delivery vs. payment transactions

There are two key elements to payments: a value is to be transferred and, simultaneously, an information is to be transported. In the case of cash payments, the transfer of value is obvious. It is realised in so-called delivery-vs-payment transactions. In this scenario, especially in the business environment, the information required as invoice and receipt is just as physical, i.e. not digital, as the transferred value.

Digital payments

In addition, a digital payment alternative has long been established with so-called electronic payments. The necessary payment information is transferred digitally by exchanging defined formats, usually XML according to ISO 20022. The file transfer usually takes place according to the EBICS standard or, analogous to online banking, according to the FinTS standard. The check of the digital signature of the file transfer sender is followed by the actual value transfer through transfers between digitally managed accounts. The operators of these accounts are regulated financial institutions, which are connected to so-called clearing houses. Thus, a payment from the payer to the payee represents a chain of bilateral file transfers and corresponding bookings.

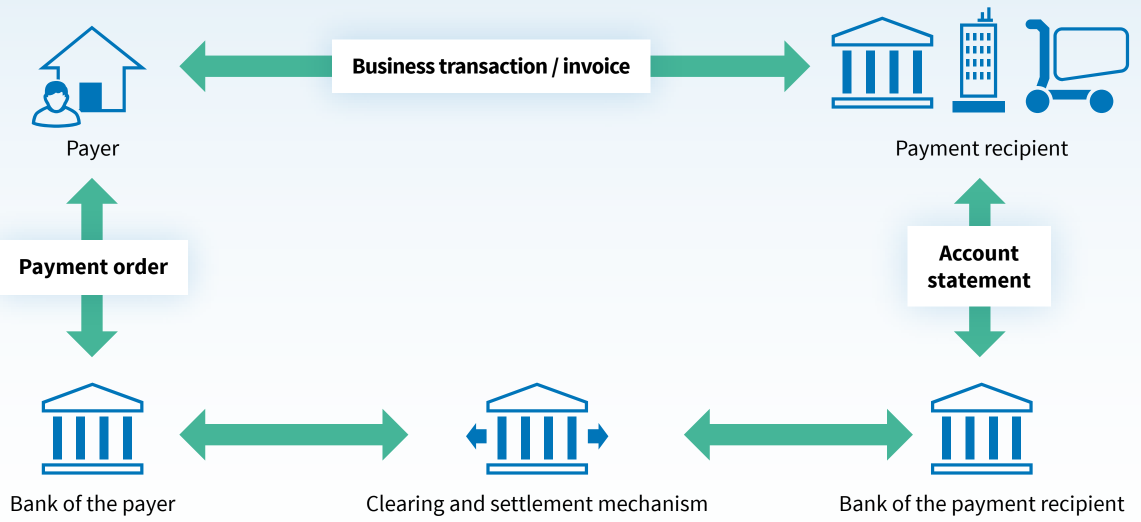
Current standards in electronic payments are ISO 20022 and EBICS.

2.2. SEPA payments

Participants of a payment process

Due to regulations and standardisation, in Europe – more specifically in the Single Euro Payments Area (SEPA) – payments are mainly conducted according to the process outlined in figure 1.

Figure 1: **SEPA payments – process diagram**



Source: Own depiction

Schematic representation of the payment flow in the Single Euro Payments Area (SEPA). Euro payments are usually made through clearing houses without complex correspondent banking procedures.

The main bilateral relations exist between the payer and their financial institution on the one hand and between the payee and their financial institution on the other hand. For the transfer of the information, the payer's financial institution searches for a route to the payee's financial institution, a so-called clearing route, i.e. the route that the payment will take from the payer's financial institution to the payee's financial institution. The route is determined by the currency of the payment, the type of payment and the availability of the recipient bank. Euro payments via SEPA are often settled via clearing houses. For payments in other currencies, however, the so-called correspondent banking procedure is used. A clearing house replaces bilateral relations for all affiliated financial institutions and facilitates multilateral clearing.

As a rule, euro payments can be settled within the SEPA via clearing houses.

Direct and indirect participants of the SEPA-Clearer

Focusing on SEPA, the SEPA system consists of a network of various national and pan-European clearing houses. We refer to indirect participants when a financial institution is connected to the clearing house via another financial institution, for example savings banks via their state banks. Otherwise, they are direct participants. Many financial institutions in Germany are linked to the clearing house of the Deutsche Bundesbank, the SEPA-Clearer, and can thus reach all other SEPA banks, if required, via the connection of the SEPA-Clearer with other clearing houses. How a financial institution is integrated into the SEPA network of direct and indirect participants at clearing houses depends on the type and size of the financial institution. In most cases, a financial institution has only one SEPA access which is optimised in terms of settlement costs. This settlement can be made on the bilateral clearing accounts of the financial institutions in commercial bank money, for example via the SEPA-Clearer in the case of indirect participation, or via TARGET2 equivalent payments in central bank money. The latter is used for bilateral bank relations that are not settled via a clearing house. When using clearing houses, the settlement in central bank money via TARGET2 is a regulatory requirement.

In most cases, a financial institution has only one SEPA access which is optimised in terms of the settlement costs.

2.3. The limitations of the SEPA payment system

Payments processing with a time delay

The regulation states that only one (TARGET) business day is allowed to pass between the debit of the payer's account and the credit of the value to the payment payee’s account. Thus, cases where a delivery-vs-payment business is paid via the conventional SEPA system always includes a risk. Either the payer pays before receiving the goods, thus making an advance payment and risking not receiving the goods, or the goods are delivered but not paid. To address this risk, systems with payment guarantees, such as instant transfer or SEPA direct debit, have created extended, fee-based options that as a workaround minimise but do not completely eliminate the risk of a party not receiving the value.

Systems with a payment guarantee minimise the risk of a value transfer not being performed, but cannot eliminate it.

Payments processing within seconds

These options also include real-time credit transfers, which are available 24/7. In less than ten seconds not only the information (as with a payment guarantee) but also the value itself is transferred across Europe so that the payee can use the received funds immediately. This process enables a delivery-vs-payment (DvP) transaction in the same manner as a DvP cash transaction, only in digital form. Unfortunately, not all financial institutions are yet accessible via this procedure, which is one of the reasons why the distribution is currently limited.

Lack of standards for automated payments processing

In the SEPA format the payee as well as the payer is always addressed by an IBAN. Universally easy-to-use means of communication such as e-mail or mobile phone numbers are currently not yet possible. For machine-to-machine payments there is still a need for suitable standards that would allow for continuous automated processing while also complying to all regulatory requirements. This is due to the fact that nowadays authorised persons have to authorise payments as part of a two-factor authentication. In the business environment, in particular, the four-eyes principle is often used.

Appropriate standards are still missing for machine-to-machine payments.

Additional fields for payment information

The possibility of transmitting information has been improved with SEPA compared to previous national payment procedures. However, SEPA has not yet resolved the usual system breaks between invoice data and remittance information, which makes it difficult to automatically reconcile incoming payments with the payee's open invoices. Today, the use of the so-called unstructured remittance information is common, i.e. 140 characters free text. This allows the recognition of invoice number, customer number and similar information in the corresponding data field only via suitable algorithms when importing the account statement into the ERP system of the payee. A structured remittance information, i.e. dedicated fields for necessary information, is not always available. These additional fields would be useful in the business environment, especially when combining several invoices in one payment, since the structured information of such data would be transferred in a standardised manner that is readable for machines. Such combinations are used today to save costs such as transaction costs. In addition, the amount of these fees is one reason why payments in the cent range – so-called micropayments – are not economically feasible today so that small units of value cannot be transferred with SEPA.

SEPA has not yet resolved the usual media breach between invoice data and remittance information.

In the business environment in particular, structured remittance information would be helpful for automation.

3. Next generation: possibilities of programmable payments

3.1. The two types of the digital euro

Definition of the public digital euro

In order to increase process efficiencies and address the limitations of the SEPA system for IoT payments described in the previous chapter, an innovative European monetary system is essential. For example, the European Central Bank (ECB) could issue a central bank digital currency (CBDC), in the following referred to as the "public digital euro". Since the ECB acts as the issuer, in contrast to commercial bank money transferred via SEPA, such a CBDC is central bank money, i.e. the CBDC holder holds a claim against the central bank. Currently, a CBDC is still only a theoretical concept: the ECB has not yet determined whether a CBDC will actually be issued. If the ECB decides to issue a CBDC, it will take at least five years for the CBDC to be available to private and institutional end customers.

In the case of a public digital euro, the holder's claim would be on the ECB.

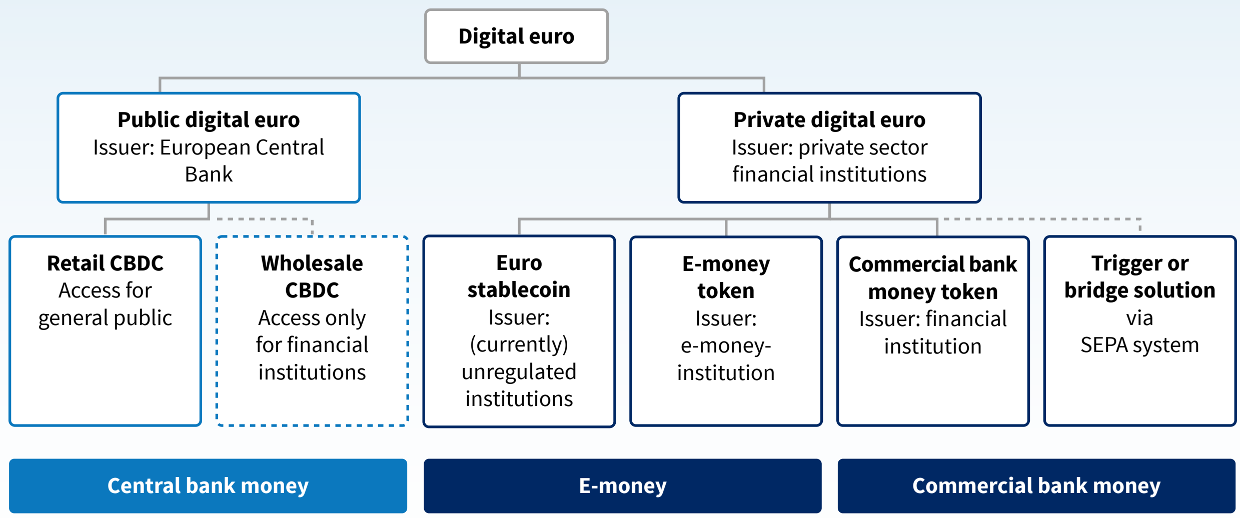
Private digital euro

In addition to the public digital euro, currently financial institutions, such as e-money institutions, banks and, in some cases, even non-regulated entities are also working on a so-called private digital euro (see figure 2) – often referred to as a DLT-based euro. A DLT-based euro allows programmable payments to be realised[2] that are particularly relevant especially for the field of IoT. Specifically, payments can be defined that follow a certain logic and are processed automatically and, most notably, without human intervention.

Programmable payments are particularly relevant in the IoT.

[2] For additional information about progammable payments, see also https://philippsandner.medium.com/programmable-money-and-programmable-payments-8038ed8fa714.

Figure 2: **Taxonomy of the digital euro**



Source: Own depiction

Overview of the different types of the digital euro. In addition to the public digital euro, currently the e-money institutions, banks and, in some cases, non-regulated actors are also working on a so-called private digital euro.

The private digital euro and IoT payments

A particular relevant example for an IoT use case is a pay-per-use process. For instance, if a machine is used for a certain period of time, it could automatically trigger a payment of the DLT-based euro using machine data such as information on maintenance or utilisation – without any human intervention. For this reason, programmable payments promise enormous automation potential. Nowadays, there are already some programmable payments available, such as standing orders or scheduled credit transfers. However, so far, the flexibility of these payments has been extremely limited. To realise the full potential of programmable payments, a DLT can be used for the underlying business process and the payment. In a few lines of code even complex business logics can be implemented relatively easily via a DLT-based smart contract. In addition, digital DvP transactions are possible through the use of a DLT as the underlying platform for the process itself and the payment. For example, a smart contract can be used to specify that the payment for goods is executed if the goods have been delivered. In this way, significant efficiency gains

Standing orders are already partially programmable payments, but with extremely limited flexibility.

and lower counterparty risks can be realised. The first programmable euro-based payments are already available and therefore enable the implementation of micropayments and innovative business models.

3.2. The trigger solution for programmable payments

The trigger solution for IoT payments

A so-called trigger solution, also referred to as a bridge solution, refers to a technological connection, in this case between the SEPA system and a DLT-based application. This trigger enables a payment to be executed in conventional payment transactions by passing on the corresponding transaction information from the DLT to the SEPA system. The DLT system connects two infrastructures: the DLT system used for performance and data communication, and the conventional SEPA system used to process the payments and settlement. Figure 3 illustrates the trigger solution and shows the interaction between the two systems. While the DLT system plays a key role for the identity of the machine and the interaction with the owner, the SEPA system is required to process the payment as soon as payments are triggered as a result of the business logic.

The trigger solution is a technological connection between the SEPA system and a DLT-based application.

Optimal DvP function cannot be implemented with trigger solution

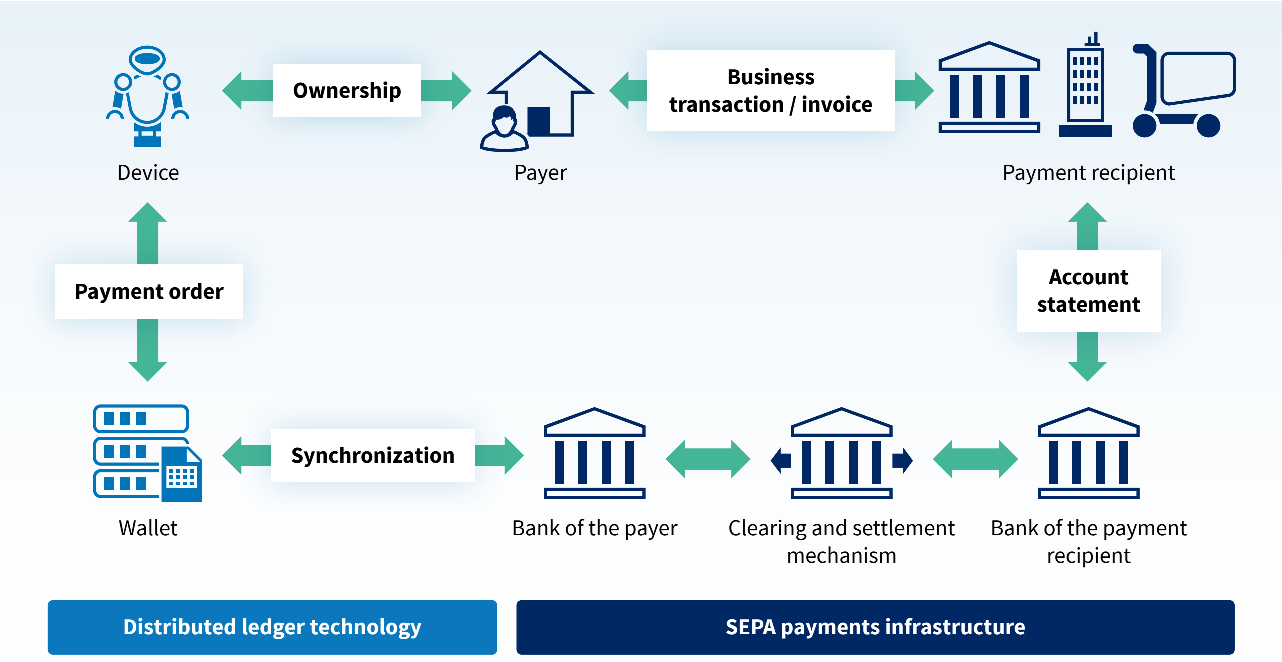
The advantage of such a solution is that no special novel, tokenised, i.e. DLT-based, monetary units need to be created for the use in the DLT environment. Such a solution is therefore relatively straightforward and can be implemented and used in the short term. A disadvantage is, however, that no optimal DvP can be implemented. The tokens created represent only a claim on the financial institution and are linked to a subsequent SEPA credit transfer. For this reason, an asymmetry exists for a short period of time, as the financial institution first has to check the account balance and/or credit limits. After successful verification, a DLT-based token is created with the credit note, i.e. a promise of payment, which is then available to the payee. When this token is redeemed, it is technically destroyed and simultaneously triggers a SEPA transaction. Depending on the financial

Even with a trigger solution, optimal delivery versus payment functions cannot be implemented.

institution, this process might happen in real time. Thus, it is technically possible to map a DvP process. However, in this context the transfer of funds happens at a later stage. Especially in DLT environments, this poses a particular challenge, as so-called atomic transaction settlements are necessary for the full transfer of ownership of the digital assets. In this context, atomic transactions settlements describe the complete and irreversible transaction processing and transfer of the assets and funds.

For the full transfer of ownership of digital assets, so-called atomic transaction settlements are a necessary requirement.

Figure 3: **Trigger solution**



Source: Own depiction

The trigger solution is a technological connection between the SEPA system and a DLT-based application.

DLT as a common decentralised platform

DLT environments are especially promising when machine-to-machine payments, IoT payments, automated payments and/or pay-per-use payments are to be realised. Due to the usually automatic execution of payments in the IoT environment based on machine and/or sensor data, the data integrity is an important success factor for the implementation. Accordingly, the DLT has the character of a single source of truth (SSOT), i.e. it serves as a technical, automatic notary

DLT has the character of a single source of truth (SSOT).

function between all parties involved. In addition, with the help of the SSOT functionality, identities are assigned to the machines. These identities are needed in an autonomous payments system to keep track of the transaction process. The SEPA system is currently unable to integrate this necessary SSOT function into the payment process. No automatic payments can be made without SSOT and without a unique assignment of the IoT devices by means of a machine identity. Although programmable payments of less complexity can be realised by means of standing orders or direct debit procedures, these instruments are increasingly reaching their limits for automated and non-discretionary (rule-based) use cases. The current forms of credit transfers are limited to 27 characters according to the Home Banking Computer Interface (HBCI) specification and can only trigger monthly transfers.

SSOT and machine identities are mandatory requirements for automatic payments.

Complexity of settlement

The trigger solution enables classic payments to be programmable and works without system breaks thanks to the seamless integration of payments and sensor data. Due to the high degree of automation, the efficiency of currently often still manual processes can be increased. The programmability of the payment flow also allows settlement models according to different metrics and any complexity, for example regarding operating hours, kilometres or weight. This process also makes data-driven business models fully comprehensive and automated.

Programmable payment streams allow the use of billing models according to different metrics.

Pioneers of the trigger solution

Some financial institutions in Europe are currently working on the realisation of payments via DLT networks. The trigger solutions outlined above can be used to map programmable payments to a DLT and trigger and execute them via the existing payment systems. In this context, CashOnLedger is active in cooperation with Landesbank Baden-Württemberg (LBBW) in the scope of a development partnership in order to make the benefits of DLT available to companies.

Trigger solution as the first step

Since the trigger solution is an additional component for existing payments, apart from the possible programmability of payments, the same limits apply as for the current payment transactions (see section 2.3). The transfer of small amounts of money is still not economically feasible and therefore the use case of streaming money is not realizable. In such business models, during the consumption or use of content, its utilisation is to be charged in the form of very small amounts. Here, it would only be possible to work with threshold values and automatically initiate credit transfers above a certain value. Furthermore, even with the trigger solution machines do not have an identity, which makes it extremely difficult to trigger a payment. Regulatory restrictions such as two-factor authentication still exist in this context. In practice, this means that a machine or IoT device cannot yet realise the settlement and debit the amount from the account. For these processes, the confirmation of the user is required as an intermediate step. In addition, only a euro token issued directly on a DLT enables real-time settlement of payments, as the money would be natively integrated into the platform. With the trigger solution, the duration for the execution of a transaction equals the typical SEPA processing time of up to one day. When issuing a euro token directly via a DLT system, the transaction processing is possible in real time without media breaks. In such a case, the liquidity would be immediately available to the payee and third parties such as clearing houses would no longer be needed.

The transfer of small amounts is not economically feasible.

When issuing a euro token directly via a DLT system, the transaction processing is possible in real time without media break.

3.3. Alternatives to the trigger solution

Native DLT-based means of payments

The limitations of the trigger solution described in the last section can be addressed by native DLT-based means of payment described below. In contrast to the trigger solution, it is thus possible to realise native DvP, micropayments, streaming money, and the integration of machines.

Stablecoins and tokenised e-money

Stablecoins are DLT-based tokens that replicate a stable asset to maintain a relatively stable price. For example, the euro can be issued as a euro stablecoin in a DLT system. The DLT plays the role of the carrier platform, the token plays the role of a unit of account. The main difference to the trigger solution is that the payment is not made via the SEPA system but via the DLT. In this way, the system break for the payment processing can be avoided. So far, there are first projects for euro-based stablecoins, but US dollar-based stablecoins have a far higher market capitalization and reach. Regulation of euro stablecoins is – as of today – non-existent but is to be created by the planned EU regulation "Markets in Crypto-assets" (MiCA). In this case, the e-money regulation would apply to such tokens, so that stablecoins can be referred to as tokenised e-money if MiCA is adopted. Currently, unregulated euro stablecoins have a significant counterparty risk. This is one of the reasons why stablecoins are hardly used so far.

First projects for euro-based stablecoins exist but appropriate regulations are still missing.

Tokenised commercial bank money

In addition to euro stablecoins, there is also the possibility that financial institutions could issue commercial bank money in DLT systems. The main difference to the previously discussed euro stablecoins or tokenised e-money is that stablecoins under the e-money regime would require 100 % backing, for example through commercial bank money. If, for example, e-money tokens worth 100 euros were issued, exactly 100 euros would have to be deposited as collateral. In contrast, full backing is not required for tokenised commercial bank money. This difference implies that financial institutions can continue to create money – but now on a DLT. A digital euro provided as tokenised commercial bank money could also be used for programmable applications. The implementation of such a solution is currently being studied by numerous financial institutions in a conceptual manner but would be extremely complex due to the standardisation measures necessary to ensure interbank interoperability. Moreover, there is currently no effort on a European level to implement such a solution in the short to medium term. However, even tokenised e-money is associated with a significant disadvantage. Due to commercial bank money being used as the collateral for e-money, tokenised e-money is not multi-bank capable

Full coverage is not required for tokenised commercial bank money.

Due to the cover with commercial bank money, tokenised e-money is not multi-bank capable.

and thus presents a different risk depending on the issuer because of its limited fungibility. Consequently, by issuing e-money the client is tied to one institution, which means that both the sender and the recipient of the payment must be customers of the same institution.

Central bank digital currencies

In addition to private sector players such as commercial banks and e-money institutions, the central bank could also issue DLT-based money. In the case of the euro area, such a form of money would be the public digital euro. At present, the ECB has not yet made a decision as to whether it will actually issue a digital euro. The question also remains open whether a digital euro would be based on a DLT, which currently seems rather unlikely. However, only a DLT-based digital euro would fully circumvent the limitations of conventional systems regarding micropayments, streaming money and machine integration into the payment process. As a result of these uncertainties, tokenised e-money and tokenised commercial bank money appear to be the most promising solutions for IoT payments in the short to medium term, with the short-term realisation of tokenised e-money currently being more likely due to the MiCA regulation that might be adopted within the next two years.

Only a digital euro based on DLT would actually break the limitations on micropayments, streaming money and machine integration.

4. Innovative business models based on programmable payments

Use cases for IoT payments

With programmable payment solutions, various use cases for IoT payments are conceivable. This chapter explains two specific use cases: an automated payment process based on a delivery of goods and an asset-as-a-service or pay-per-use scenario based on the financing of machines.

4.1. Use case 1: automated payment processes in goods logistics

Lack of synchronisation of payment and goods flow

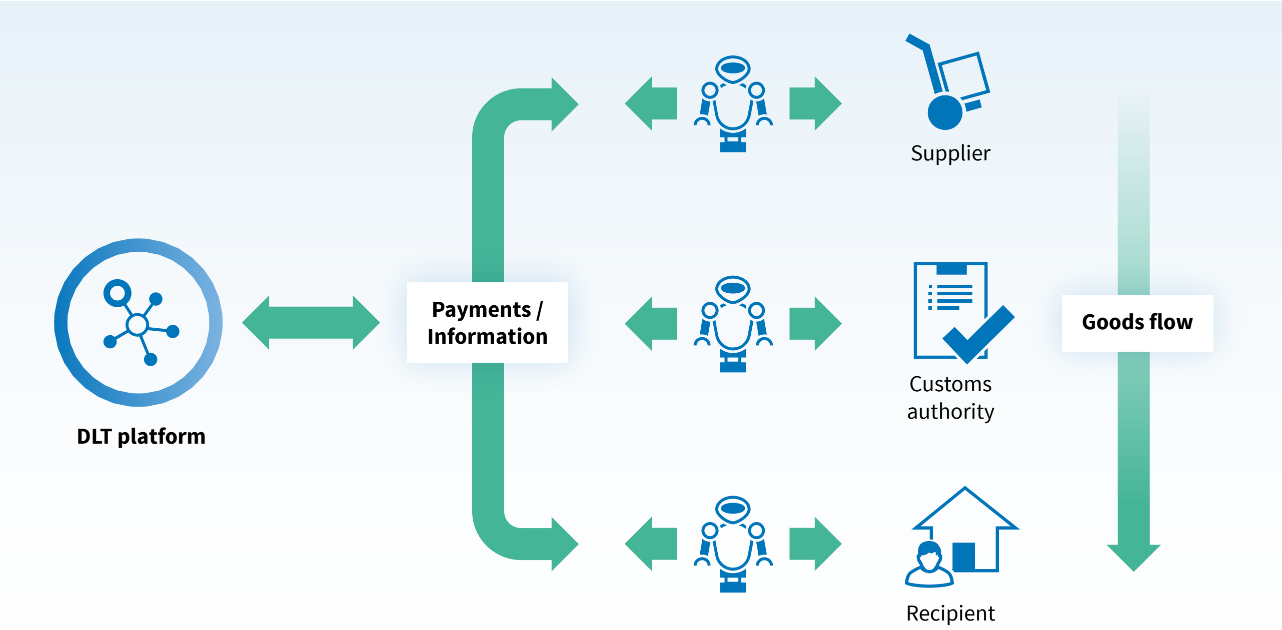
In goods logistics, cash flows are often neither synchronised nor automated as transactions often still take several days. In addition, goods logistic is still predominantly paper based: delivery notes, freight documents, customs documents and invoices are exchanged between the parties.

Efficient payment processes throughout the entire supply chain

With IoT it is possible for intelligent and interconnected sensors, robots and machines to execute certain processes independently and without human intervention. Machines can be equipped with wallets, which are charged with a certain budget of digital euros. In conjunction with smart contracts implemented via a DLT, machines could automatically trigger payments as soon as certain conditions are met, such as the arrival of the goods, their completeness and the absence of defects. All parties may pre-define these terms in a DLT protocol. With self-paying machines the following use case of a goods delivery, as shown in figure 4, would be feasible:

Machines can automatically trigger payments using smart contracts implemented through DLT.

Figure 4: **Efficient payment processes – example of goods delivery**



Source: Own depiction

In conjunction with smart contracts implemented via a DLT, machines could automatically trigger payments as soon as certain conditions are met.

1. The buyer has ordered goods from the supplier. An intelligent machine from the supplier triggers the sending process of goods. It places a specific token, such as a QR code, on the goods that contains various data as well as payment information. The token may be registered by the machine in a DLT platform. All parties involved in the goods logistics are thus informed about the current status of the order.

It places a token, such as a QR code, on the goods.

2. The goods are sent in several intermediate steps. At the respective intermediate steps and during the receipt of the goods, intelligent machines check the goods via the attached token. In the case of a shipment from abroad, the first stop could be at the customs or the port authority. At customs, a machine checks the goods and automatically determines the customs duties based on the weight, size, and origin. The customs office machine sends the collected data to a supplier's machine for the purpose of determining customs duties. The supplier's machine will then automatically pay the customs duties after the information has been received.

3. As soon as the goods have arrived at the recipient, the goods are registered by a machine via the token. A scanner checks the goods for completeness and defects. If discrepancies or defects are found, the supplier will be informed accordingly, accompanied, if necessary, by a photo or a scan of the damage. Certain discounts could be automatically included, or a new shipment of the goods could be triggered. If, on the other hand, all checks are positive, the recipient's machine triggers a payment via its wallet. The machines receive the transaction confirmations in their wallets. The buyer and the supplier could also receive these confirmations, for example, via an app in the form of structured data records for accounting or in the form of an invoice for downloading.

The machines receive the transaction confirmations in their wallets.

In the long term a DLT-based euro is needed

All solutions described in chapter 3 can be used to implement this use case. In the short term, a trigger solution with the combination of the SEPA payment system and the DLT system could be implemented. The trigger solution, however, is only a technical bridge solution since conventional payments are supplemented by DLT-based applications. The current limits of SEPA payments, such as the payment authorisation by a person as part of a two-factor authentication, remain in place. As a consequence, complete automation of the processes cannot be achieved, which will be necessary in the future. In the medium to long term, the digital euro based on DLT is the preferred solution, without the need for a bridge solution.

In the medium to long term, the digital euro based on DLT is the preferred solution.

4.2. Use case 2: asset-as-a-service / pay-per-use

CAPEX to OPEX as growth driver

Another use case is an asset-as-a-service using the example of machine financing. Pay-per-use is the billing modality in which costs for machines are calculated after its effective use. Today, the forms of financing for the purchase of a machine are relatively rigid and do not offer the necessary financial flexibility for medium-sized companies and customers. Classic (operating) leasing binds companies to a

Current forms of financing for machine purchase are not flexible for medium-sized companies.

machine over a fixed term, regardless of its utilisation. A purchase via financing usually binds the customer's capital over several years or even decades.

Asset-as-a-service models

Asset-as-a-service models extend today's operating leasing. The customer now pays primarily after the use of a machine, but not according to its possession. The rental periods are shortened and can be limited to the desired project periods. As a result, long-term obligations are eliminated and the company that uses the machine retains greater financial flexibility. However, the manufacturer now bears the risk of the utilisation and profitability of the machines, since ownership of these machines does not pass to the customer. The manufacturer has to trust that his end customer will generate the necessary utilisation of the machine.

In asset-as-a-service models, the manufacturer bears the risk in terms of utilisation and profitability of a machine.

New collaborations

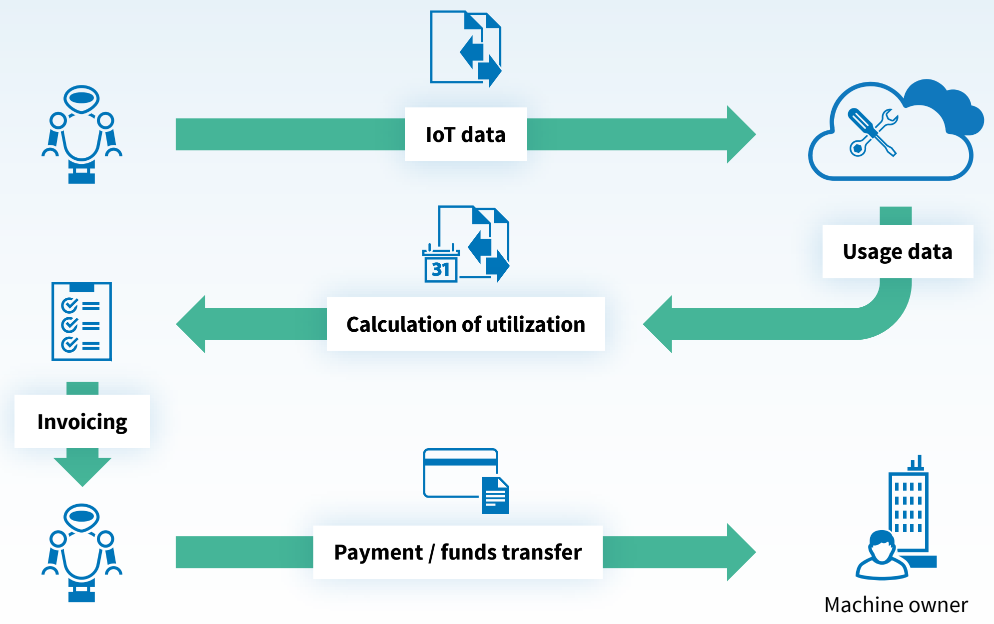
In order to address this risk, the manufacturer can now work in partnership with financial services providers in new ways, and thus increase the borrowed capital. A potential solution could be to sell the machines to the financial service provider, who in turn provides renting services. The maintenance is performed by the manufacturer since the highest possible residual value can be achieved in the event of a subsequent sale on the secondary market. Given the ongoing low interest rate environment, this option seems attractive to asset managers and financial institutions.

The combination of financial service and technology

Instead of a lump sum, the different use types and utilisation of the machines should be considered for the billing.

To exploit the full potential of renting out the asset, it is necessary to further consider the different use types and the utilisation rates of the vehicles and machines for the billing instead of applying the same inflexible price across all use scenarios. For agricultural machinery, it is possible to distinguish between light- and heavy-duty use of the vehicles – for example, depending on how much the machine is actually used in what type of terrain. Higher usage scenarios not only generate a higher profit, but also help in calculating the residual value on the basis of the resulting wear profiles. The necessary steps and technical interfaces are depicted in figure 5. In the first step, the vehicles or machines must provide corresponding telemetry data, which is then transferred to a cloud. The utilisation is then calculated based on this machine data. This also allows to draw conclusions regarding the product life cycle. Subsequently, the corresponding invoice is settled by means of a payment.

Figure 5: **Asset-as-a-service model based on IoT data**



Source: Own depiction

The existing usage data can be used to determine the product life cycle and thus also the residual value at the end of the rental period of a machine.

Programmable payments

This advanced level of complexity necessitates the use of programmable payments. New business models require not only programmable payment flows but also the necessary technical infrastructure for their full use by the industry. Such payments can only be triggered if a corresponding accounting logic is predefined.

Asset-as-a-service: Leasing 2.0

The success of asset-as-a-service models therefore depends to a large extent on the cooperation between financial services providers and the industry. Without the seamless integration of these two worlds, it will be impossible to implement and leverage new digital business models based on IoT data. Today's payment systems have certain limitations and requirements that can only be solved by manual processes. For example, two-factor authentication prevents a machine from paying independently. The owner or user must release a trans-action. Even though this security feature is justified, new approaches are necessary if machine payments are to be implemented in a scalable manner. Furthermore, scaling through automation requires overcoming the system discontinuities that exist in today's payment sector.

For asset-as-a-service models, a completely seamless integration of the worlds of industry and financial services is absolutely essential.

5. Conclusion

The ECB's digital euro is coming

It is likely that the ECB will indeed issue the public digital euro, but not before 2026. It is also unclear if the ECB will use a DLT as the underlying technological basis. Nevertheless, the digital euro on a DLT will already exist beforehand and will be realised by private sector financial institutions. Already this year, there will be a private digital euro based on DLT that can leverage smart contracts.

Already this year, there will be a private digital euro based on DLT.

Euro-based smart contracts

The benefits of euro-based smart contracts are clearly visible for the automation of business processes, e.g., a significantly increasing process throughput times, simplifying payment processes, and enabling IoT payments from machines or other devices. These benefits can be reached already in 2021, when solutions are created in various ways to enable smart contracts to execute euro-based payments.

Trigger solution and e-money token

In the short term, the trigger solution will enable programmable payments. Here, DLT networks are connected to the existing IBAN account infrastructure. The result: the euro gets accessible for smart contracts, even if it remains in the traditional IBAN infrastructure. Another alternative is tokenised e-money. In this case, a euro token is issued – based on the e-money regulations – which can then be transferred directly on a DLT network.

The trigger solution will realise the digital euro in the short term.

2021 is the starting signal for the application of the digital euro

2021 will be the starting point for companies from various sectors – for example production, logistics and medical technology – to utilize and leverage new business models and automated business processes. With the DLT-based digital euro, previously impossible or inefficient B2B processes can be realised in important industrial sectors in Germany and Europe, such as industry 4.0, supply chain management and future mobility. The digital DLT-based euro will contribute to the digital transformation of these areas and enable new business models. Even more: the digital transformation in these areas is even accelerated by the digital euro, and in some cases only made possible. It is therefore important for companies in the above-mentioned areas to carefully analyse the potential of the digital euro and the resulting possibilities such as programmable payments.

Content partners

CashOnLedger

CashOnLedger is a deep tech startup that develops an IoT payment infrastructure for autonomous payments. Founded in Cologne in 2019, the company is working in a development partnership with Landesbank Baden-Württemberg (LBBW), tartgens, Infineon & R+V Versicherung and is currently implementing a use case at Lindner Traktorenwerke in Austria.

CashOnLedger Technologies GmbH
Ubierring 35
50678 Cologne (Germany)
www.cash-on-ledger.com

DEA
DIGITAL EURO ASSOCIATION

The Digital Euro Association (DEA) is a think tank specializing in central bank digital currencies (CBDCs), stablecoins, crypto assets, and other forms of digital money. In particular, we focus on the digital euro. Our mission is to contribute to the public and political discourse through research, education, and by providing a platform and community for policy-makers, technologists, and economists to discuss digital money-related topics. We are committed to independence and excellence, aiming to set the agenda and to shape policy by encouraging new ideas and forward-thinking in the field of digital money. We target new and innovative topics such as the digital euro and Diem, but also “classical” crypto assets such as Bitcoin and Ether.

Digital Euro Association
c./o. Frankfurt School Blockchain Center
Adickesallee 32–34
60322 Frankfurt/Main (Germany)
https://home.digital-euro-association.de/en

The Frankfurt School Blockchain Center is one of the first university research centres on the subject of blockchains, which deals with the implications of the blockchain technology for companies and businesses. At the same time, the Blockchain Center sees itself as a think tank and, in addition to scientific research, also deals with the development of blockchain demonstrators and the realisation of implementation projects of various blockchain applications.

Frankfurt School Blockchain Center
Frankfurt School of Finance & Management gGmbH
Adickesallee 32–34
60322 Frankfurt/Main (Germany)
www.fs.de/blockchain

PPI AG has been working successfully as a consulting and software company for financial institutions, insurance companies and financial services providers for over 30 years. As a steadily growing, family owned joint-stock company, we combine business and technology expertise to realise projects competently and in an uncomplicated manner. Our about 700 employees are entirely focused on our customers' success.

PPI specialises in software products as well as consulting in the field of payments and is market leader for EBICS and FinTS solutions. With its products, PPI AG offers the complete payment processing chain for banks from a single source, from customer-bank communication and payment core processing to interbank communication. The consulting offer ranges from strategic and bank-technical consulting to IT consulting with relation to payments. Among other things, PPI advises its clients on the topics of regulation (e.g. PSD II), instant payments, high-value and cross-border payments, SEPA and card-based payments.

PPI AG
Moorfuhrtweg 13
22301 Hamburg (Germany)
www.ppi.de

Authors

Maximilian Forster
Co-founder and CBDO,
CashOnLedger
M: +49 152 22968653
maximilian.forster@cash-on-ledger.com

Dr Mario Reichel
Managing Consultant
Payments, PPI AG
M: +49 151 1400 9351
mario.reichel@ppi.de

Jonas Gross
Chairman,
Digital Euro Association
jonas.gross@digital-euro-association.de

Prof Dr Philipp Sandner
Head of the Frankfurt School
Blockchain Center
P: +49 69 154008-790
email@philipp-sandner.de

Anja Kristina Kamping
Senior Consultant
Payments, PPI AG
M: +49 160 97983948
anja.kamping@ppi.de

Philipp Schröder
Managing Consultant
Payments, PPI AG
M: +49 160 90829619
philipp.schroeder@ppi.de

Serkan Katilmis
Co-Founder and CEO,
CashOnLedger
M: +49 171 7476908
serkan.katilmis@cash-on-ledger.com