BIS Innovation Hub

Bank of England

▶ **Project Meridian**

Simplifying transactions through innovation

Contents

With thanks to

HM Land Registry

1 Executive summary

Project Meridian is a joint project between the Bank for International Settlements (BIS) Innovation Hub London Centre and the Bank of England. It investigates how recent rapid advances in financial technology could deliver innovations in real-time gross settlement (RTGS) systems, which sit at the core of modern electronic payment systems.

Project Meridian experiments with the concept of synchronisation. This involves settling a transaction using central bank money in an RTGS system. Funds move if and only if an asset on another ledger also moves, reducing costs and risks, and increasing efficiencies. Synchronisation builds on the existing concept of interlinking asset ledgers with RTGS systems, seeking to develop functionality that allows synchronised settlement in central bank money for a wide range of assets.

Synchronisation is achieved by the introduction of a new entity called a synchronisation operator.[1] This operator would interlink RTGS systems with other financial market infrastructures (FMIs) and ledgers, automatically orchestrating the exchange in ownership of funds and assets. The operator does not hold the funds or assets on a balance sheet of its own.

Synchronisation using central bank money could reduce the time, cost and risk of transactions. It eliminates the risk of a counterparty failing to hand over ownership of an asset ("settlement risk"). It could also reduce liquidity costs, by cutting the amount of time that assets need to be reserved for a specific transaction.

The Meridian prototype develops a synchronisation network using distributed ledger technology (DLT). The prototype demonstrates how a DLT network can connect to the resilient and secure centralised systems of actors in a transaction – including the RTGS operator – using open-standard application programming interfaces (APIs).

The API messages exchanged between financial institutions leverage existing global standards for payment messages, namely ISO 20022. A relatively simple generic interface gives a synchronisation operator a high level of control over the movement of central bank money and of an asset in a transaction. This control enables synchronised settlement of funds and an asset.

"Synchronisation using central bank money could reduce the time, cost and risk of transactions."

The Meridian prototype demonstrates how to orchestrate synchronised settlement in central bank money using housing transactions as an exploratory use case. Applying the prototype to other asset classes, such as foreign exchange, was a principal design consideration. The generic interface could offer a standard way for synchronisation operators to connect multiple types of asset ledgers to an RTGS system and settle in central bank money.

The prototype also highlights the opportunity for additional efficiencies that enable innovation beyond the direct benefits of synchronised settlement. The prototype digitises the change in asset ownership by introducing a digital deed, which is time stamped at the point of settlement finality. This could act as a catalyst for industry participants to streamline the transaction by supporting further innovation. With the development of electronic signatures into the digital deed – which was not done as part of the project – the prototype could, for example, support improvements in anti-money laundering (AML) or counter terrorism financing (CTF) compliance checks.

Project Meridian was a highly collaborative effort between the Bank of England, HM Land Registry, the project's vendor – Coadjute, and the Bank for International Settlements (BIS) Innovation Hub London Centre.

Central banks can use the findings from the project to inform considerations on whether to implement synchronisation in their RTGS systems. As they do this, further exploration of the potential for synchronisation to drive innovation in wholesale payments and support the emergence of new payments infrastructures is needed in collaboration with participants in a range of asset markets.

"Central banks can use the findings from the project to inform considerations on whether to implement synchronisation in their RTGS systems."

2 Context for Project Meridian

Project Meridian is a joint experiment between the BIS Innovation Hub London Centre and the Bank of England. It seeks to understand how innovations in RTGS systems could improve payment infrastructure.

Payment system innovations range from exploring better ways to use existing infrastructures to investigating completely new ones.

Previous work by central banks has investigated ways that innovative technology can be used to link existing payment infrastructures to meet consumer demands.[2,3] Other projects have demonstrated the potential of central bank digital currencies (CBDCs) to improve domestic and cross-border payments, and retail payments.[4,5,6,7] Project Meridian adds to the understanding garnered from the suite of projects investigating how to interlink existing FMIs.[8] It builds a prototype for synchronisation, previously considered in Bank of England consultations on future RTGS system functionality.

Project Meridian experiments with synchronised settlement by interlinking RTGS systems with other asset ledgers. It introduces a "synchronisation operator" that is responsible for connecting all the actors with roles in the settlement stage of a transaction (Section 3). The actors considered in Project Meridian are the operator of an RTGS system, the asset ledger and the commercial banks and legal representatives of the buyer and seller. The buyer and seller themselves are not represented in the prototype. The synchronisation operator's role is to automatically synchronise the change of ownership of funds in an RTGS system with the change in ownership of assets.

The prototype for synchronised settlement uses a housing transaction as a first asset class (Section 4). Experimenting with this complex transaction offers insights from synchronised settlement that apply to a range of asset classes. It develops APIs that interlink a synchronisation operator with an RTGS system and to a land registry. Both the RTGS system and the land registry would require additional development to support synchronisation.

Synchronised settlement is orchestrated using open API formats, and global financial messaging standards (ISO 20022) (Section 5). Using harmonised standards supports the application of synchronisation in a range of asset markets (Section 6).

Harmonising the use of APIs and ISO 20022 messages are two of the 19 elements of the G20 roadmap for improved cross-border payments.[9] This work programme is considering how to deliver economic benefits through: improved payments infrastructure; legal, regulatory and supervisory frameworks; and crossborder data exchange and messaging standards.[10]

Central banks periodically review RTGS system functionality. In the United Kingdom, the Bank of England is currently renewing its RTGS service.[11] The new RTGS system will be more resilient and flexible, and act as a safe platform for innovation. Synchronisation functionality is one of the features that the Bank of England is considering introducing as a new service in its RTGS system beyond 2024, once the new core settlement engine has been introduced.

Insights from Project Meridian will support analysis of the benefits of introducing synchronisation services and shape how that service should be designed. The project identified several operational, regulatory and legal questions that central banks would need to consider before offering synchronisation functionality (Section 7).

3 Introduction to synchronisation

Synchronised settlement is the conditional transfer of funds in an RTGS system and assets or funds on another ledger. It has the potential to reduce the time, costs and risk associated with settling transactions for a wide range of assets. Project Meridian is an experiment that informs how these benefits can be realised.

Project Meridian is an experiment in synchronised settlement using central bank money.

Synchronisation is a way of ensuring the exchange in ownership of funds occurs if and only if ownership of another asset also changes (Section 3.1). This has the potential to reduce the time, cost and risk associated with settling a transaction (Section 3.2). The specific benefits in different asset markets will vary (Sections 4 and 6).

Terminology

A full glossary of payments and markets infrastructure terminology is provided by the Committee on Payments and Market Infrastructure (CPMI), available on the BIS website.[12] Terminology specific to Project Meridian is included here.

Central bank money: money directly issued by a central bank. This is free of credit risk and includes bank notes and funds held by commercial banks in RTGS accounts. Most transactions by households and businesses will happen through commercial banks, who will reconcile credits and debits with each other at set times during the day using central bank money.

Synchronisation functionality: a feature of RTGS systems which would allow a synchronisation operator to interlink RTGS systems with other external asset ledgers to change ownership of funds and assets on those two ledgers if and only if the other also moves.

Synchronised settlement: a way to change ownership of funds in RTGS systems using central bank money if and only if ownership of an asset also changes.

Synchronisation operator: an entity that interlinks RTGS and other ledgers to synchronise the transfer of funds in RTGS with asset movements on another ledger.

Project Meridian: the joint project between the BIS Innovation Hub and Bank of England that experiments with building a prototype for synchronised settlement.

The Meridian prototype: the prototype solution for achieving synchronised settlement.

Synchronisation network: the technology network for transmitting data to achieve synchronised settlement of a transaction in the Meridian prototype.

3.1 What is synchronisation?

Supporting synchronisation in RTGS systems could provide a harmonised and flexible way to settle using central bank money.

In payment versus payment (PvP) or delivery versus payment (DvP) settlement arrangements, ownership of funds or an asset is conditional on the movement of funds. In synchronisation, PvP and DvP arrangements could become more widely available by simplifying the process for new or existing businesses to offer settlement services using central bank money, for a wide range of assets.

The concept of synchronised settlement exists in some markets today, for example Australia and Switzerland. In Australia, third parties known as a "batch administrator" can submit a linked set of payments for property transactions to the Reserve Bank Information and Transfer System (RITS).[13] In Switzerland, "third-party system operators" can effect debit and credits to Swiss Interbank Clearing (SIC) payment system participants' accounts, provided the third-party system has received one-off authorisation in this respect from the SIC participant in question.[14]

A model for synchronisation

In synchronised settlement, a synchronisation operator would coordinate the conditional settlement between an RTGS system and a payment or asset ledger. Operators in different asset markets would connect to an RTGS system using the same generic interface.

The synchronisation operator is introduced as a new entity in a resilient payments ecosystem. It links together the existing resilient ledgers and enables secure settlement of a transaction (Figure 1).

The actors that are linked together are the RTGS operator, the other asset ledger, the transaction counterparties (end users) and the financial institutions providing services to end-users. The synchronisation operator does not itself hold the funds or assets on its own balance sheet and does not have an account in the RTGS system.

A synchronised settlement is assumed to be initiated at the request of end users (step 1). The synchronisation operator would then orchestrate the transaction from this point. The operator confirms that funds and assets are available for the transaction (step 2). Funds would then be reserved in an RTGS participant's account and assets on an asset ledger (an "earmark", step 3). After earmarks are placed, and at an agreed time, the operator initiates the transfer of funds and assets by releasing the earmark: the transaction settles (step 4). Once settlement finality is achieved, confirmations would be sent to the end users (step 5).

Figure 1: Synchronisation model
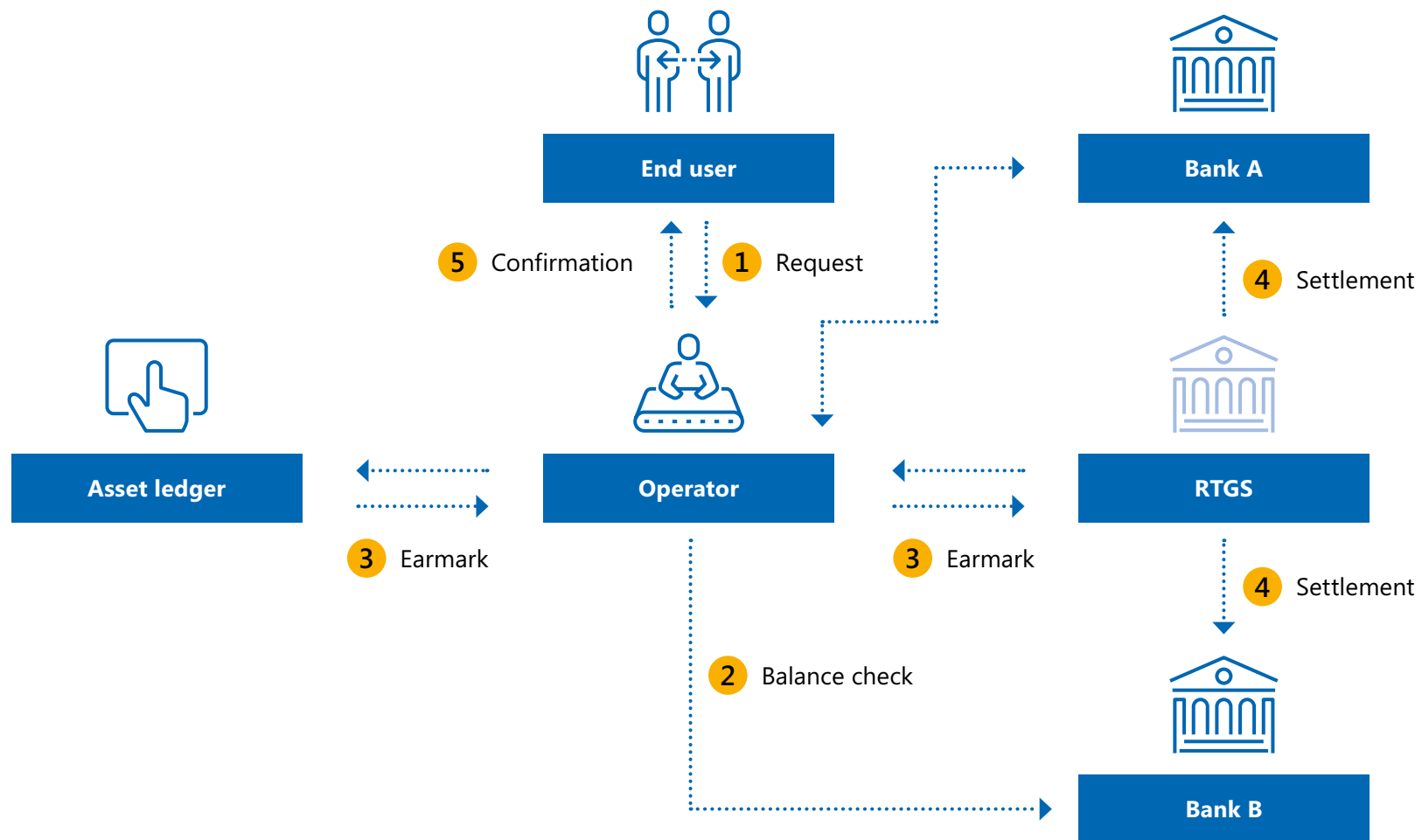
3.2 Benefits of synchronisation

Synchronisation could reduce the risk, time and costs involved in settling a range of transactions. Synchronised settlement in RTGS systems could eliminate settlement risk and reduce liquidity costs.

Interlinking RTGS with other ledgers could also streamline the settlement processes for complex transactions. Manual steps in the process could be automated and enhanced transparency can give counterparties more certainty.

The more complex a transaction is, for example if multiple individual transactions need to simultaneously settle as part of a chain, the greater the potential benefits of synchronisation. In addition to improving existing functionality, synchronisation could provide a platform for innovation, enabling new services to be developed for transactions in a range of markets, backed by the security of central bank money.

Eliminate settlement risk

Settlement risk is the risk that one counterparty to a transaction fails to hand over ownership of their asset.[15] This risk remains in some markets where there is no cost-effective mechanism to commit both counterparties to the transaction. In foreign exchange markets, for example, $2.2 trillion of transactions were exposed to settlement risk each day in April 2022, according to the 2022 BIS Triennial Survey.[16]

$2.2trn

of transactions were exposed to settlement risk each day in April 2022

Synchronised settlement eliminates settlement risk by achieving DvP or PvP settlement in central bank money. Conditional changes in the ownership of assets on different ledgers guarantees that either all assets in a transaction, or a chain of transactions, will change ownership or none will. Synchronisation would be enabled by the placing and simultaneous release of earmarks. This locks the funds or assets for a short period of time before settlement of a specific transaction.

The synchronisation operator would not hold either funds or assets on its balance sheet, or have an account in RTGS. In the event that a synchronisation operator fails, the funds and the asset would not, therefore, be at risk.

Lower liquidity costs

In the absence of synchronised settlement, an escrow arrangement is commonly used to mitigate settlement risk. Typically, funds are sent to, and temporarily held by, a trusted third party until after settlement. This arrangement prevents funds being used for other purposes or earning interest: as such the settlement participants face a liquidity cost. This cost is particularly significant in cross-border payments, where funds can be trapped for a longer period than domestic payments due to different processes across jurisdictions (Section 6).

In synchronisation, settlement is automated and conditional and thereby reduces the need for arrangements like escrow. Escrow is replaced by temporarily earmarking the assets and funds for a short period of time before settlement without moving them from their existing account. In addition, by simultaneously settling groups of payments in RTGS systems that currently settle individually, synchronisation arrangements could deliver higher levels of liquidity efficiency.

Automation of manual processes

In some transactions, such as housing, cross-border payments and corporate financial activities, the movement of funds is associated with a complex business process.[17] Current processes can involve repetitive manual procedures and reconciliation of data between multiple actors. This can be time consuming and costly, and at risk of errors, generating uncertainty for all parties involved. Through automation, the cost of settlement could fall and transparency increase.

New opportunities for innovative financial services

Synchronisation provides an opportunity for the private sector to offer innovative settlement services. It allows a broad range of ledgers to interlink with RTGS systems through a synchronisation operator. The anticipated technical changes to RTGS systems and systems of other actors to enable this are expected to be small in comparison to alternatives that involve building completely new infrastructure. In this sense, synchronised settlement presents an opportunity to deliver the benefits in a quicker and more cost effective way.

Synchronisation functionality could widen participation in a market to include new entrants. The generic interface to an RTGS system provides a harmonised and flexible platform for synchronisation operators to connect to. This is in contrast to bespoke PvP or DvP settlement arrangements in RTGS systems in different markets, as is often the case. Synchronisation functionality should make it easier to offer synchronised settlement for new asset classes, and for new businesses to offer competing settlement services in a market.

4 A prototype for synchronised settlement

Project Meridian is an experiment that builds a technology prototype for achieving synchronised settlement.

To conditionally exchange ownership of funds and an asset, the synchronisation operator needs to consider the conditions under which each moves.

Building a prototype that could be applied to a range of assets was a principal design consideration. The complexities involved in achieving settlement in an English or Welsh housing transaction are considered as a first experimental use case. A digital deed is introduced to represent the change in ownership of the house.

Project Meridian builds a technology prototype for synchronised settlement, experimenting with the complex process of buying a house as the first use case (Sections 4.1 and 4.2). The Meridian prototype will allow RTGS system operators to understand how they could offer synchronisation functionality to settle a single transaction or a chain of housing transactions simultaneously (Section 4.3).

The functionality built in the prototype could reduce settlement risk, liquidity costs and uncertainty (Section 4.4). A digital deed was created as part of the project. Such digitisation illustrates how potential benefits for the whole process of buying an asset could be streamlined (Section 4.5).

"Building a prototype that could be applied to a range of assets was a principal design consideration."

4.1 Objectives of building the Meridian prototype

The insights of Project Meridian will support RTGS operators who wish to explore and develop synchronised settlement functionality.

In the Meridian prototype, the settlement stage is digitised and automated. The process of moving funds can be dependent on the complexities involved in changing ownership of an asset. To fully understand technical requirements for central banks to build synchronisation functionality in to RTGS systems (Section 5), understanding the business of an asset market is insightful.

In the prototype, three broad elements are digitised to automate the settlement stage of a transaction.

▶ A synchronisation network, with its own data model and managed by the synchronisation operator, through which information is exchanged with the actors in the transaction.

▶ A set of messages to instruct the change in ownership of funds and the asset. For the payment, these are based on ISO 20022 messaging standards. For the asset, these are data points in an API.

▶ API specifications for sending and receiving messages to settle the transaction.

When a digital representation does not currently exist, one is introduced to the prototype to test an approach.

The Meridian prototype did not consider how each actor responds to the information. This includes, for example, how an RTGS system or commercial bank would process payment messages in their own systems. Functional considerations – along with operational and policy, regulatory, and legal issues – relating to the practical implementation need further analysis (Section 7).

The first use case: housing

The Meridian prototype experimented by considering English and Welsh housing transactions as a first use case. Many of the current business processes involved in a housing transaction – such as coordination across many parties and escrow arrangements – can also be seen in other asset classes. A theoretical extension to other assets was considered in building the prototype (Section 6).

The settlement stage of a housing transaction involves coordination across multiple actors (Table 1). The actors considered in building the Meridian prototype are the buyer's and seller's conveyancers (legal specialists in transferring ownership of a property), commercial banks, the RTGS system operator and HM Land Registry. To digitise the transaction, a "digital deed" is introduced. This is in the absence of a digital representation of the property on a ledger in the current purchase process.

Coordination among the actors is often achieved by sharing information by email and in telephone calls. These manual processes, and lack of transparency about the status of a transaction, mean that uncertainty remains for the buyer and seller even when the transaction has settled. This can be a source of stress and at times additional costs. Settling transactions in a chain sequentially further contributes to this stress; and manual processes require steps to mitigate the risk of errors.

Table 1: Comparing a synchronised settlement to the current approach

	Stage of house purchase process	Purpose	Current approach	Synchronised settlement
	Conveyancing (once complete, step 1 occurs)	Buyer and seller agree to the terms of the transaction following legal due diligence by conveyancers.	The buyer and seller agree contracts and completion forms are prepared.	Contracts are agreed and the conveyancer registers the transaction on the synchronisation network. Details are input to a new digital deed built in the prototype (Table 2).
The settlement stage orchestrated in the Meridian prototype	**Exchange/deposit** (step 2)	Buyer pays a deposit.	Buyer sends deposit funds to their conveyancer's client account.	Deposit funds are put on "hold" in the buyer's bank account(s) so that they cannot be used for other purchases.
	Ahead of completion (steps 2 and 3)	All the funds required for the purchase and the property are reserved for the transaction.	Buyer sends the remaining cash funds to their conveyancer's client account. Mortgage lender disperses funds to the conveyancer.	Remaining cash funds put on hold in buyer's bank account(s) and mortgage funds put on hold in a mortgage account at the lender. Just before settlement, all the funds are earmarked in RTGS accounts.
	Moment of completion/settlement finality (step 4)	Ownership of the funds and the property change.	Buyer's conveyancer requests funds are sent to the seller's conveyancer using a CHAPS payment in RTGS. The transfer of home ownership is confirmed in a telephone call.	Funds flow between banks' RTGS accounts and the new digital deed is time stamped.
	After completion (steps 5 and 6)	The seller needs to have received the proceeds of funds and the registration of ownership needs updating.	The seller's conveyancer sends funds to the seller. Forms to update the land registry are submitted to HM Land Registry.	The bank account balances of the buyer and seller update as funds are transferred from the buyer to the seller. The digital deed is sent from the synchronisation operator to HM Land Registry as an API.

4.2 Synchronised settlement for a single transaction

There are six steps to orchestrate a synchronised settlement in the Meridian prototype (Figure 2):

1. conveyancers request synchronised settlement services;

2. commitment of buyer funds to a transaction (hold);

3. reservation of funds in an RTGS account (earmark);

4. settlement finality;

5. updating the buyer's and seller's account balances; and

6. confirmation, which enables the rest of the purchase process to occur.

Each of these steps is dependent on the previous one being completed. Once settlement finality is achieved (step 4), ownership of the funds and assets has changed, and the update of counterparties' balances and other processes associated with buying a house must occur (steps 5 and 6). To deliver these in the prototype, assumptions have been made about technical functionality and to simplify some of the workflow (Table 2).

Table 2 Summary of assumptions made in the Meridian prototype

Four simplifying assumptions are made

▶ Commercial banks involved in the transaction have an RTGS account – they are direct participants (steps 3 and 4).

▶ All funds – deposit and the remaining cash funds – are instructed to be placed on hold on the buyer's bank accounts at the same time. In practice, a deposit would be held a few weeks before settlement (step 3).

▶ The change in ownership of the property is represented by the introduction of a digital deed.

▶ The change in ownership of the property can be represented by a standard set of data in the digital deed; housing transactions with unusual sale conditions are not considered.

Four technical choices are made

▶ All actions – hold (step 2 in Figure 2), earmark (step 3), settlement (step 4), balance updates (step 5) and post settlement actions (step 6) – are orchestrated by the synchronisation operator.

▶ Control points for commercial banks are introduced to approve or reject the hold (in commercial banks) or earmark (in RTGS accounts) of funds.

▶ Funds are actively reserved in the buyer's bank account (through a hold) rather than being sent to the buyer's conveyancer (escrow).

▶ At the moment of settlement finality the digital deed is time stamped on the synchronisation network (step 4).

Figure 2: Steps in a synchronised settlement of an English or Welsh housing transaction

1 Request settlement service

To start a transaction, counterparties appoint a synchronisation operator.

2 Buyer commits funds

Reservation of the buyer's funds for the transaction by applying a hold is instructed.

3 Funds reserved

To prevent the funds or assets being used in other transactions, an earmark is placed. This can last for minutes, and approval is needed before they are placed.

4 Settlement

Final settlement is achieved when the synchronisation operator instructs funds to move from the buyer's bank to the sellers in the RTGS system. Ownership of the asset changes.

5 Balances updated

The buyer's and seller's bank account balances are updated after settlement finality is achieved.

6 Confirmation of settlement

End users receive confirmation that the transaction has been completed, and the digital deed is sent to HM Land Registry. Remaining steps in the house purchase process can now occur.
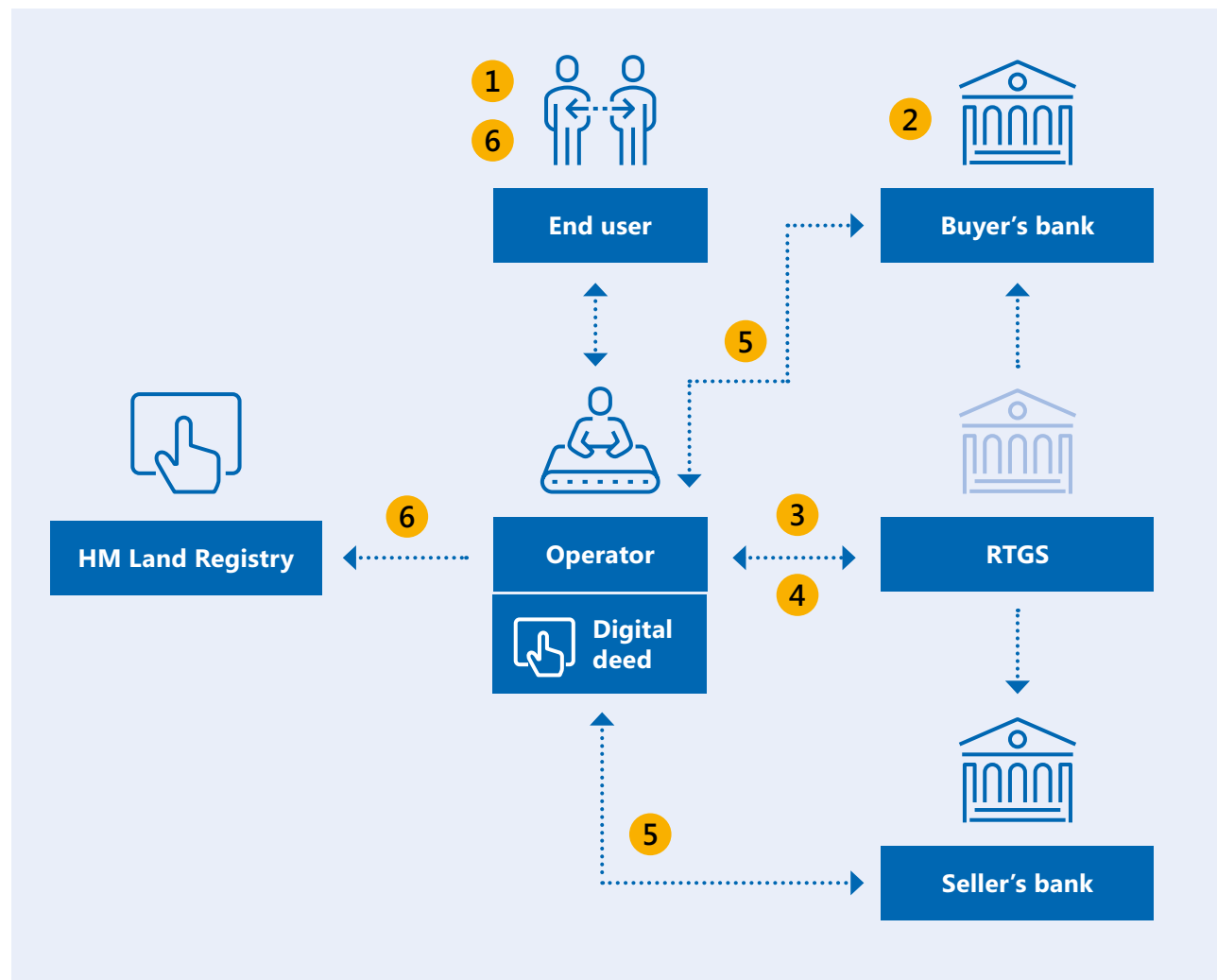
Step 1   Request settlement services

The appointment of a synchronisation operator by the buyer's and seller's conveyancers is the starting point for a synchronised settlement. This initiates a sequence of steps to settle a transaction. In the prototype, all actions are instructed by the synchronisation operator. The buyer's and seller's conveyancers will provide the operator with details of the source and destination bank accounts, along with the amounts that need transferring. They will also provide information required to change the ownership of the property on the land registry, which is input to the digital deed that is introduced in the prototype.

Step 2   Buyer commits funds

Funds are first instructed to be placed on hold in the buyer's bank account. This replaces escrow arrangements, where the buyer transfers funds to their conveyancer. The prototype assumes all funds are placed on hold at the same time: in practice, a deposit would be held a few weeks before settlement. A hold prevents the buyer from using the funds for other purchases. The hold on funds replaces the balance check in the baseline model (Section 3). A balance check alone would not prevent funds from being spent elsewhere.

Step 3   Funds reserved in RTGS accounts

Shortly before the agreed settlement time, an earmark is instructed to be placed on all of the buyer's funds. The earmark is placed on funds in the RTGS accounts of the buyer's banks, which are assumed to be a direct participant holding an RTGS account. Earmarks typically last for a very short period, potentially only minutes. All payments are introduced together to ensure that all the funds needed for the purchase are earmarked. Before placing an earmark on these funds, the synchronisation operator asks for the bank's permission. This control point was introduced following industry consultation.

"A hold prevents the buyer from using the funds for other purchases."

Step 4 **Settlement finality**

At the agreed settlement time, the synchronisation operator triggers settlement. It asks for the earmark to be released, moving funds to the RTGS account of the seller's bank. Simultaneously, the digital deed is automatically time stamped to change ownership. In the Meridian prototype, this is a digital deed, which contains the data required to update the property register at HM Land Registry. Settlement finality is achieved.

This digital deed sits in the synchronisation network and is completed in advance of settlement by conveyancers. A number of land registries are investigating how to digitise the updating of their registers. The digital deed introduced in the prototype would replace a telephone call to confirm funds have been received by the seller and an email containing completion documents to say that the buyer has taken ownership of the property. The documents that are exchanged are used by HM Land Registry to update the land registry after the transaction has settled, a process that can involve checks by HM Land Registry on the information provided. The digital deed is introduced in the absence of an asset ledger. The baseline model for synchronisation (Section 3) assumes that a synchronisation operator can instruct that the change in ownership on an asset ledger takes place at the exact time of settlement finality.

Step 5 **Balances updated**

As soon as ownership has legally changed, all parties to the transaction can be informed so that they can update their records. Messages will be sent by the synchronisation operator to the buyer's and seller's banks for them to update account balances of their clients. These updates would be near instantaneous.

Step 6 **Confirmation**

Once the settlement stage has been completed, the end user will be informed and the digital deed will be sent to HM Land Registry in an API to update the land registry. The digital deed includes details of the new property owner. Details of the seller's mortgage – which will have been repaid – will be removed from the registry, and the claim discharged. And the buyer's mortgage provider will have a charge on the property added to the register.

"The digital deed is introduced to represent the change in ownership of the house."

4.3 Settling interrelated transactions simultaneously

The ability to exchange ownership of multiple assets and funds simultaneously has the potential to increase benefits from synchronisation further. In particular, settling a whole chain of transactions simultaneously and conditionally will reduce liquidity costs further by enabling individual payments to be offset and providing more certainty to counterparties.

The Meridian prototype settles multiple transactions simultaneously by introducing a common "chain identifier" in messages sent to the RTGS system. For each transaction to settles if and only if all other related transactions settle, the RTGS system would need to be able to move all funds linked by a chain identifier simultaneously. Either all funds move and every transaction settles, or no funds or assets change ownership.

The RTGS system receives details of every gross payment for a transaction chain. At settlement finality, each payment for each transaction has settled. To minimise the funds that needs earmarking and transferring, each transaction in a chain is processed simultaneously. In effect, only net transfers between banks are earmarked and moved.

In England and Wales, a chain of property transactions that are interdependent on each other is common. In such cases, an individual will simultaneously buy and sell a property, and the proceeds from the sale of one property will immediately fund the purchase of another (Figure 3).

Commercial banks, to implement the hold, are sent instructions for the cash source of funds – cash and mortgage – only. Each commercial bank only sees the movement of funds relevant to their client. This is sufficient to achieve settlement across the chain: the remaining value of all house purchases is paid for by sale proceeds.

"Conditionality across transactions is achieved by making payments dependent [on each other]."

First-time buyer

Home mover

Final seller

Bank account: £60,000

Mortgage account: £100,000

Transaction 1

Purchase price £160,000

Mortgage redemption: £110,000

Final seller

The final seller will take all the sale proceeds as cash. A portion will pay off any mortgage secured on the property. The remaining funds will be deposited in the individual's bank accounts.

First-time buyer

First-time buyer(s) fund the purchase of a property using funds in a bank account and through mortgage borrowing.

Home mover

Home movers simultaneously sell and buy a house. This involves a larger number of payments than for a first-time buyer or final seller. The mortgage secured on the sold property will be redeemed. The new property will be purchased using a combination of proceeds from the sale of the property that was sold, a new mortgage and money held in a bank account.

Sale proceeds: £50,000

Bank account: £50,000

Mortgage account: £300,000

Transaction 2

Purchase price £400,000

Mortgage redemption: £100,000

Bank account: £300,000

4.4 Benefits of the Meridian prototype for settlement

The Meridian prototype demonstrates that the benefits of synchronisation could be realised by digitally orchestrating settlement.

Liquidity costs for transactions are reduced as funds could move directly from the buyer to the seller. They would not need to be transferred to a third party to hold on a client's behalf. The precise amounts for a transaction are reserved, and until settlement, the owner of the funds receives interest income on the funds. Credit facilities – in this case a mortgage – could be drawn down directly to pay the seller.

In synchronised settlement of a housing transaction, the conveyancer will lose interest income, but this would be offset – either partially or fully – by lower insurance premiums associated with holding clients' funds. Liquidity savings for commercial banks would probably – in practice – be small for housing transactions, but much larger in other use cases such as foreign exchange transaction (Section 6).

Digitisation reduces uncertainty by giving greater clarity to all actors in a transaction. Greater certainty around the status of a transaction is a potentially large benefit for a housing transaction in England or Wales. Currently the buyer and seller may not be immediately updated and delays can cause unexpected costs, including, for example, additional removal fees when people are delayed in moving.[18] The hold and earmark of funds are key functionalities that provide certainty in a transaction.

"Digitisation reduces uncertainty by giving greater clarity to all actors in a transaction."

4.5 Potential benefits of the Meridian prototype beyond settlement

In the Meridian prototype, the transaction is digitised, and the movement of funds is conditional on the movement of assets. This offers an opportunity for professionals who work in the asset market – in this case the housing market – to streamline their processes.

The synchronisation network and the digital deed in the Meridian prototype are features of the prototype that could support broader innovation. These features digitise the settlement process using a single set of data and processes. The digital deed could tie the information collected in advance of settlement to the processes that come after.

Further innovation, by asset market participants, could replace existing manual process.

One way the synchronisation network and digital deed could lead to improvements in transactions is by making important existing pre transaction checks to guard against financial crime more efficient. AML and know your customer (KYC) checks on purchase funds, the asset and the counterparties, including confirming their identities are frequently required. A synchronisation operator could connect to any existing trusted sources to complete the data fields in the digital deed and sign with a trusted electronic signature, streamlining AML and KYC checks.[19] This functionality was not tested in the prototype.

In housing transactions in general, manual processes are cited by approximately a quarter of conveyancers as one of the most important aspects of a property transactions in need of improvement.[20]

The data that are contained in the digital deed in the prototype includes details of the owners and of the claims lenders may have on the property in case the registered owner defaults on their debt. This digital deed can significantly automate the update of the registry by containing information that:

▶ transfers ownership of the property from the seller to the buyer ("transfer");

▶ removes the claim the seller's mortgage lender has on the property in the event of default ("discharge"); and

▶ applies a claim for the buyer's mortgage lender on the property in the event of default ("charge").

Updating the land registry after settlement is currently a slow and manual process. When ownership changes, the buyer's conveyancer is responsible for providing the information required to update the register. HM Land Registry will review information sent to it and might ask the conveyancer for further supporting evidence.

Key insights from Project Meridian

Synchronisation

Ledgers interlinked with a new synchronisation operator.

▶ To achieve conditional change in ownership of funds an assets, a synchronisation operator would need to be able to reserve funds by instructing earmarks on funds in banks RTGS accounts, and holds on funds in customers' bank accounts.

▶ To settle interrelated transactions, RTGS systems would need to be able to simultaneously settle all the payments for every transaction that are linked by a chain identifier. This chain identifier is introduced in the prototype.

▶ The time stamping of a digital deed at the point of settlement finality would need to represent the change in ownership of the asset. This is introduced in the prototype in the absence of a digital ledger that can update in real time.

Transparent transactions

Information aligned across all actors involved in the transaction, with live status updates.

▶ A synchronisation operator needs to handle the different data standards used by RTGS systems, commercial banks and the ledgers and registers for other assets.

▶ All the information required to achieve settlement could be combined on a synchronisation network, offering the potential to share statuses on the progress towards settlement, included completed and outstanding steps.

Innovation

Automating the payment opens up opportunities to enhance the entire transaction process.

▶ Synchronisation functionality should make it easier to for new businesses to offer synchronised settlement for a wide range of asset classes.

▶ A single, digitised, information set offers the opportunity for asset market participants to streamline business processes above and beyond benefits for settlement from synchronisation

Open standards

Widening access to central bank payment systems by setting open standards.

▶ The use of ISO 20022 messages and JSON APIs can provide a generic interface for a synchronisation operator to connect to an RTGS system.

5 Technology findings

The Meridian prototype demonstrates that synchronised settlement can be achieved between RTGS systems and other ledgers. RTGS systems need to support earmarking and the simultaneous movement of specified funds. The solution and data standards that achieve this have the potential to support innovation.

Synchronised settlement is reliant on instant and simultaneous exchange of information and instruction of payments. The Meridian prototype applied open standards in an innovative way to achieve this (Section 5.1).

The Meridian prototype uses a DLT-based network to orchestrate the change in ownership of funds in an RTGS system and of the asset (Section 5.2) although – in practice – synchronisation operators could develop non DLT-based solutions.

5.1 Innovative use of data standards

The exchange of information across all actors in the transaction is central to synchronised settlement. The challenge addressed in Project Meridian is to achieve this, at high speed, low cost and in a transparent way across different actors' technology systems.

The synchronisation operator interlinks actors using a common platform. It handles the different data standards of all the actors on the network so that the common platform can store and share information with the actors.

There are two key data elements required for the synchronisation network to communicate with the actors. First, the data points required for the transaction. Second, the modelling of these data points in API messages in a way that is consistent with each actors' infrastructure.

The payment leg (RTGS operator and commercial banks) uses the ISO 20022 messaging standard. Bank accounts are identified using IBANs. Where payments data modelling work did not identify messages that fulfil the required functionality, specific changes are proposed, in particular new identifiers to ISO 20022 messages.

To ensure that conveyancers and HM Land Registry can execute their responsibilities before, during and after settlement, the synchronisation operator exchanges messages with them in a format that they can process.

The synchronisation operator communicates with each of the actors in a transaction using JSON APIs. JSON is an open standard file format that uses a common data format offering an effective way to exchange information. Individual APIs have been written for each part of the workflow.

## The financial sector: RTGS and commercial banks

The ISO 20022 messaging standard is a new standard being adopted globally. It is a common and open messaging standard for domestic and international payments. Adoption of this standard is a crucial element of the G20 roadmap to improve cross-border payments.[21]

The ISO 20022 messaging standard can be applied to achieve almost all of the functionality for payments in the prototype (Figure 4). For a single payment, ISO 20022 messages have been used to: (stage 1) hold funds in a counterparty's account at a commercial bank; (2 and 3) apply an earmark in RTGS; (4) trigger the interbank payment on RTGS; and (5) instruct commercial banks to update clients' accounts.

Simultaneous settlement of specified payments requires additional payment message functionality (Section 4.3). Most housing transactions will involve multiple payments, which must happen at the same time. To simultaneously reserve multiple funds or trigger multiple payments new fields are proposed to relevant ISO 20022 messages. These would need to be implemented through existing governance processes.

Figure 4: Use of ISO 20022 messages for payments in a synchronised settlement

1. **The buyer's funds are held.**
   - ▶ Instruction to hold: camt.103.
   - ▶ Confirmation of hold: camt.025.

2. **Earmark request made to buyer's bank.**
   - ▶ Earmark request: camt.103.
   - ▶ Confirmation of approval: camt.025.

3. **Earmark placed in the RTGS account of the buyer's bank.**
   - ▶ The camt.103 and camt.025 in stage 2 are sent to RTGS.
   - ▶ RTGS system confirms earmark placed by sending a camt.047.

4. **Movement of funds instructed.**
   - ▶ Settlement instruction: pain.001.
   - ▶ Confirmation of settlement: pain.002.

5. **Customer account balances updated in their banks.**
   - ▶ Instruction to update: camt.054.
   - ▶ Confirmation of update: camt.025.
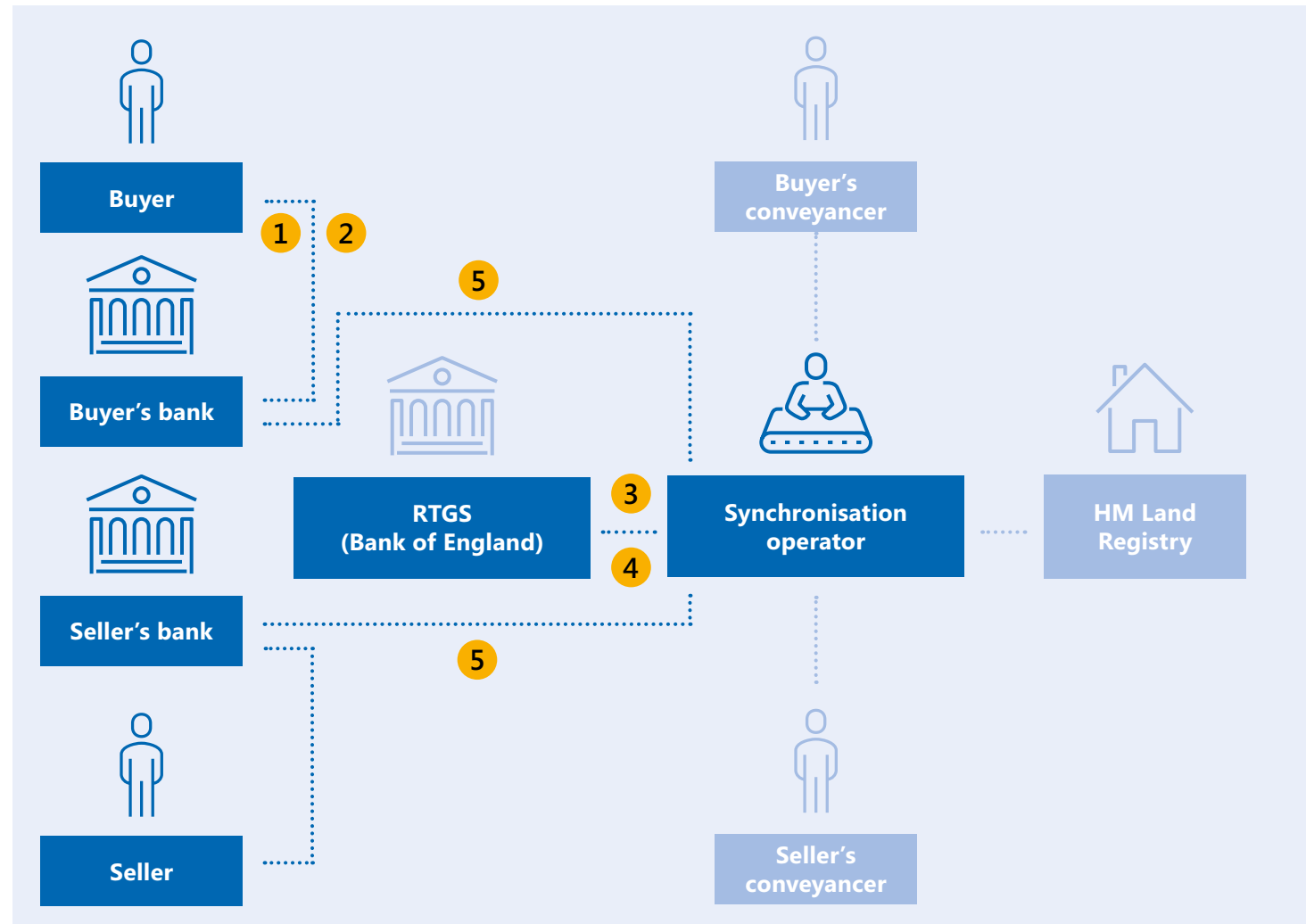
To simultaneously settle multiple payments, two additions are introduced to messages. First, each API in the prototype needs to exchange information on multiple transactions. Second, the RTGS system and commercial banks need to be able to confirm that they have received all payments for a transaction. The chain identifier and a "message count" are included in messages so that the RTGS system can identify all the payments and transactions that are interdependent. The chain identifier and message count allow for multiple messages to be processed for a set of related transactions in the RTGS system. This would allow many synchronisation operators to be involved in one transaction chain.

Land registry

To update the land registry, HM Land Registry requires details on the individual, the asset, and the mortgage account related to the property. Synchronisation operators could replace existing approaches for this using the digital deed. Required details could be input by the conveyancer alongside information on payments when the transaction is registered with the synchronisation operator. In the prototype, the digital deed contains an example set of information required to update the land registry based on the PDF forms currently submitted by conveyancers (Section 4.5). The digital deed is sent by the synchronisation operator using API standards that are published by HM Land Registry.

The buyer's and seller's conveyancers

The buyers and sellers and their conveyancers are the end user of a synchronisation service. In the prototype, conveyancers input data to a web-based user interface, which sends API messages to the synchronisation network. Alternatively, the APIs could be exposed for conveyancers to use.

"[A] chain identifier and a message count are included in messages."

5.2 Use of a DLT network to orchestrate settlement

For an RTGS system to move funds as part of a synchronised settlement, it needs to be able to receive payments messages (Section 5.1). The RTGS system is agnostic to the technology that the system generating these messages is based on.

Project Meridian uses a synchronisation network based on DLT. It has proved that RTGS systems, which have a centralised ledger, can interlink with a DLT-based network.

The synchronisation operator in the Meridian prototype uses a permissioned DLT platform.[22] Each of the actors involved in a transaction – and only those actors – has a node on the network. The identity of each actor would be confirmed using trusted credentials, providing confidence that synchronised settlement is secure.

The synchronisation network contains all the data required for the whole transaction to settle. It also contains the definitions of messages that are sent to and received from each of the actors' own systems (Section 5.1). Apart from conveyancers, each actor accesses information on the synchronisation network via their own node. Conveyancers send and receive information via web-based user interfaces in the prototype. This could alternatively be achieved by directly connecting using APIs.

Messages between the actors' nodes on the synchronisation network are exchanged confidentially and in a way that recipients can be confident of the identity of the sender. This is achieved by actors using public and private keys associated to credentials managed by certificate authorities within the Meridian prototype.

"The synchronisation network contains all the data required for the whole transaction to settle."

6 Applying synchronisation to other asset classes

Applying the Meridian prototype to multiple asset classes was an important consideration in building the prototype.

Bank of England consultations on synchronisation have highlighted a number of asset markets in which it could offer benefits. The most frequently cited are housing transactions, corporate actions, securities settlement and cross-border payments. The Meridian prototype is designed to be extensible from a housing transaction to other asset classes.

How the prototype could be applied to a foreign exchange transaction was considered from a theoretical perspective (Section 6.2). Applying the prototype to a foreign exchange transaction requires an examination of the messaging standards and control points in the prototype.

6.1 G20 roadmap for improved cross-border payments

Cross border payments are of significant interest to the global central banking community. They are typically slower, more expensive and less transparent than domestic ones. It can sometimes take several days to remit money to a different jurisdiction, and cost an average of around 6% of the value of the transfer.[23,24]

The G20 has launched a programme of work to consider how cross-border payments can be made faster, cheaper, more transparent and accessible. To achieve this, the Financial Stability Board (FSB) is leading a number of workstreams in coordination with the CPMI and other relevant international organisations.

In 2021, it announced clear quantitative targets for speed, cost, transparency and access to cross-border payments. Workstreams cover a range of topics, including improving existing payment infrastructures, developing common standards and coordinating regulatory and oversight frameworks.

Building block 9 of the roadmap is facilitating increased adoption of PvP settlement in foreign exchange transactions. The importance of synchronised settlement is widely recognised, with benefits including eliminating settlement risk and improving efficiency.[25]

6.2 Exploring a foreign exchange transaction

In foreign exchange transactions, settlement for each currency occurs in different jurisdictions. A significant number of intermediaries are often involved.

Some banks do not have a presence in each jurisdiction, or a counterparty to act on their behalf. Instead they use correspondent banks to settle a foreign exchange transaction. Correspondent banks provide accounts to other banks that do not have a direct relationship with each other. A chain of transactions is needed for less common currency pairs. Each additional transaction has additional costs associated with moving funds and meeting regulatory requirements of cross-border payments.

Challenges in foreign exchange transactions

There are several frictions that need to be overcome to improve cross-border payments, including foreign exchange transactions:

▶ fragmented and truncated data formats make it difficult to automate processes, leading to delays and higher costs of exchanging information for a transaction;

▶ complex and varying AML and CTF compliance checks in different countries can lead to the same transactions being checked multiple times;

▶ settlement can only occur during RTGS system operating hours, which do not necessarily overlap;

▶ a significant proportion of cross-border payment systems operate using legacy technology platforms causing delays in settlement, and introducing costs such as funding costs; and

▶ banks are required to pre-fund transactions to minimise delays, which leads to high funding costs.

"Faster settlement could lower liquidity costs for counterparties by eliminating the need to set aside funds for extended periods to settle transactions."

Settling a foreign exchange transaction using synchronisation has the potential to address several of these challenges. In markets in which PvP is not currently adopted, settlement risk could be eliminated by making the exchange of currencies conditional. Each day in April 2022, $2.2 trillion of transactions were exposed to settlement risk according to the 2022 BIS Triennial Survey.

Faster settlement could lower liquidity costs for counterparties by eliminating the need to set aside funds for an extended period to settle transactions. Streamlined processes – especially when combined with other initiatives such as the introduction of the global legal entity identifier (LEI) standards – could also reduce processing costs.

Theoretically applying the Meridian prototype to a foreign exchange transaction

Achieving synchronous settlement for a foreign exchange transaction would involve simultaneous actions in RTGS systems in the two jurisdictions. A prototype for a foreign exchange transaction would, therefore, send symmetric instructions to two RTGS systems, one for each currency. The functionality to settle in two RTGS systems has been developed for the housing use case. Once earmarks are confirmed in both currencies, the synchronisation operator could trigger settlement across the two RTGS systems simultaneously.

The synchronisation model should cater for chained foreign exchange transactions involving correspondent banks. Settlement finality in a synchronised settlement is ultimately achieved in RTGS systems. The hold functionality in the Meridian prototype reserves funds in a counterparty's account when they do not have an RTGS account. This model can, therefore, theoretically be extended to a foreign exchange transaction involving correspondent banks.

"Synchronisation is an asset agnostic concept. And the Meridian prototype has been developed to be adapted to many asset classes."

Questions outstanding for a synchronised foreign exchange transaction

Synchronisation is an asset agnostic concept. And the Meridian prototype has been developed to be adapted to many asset classes. To apply the prototype to a foreign exchange transaction there are a number of design and policy questions that would need to be considered.

▶ **Scalability** – performance testing was not a focus for Project Meridian, but is an important consideration for foreign exchange transactions.

▶ **Messaging standards** – the messaging standards built in the Meridian prototype are sufficient for a domestic transaction. Cross-border transactions will probably need additional information to meet, for example, AML or CTF requirements. Building block 14 of the cross-border payments programme considers data standards.

▶ **Controls** – the Meridian prototype introduces controls for placing an earmark on funds in an RTGS system. The controls required in a foreign exchange transaction could be different to those needed in a house purchase.

▶ **Operating hours** – synchronisation requires both RTGS systems to be open and able to settle. Extending operating hours is considered by building block 12 of the cross-border payments programme.

▶ **Policy** – the roles and responsibilities of synchronisation operators and granting non-residents access to RTGS systems need further consideration. In a simple application of the synchronisation model to a cross-border payment, a single synchronisation operator could orchestrate a movement in funds in two RTGS systems. For at least one of those RTGS systems, an instruction to earmark would come from outside the jurisdiction.

7 Future considerations

Project Meridian has demonstrated that synchronised settlement could be achieved using central bank money. In order to implement synchronisation, operational and policy, regulatory and legal questions will need to be considered.

BIS Innovation Hub projects investigate and present options for how financial technology could be used by central banks.

Project Meridian has demonstrated that synchronised settlement in central bank money can be achieved for a house purchase in England and Wales. The messages sent between the synchronisation network and RTGS system using APIs provide a generic interface that could be extended to other asset classes, such as foreign exchange, relatively easily.

The project concludes that synchronisation is a relatively simple way to reduce the time, costs and risks of a transaction. Central banks and RTGS operators can consider the benefits of this approach alongside others that improve payment infrastructures to improve wholesale settlement (Section 2). Synchronisation can provide a catalyst for innovation in wholesale payments and support the emergence of new payments infrastructures that settle using central bank money.

The Bank of England will use the insights from the project to inform their work considering the introduction of synchronisation in its RTGS system beyond 2024. Assumptions that were made in the prototype will need to be considered (Section 4.2). In developing synchronisation functionality, RTGS operators will need to review these and assess policy and operational (Section 7.1), regulatory (Section 7.2) and legal considerations (Section 7.3). Specific implementation will probably vary across jurisdictions.

"The project concludes that synchronisation is a relatively simple way to reduce the time, costs and risks of a transaction."

7.1 Policy and operational considerations

Control points

The synchronisation operator is responsible for holding, earmarking and releasing funds on an RTGS account holder's behalf. To provide the owner of the funds with assurance over the synchronisation operator's actions, a control point has been introduced before placing a hold or earmark. Commercial banks with RTGS accounts confirm to the synchronisation operator that they agree with placing the earmark.

Control points are implemented as a manual confirmation process for demonstration purposes in the prototype. RTGS operators would need to consider how they are implemented in practice. For example, a control point could be an automatic process with predefined rules (such as rules based on the value of the transaction). A control could also be accompanied by a notification to RTGS participants or could allow them to place limits on the value of funds in an RTGS account that they are content to earmark.

Security implementation

A trust model for synchronisation services needs to be considered. The synchronisation operator would secure its own network from being compromised but supporting this with the validation of a participant's identity would reduce the security impact of a synchronisation operator being compromised. How such identity services provided by RTGS systems and other asset ledgers could be used to ensure the end-to-end security of synchronised transactions need to be considered. In the United Kingdom, for example, the Bank of England is considering how to offer a centralised RTGS public key infrastructure identity service.

RTGS operating hours

Synchronisation services would be restricted by existing RTGS operating hours, in the absence of any change. In some cases using synchronisation for cross-border transactions would be restricted to the overlapping operating hours of the two RTGS systems. Many jurisdictions around the world are considering extensions to the operating hours of their national payment infrastructures. Extending RTGS operating hours could increase opportunities for synchronisation, especially for cross-border payments.

"Project Meridian built a prototype for housing transactions and conducted a theoretical analysis of extending the prototype to foreign exchange transactions."

Synchronisation to other use cases

One key principal of the synchronisation functionality is that it aims to be applicable to multiple asset classes, settling in central bank money. Project Meridian built a prototype for housing transactions and conducted a theoretical analysis of extending the prototype to foreign exchange transactions. The practical application of the prototype to foreign exchange needs developing to prove that a live system would support a wide range of asset classes in practice.

7.2 Regulatory considerations

7.3 Legal considerations

The synchronisation operators place an earmark and initiate fund transfers in the RTGS system on behalf of account holders. This activity will require some regulatory or supervisory oversight, although potentially less than if the operator actually took ownership of funds during the transaction process. The degree to which the operators would be regulated or overseen needs further consideration.

Implementing synchronisation in practice would raise several legal questions, which are likely to vary across jurisdictions.

▶ Settlement finality – at what point does the movement of cash in an RTGS system and the movement of the asset become final and irrevocable?

▶ Digital representation of asset ownership – is the time stamp of a digital deed, as implemented in the Meridian prototype for the housing market, legally deemed as a change of property ownership?

▶ Hold at commercial banks account – what are the regulatory and legal implications of commercial banks holding funds in clients' accounts to prevent them from being used for other purposes in advance of a transaction date?

Endnotes

1 See, for example, Bank of England (2019) and Bank of England (2023).

2 See, for example Deutsche Bundesbank (2021) and Banca d'Italia (2022).

3 See BIS Innovation Hub, Bank of Italy, Bank Indonesia, Central Bank of Malaysia, Bangko Sentral ng Pilipinas, Monetary Authority of Singapore and Bank of Thailand (2023).

4 BIS Innovation Hub, SNB and SIX (2022) demonstrates CBDCs offer a safe way to settle tokenised assets.

5 BIS Innovation Hub, Banque de France and SNB (2021), BIS Innovation Hub, Hong Kong Monetary Authority, Bank of Thailand, Digital Currency Institute of the People's Bank of China and the Central Bank of the United Arab Emirates (2022) and BIS Innovation Hub, Central Bank of Malaysia, Monetary Authority of Singapore, Reserve Bank Australia and South Africa Reserve Bank (2022) explore the feasibility of common platforms for cross-border payments.

6 See CPMI, BIS Innovation Hub, IMF and World Bank (2022) for an assessment of different CBDC models for improving cross-border payments.

7 BIS, Bank of Israel, Norges Bank and Sveriges Riksbank (2023) investigates the extent to which retail CBDC (rCBDC) systems with different technical infrastrucutre can interoperate with one another.

8 See BIS (2022a) for a discussion of interlinkage models.

9 See the CPMI (2023b) (building block 14) consultative report and CPMI (2022a) (Building Block 15).

10 See FSB (2023).

11 See the Bank of England's RTGS Renewal Programme.

12 See the CPMI Glossary.

13 See Enhanced Batch Processing in RITS.

14 See Instruction sheet on admission to the SIC system and sight deposit accounts.

15 According to the CPMI Glossary, settlement risk is a general term used to designate the risk that settlement in a funds or securities transfer system will not take place as expected. This risk may comprise both credit and liquidity risk. In this report, we focus on principal risk, the risk that a counterparty will lose the full value involved in a transaction.

16 See BIS (2022a), using data from the Triennial Central Bank Survey of foreign exchange and Over-the-counter (OTC) derivatives markets in 2022.

17 Corproate financial actions covers a range of transactions including issuance or redemption of equities or bonds, or merger and acquisition activity.

18 See Ministry of Housing, Communities & Local Government (2018), for a summary of responses to a UK government Call for Evidence and response.

19 Project Aurora aims to identify suspicious networks and flows of funds across firms and borders using payment transaction data to combat money laundering. See Project Aurora: using data to combat money laundering across firms and borders.

20 See Coadjute (2022).

21 See the CPMI (2023b) (building block 14) consultative report.

22 The solution uses r3's Corda network.

23 See CPMI (2022b) for further discussion on the time taken to settle cross-border payments.

24 See The World Bank (2022).

25 See CPMI (2023a).

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Appendix:
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