Project Helvetia Phase II

Settling tokenised assets in wholesale CBDC

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BIS Innovation Hub

SIX

Participating commercial banks ——

Citi®

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Goldman Sachs

Hypothekarbank Lenzburg

UBS

Foreword:
BIS Innovation Hub ——

Tokenisation and distributed ledger technology (DLT) could bring significant changes to the financial system. Phase I of Project Helvetia showed that wholesale central bank digital currency (wCBDC) can be used to settle tokenised assets in central bank money. Phase II – as described in this report – expanded on the practical complexities, legal questions and policy implications of issuing wCBDC.

Phase II showcased the continued collaboration between the Swiss National Bank, SIX and the BIS Innovation Hub, together with five commercial banks. Building on earlier work, it successfully demonstrated how infrastructures based on DLT can integrate and interoperate with a range of existing systems. In this way, innovation is harnessed to preserve the best elements of the current financial system while also unlocking potential new benefits. As DLT goes mainstream, this will become more relevant than ever.

I wish to thank our partners for their excellent teamwork. The opportunities and challenges of innovation and interoperability in the financial ecosystem can only be addressed cooperatively. Project Helvetia continued our demonstration of what the future could look like – and how we can work together to get there.

Benoît Cœuré
Head, BIS Innovation Hub

Foreword:
Swiss National Bank ——

Driven by technological innovation, the financial system continues to evolve rapidly and its future architecture is still uncharted. The implications for central banks' monetary and stability mandates cannot be explored in a vacuum and on a purely conceptual basis. Experimentation that entails public-private sector collaboration, interdisciplinary cooperation and agile mindsets are needed.

Project Helvetia was executed in this spirit. With Phase II, the Swiss National Bank has deepened its understanding of how the safety of central bank money could be extended to tokenised asset markets. Together with the BIS Innovation Hub Swiss Centre, SIX Group and five commercial banks, wholesale central bank digital currency was successfully tested in a realistic setting that was both operationally and legally feasible.

This report outlines the lessons learned from an operational and legal perspective and discusses the policy considerations and options for central banks. Whether a central bank decides to extend the reach of central bank money to tokenised asset markets is a policy matter and motivations may differ depending on the context and mandates. Project Helvetia is purely experimental and does not indicate that the Swiss National Bank intends to issue wholesale central bank digital currency.

I would like to thank our partners for their collaboration and insights. Working together in this way has demonstrated a common motivation that paves the way towards an innovative, efficient and secure financial system.

Andréa M Maechler
Member of the Governing Board, Swiss National Bank

Foreword:
SIX ——

With the successful launch of the SIX Digital Exchange (SDX) in 2021, we laid the foundation for the transition of financial market infrastructure to a next-generation financial ecosystem. In making this transformation, we do not want to merely replicate existing processes with new technology to create new silos. Instead, we want to foster and support the emergence of a new token-based financial ecosystem. Together with our partners from the financial industry, we are proud to play a leading role in this transformational journey through SDX.

SDX is the world's first fully regulated digital asset exchange, with a central securities depository based on distributed ledger technology (DLT). In collaboration with the Swiss National Bank, the BIS Innovation Hub Swiss Centre and five commercial banks, we have demonstrated how wholesale central bank digital currency (wCBDC) could facilitate the settlement of digital assets.

Today, SDX settles transactions using tokenised commercial bank money. These experiments demonstrate that our platform can equally support wCBDC to settle transactions in digital assets. They also confirm that our technology can be integrated end to end with the current processes and systems of commercial and central banks.

Our new DLT-based settlement system, the Swiss central bank payment system and core bank platforms are likely to coexist for the foreseeable future. Interoperability and collaboration with private sector participants and central banks are – and will continue to be – crucial. Project Helvetia Phase II has continued along this path, providing valuable insights. We would like to thank all our partners for their efforts and contributions.

Jos Dijsselhof
Chief Executive Officer, SIX

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Executive summary ——

Trading, clearing and settlement are in flux. Domestically and across borders, efforts are under way to improve the safety and efficiency of "traditional" financial market infrastructures (FMIs). At the same time, a new generation of FMIs based on distributed ledger technology (DLT) is emerging. In Switzerland, for example, SIX Digital Exchange (SDX) offers trading and settlement of so-called tokenised assets.

At this early stage, SDX and other DLT-based infrastructures depend on privately issued forms of money to settle tokenised asset transactions. However, this might change in future. For instance, if such infrastructures were to become systemically important, international regulatory standards suggest that obligations should be settled in central bank money whenever practical and available. In addition, central banks might consider extending monetary policy implementation to tokenised asset markets or facilitating the build-up of a tokenised ecosystem.

Project Helvetia is a response to this possible transition to a tokenised financial ecosystem. It is a multi-phase investigation into how central banks could offer settlement in central bank money provided that there is significant adoption of this new generation of FMIs. The project is experimental and does not indicate that the SNB intends to issue wCBDC.

Project Helvetia Phase I – published by the BIS Innovation Hub (BISIH) Swiss Centre, SIX Group (SIX) and the Swiss National Bank (SNB) in 2020 – tested two approaches for settling tokenised assets in central bank money. The first approach demonstrated that a wholesale central bank digital currency (wCBDC), a tokenised form of central bank money available to financial intermediaries, could offer safe and efficient settlement on a tokenised asset platform. It opens up more of the functionalities that are possible with tokenisation, as compared with settling tokenised assets in traditional reserve balances, tested in the second approach.

Project Helvetia Phase II focused on wCBDC. It expanded on the work carried out in Phase I by (i) adding commercial banks to the experiment – Citi, Credit Suisse, Goldman Sachs, Hypothekarbank Lenzburg and UBS; (ii) integrating wCBDC into the core banking systems of the central bank and commercial banks; and (iii) running transactions from end to end. That is, settlement instructions for financial transactions were entered by the commercial banks or the SNB, instructions were matched and subsequently settled in wCBDC with finality on the SDX platform and booked and reconciled in core banking systems.

The additional dimensions addressed more of the operational, legal and policy questions necessary for wCBDC issuance. First, establishing interoperability between DLT-based and traditional systems is operationally complex but feasible. The solution design involved the specification of interfaces, messaging standards as well as booking and reconciliation procedures. Second, under Swiss law, issuing wCBDC on a DLT platform operated and owned by a third party and delegating tasks related to wCBDC to the op-

erator is feasible, provided that the central bank retains necessary wCBDC control and monitoring functions. Third, policy considerations were addressed in two dimensions. On the one hand, the experiment confirms that settling monetary policy transactions (eg open market operations and standing facilities) and international transactions (eg cross-border and offshore transactions) is operationally feasible on a tokenised asset platform. On the other hand, conceptual analysis of alternative design options to settle tokenised assets identifies distinct opportunities and challenges for central banks.

In the context of an emerging tokenised ecosystem, further work is needed. Existing systems may need to be upgraded or replaced to cope with new processes and use cases leveraging the potential of DLT and tokenisation. Moreover, broader potential implications require further investigation. These include (i) the integration of trading and settlement; (ii) the potential challenges to liquidity management by financial institutions and liquidity provision by central banks when moving to shorter or instant settlement; and (iii) the effect of system and technology changes to the operational reliability, security and resilience of an ecosystem.

Clearly, a safe and orderly transition to any prospective tokenised ecosystem would require financial market participants to coordinate and collaborate. Within the realm of their mandates, central banks should be part of this process.

Acronyms and abbreviations ——

API	Application programming interface
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
BISIH	BIS Innovation Hub
CBDC	central bank digital currency
CPMI	Committee on Payments and Market Infrastructures
CPSS	Committee on Payment and Settlement Systems
CSD	central securities depository
DLT	distributed ledger technology
DvP	delivery-versus-payment
FINMA	Swiss Financial Market Supervisory Authority
FMI	financial market infrastructure
FSB	Financial Stability Board
IOSCO	International Organization of Securities Commissions
IMF	International Monetary Fund
PvP	payment-versus-payment
RTGS	real-time gross settlement
SDX	SIX Digital Exchange
SIC	Swiss Interbank Clearing
SNB	Swiss National Bank
wCBDC	wholesale central bank digital currency

1. Introduction ——

Distributed ledger technology (DLT) is making inroads into the traditional financial system, paving the way for new infrastructures. The private sector is investing heavily in DLT and tokenisation with a view to streamlining and automating existing processes, creating new use cases and potentially serving a more diverse array of participants. In fact, the contours of a token-based financial ecosystem are emerging in several places around the world.[1]

At this early stage, DLT-based infrastructures are using privately issued forms of money to settle transactions involving tokenised assets. However, this might change going forward. For instance, if such infrastructures were to become systemically important, international regulatory standards suggest that obligations should be settled in central bank money whenever practical and available. In addition, central banks might consider extending monetary policy implementation to tokenised asset markets to ensure the continued efficacy of relevant transmission channels. Finally, a central bank could also facilitate the build-up of a tokenised ecosystem by providing central bank money for safe and efficient settlement.

In the first phase of Project Helvetia, BIS Innovation Hub (BISIH) Swiss Centre, SIX Group (SIX) and the Swiss National Bank (SNB) explored different ways of settling tokenised assets with central bank money in the test environment of the SIX Digital Exchange (SDX) platform. Specifically, two proofs of concept were conducted for this purpose. In the first, a central bank digital currency for financial institutions (wholesale CBDC, wCBDC) was issued on the SDX test platform and used for the settlement of tokenised assets.[2] In the second, tokenised assets were settled in reserve balances by linking the SDX test platform to the test environment of the Swiss real-time gross settlement (RTGS) system (SIC system). The two proofs of concept showed that both ways to settle tokenised assets in central bank money are feasible and legally effective under Swiss law. From a central bank perspective, the RTGS link is operationally simpler, as it requires no changes to existing central bank operated systems, and raises fewer policy questions, while wCBDC provides more scope for future innovation and efficiency gains in the settlement process.

Project Helvetia Phase II focused on wCBDC. It expanded on the work carried out in Phase I by (i) adding commercial banks to the experiment – Citi, Credit Suisse, Goldman Sachs, Hypothekarbank Lenzburg and UBS; (ii) integrating wCBDC into the core banking systems of the central bank and commercial banks; and (iii) running transactions from end to end. That is, settlement instructions for financial transactions were entered by the banks or the SNB, and instructions were matched and settled in wCBDC with finality on the SDX platform and booked and reconciled in the respective core banking systems.

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[1] For this report, tokenised assets are assets issued and settled on DLT platforms, while traditional assets are issued and settled on traditional account-based systems.

[2] SDX is a subsidiary of SIX, which provides essential elements of the financial market infrastructure in Switzerland and is owned by its member institutions (around 120 Swiss and international financial institutions (SIX (2021)).

The experiment demonstrated the successful integration of a DLT-based system with traditional systems, allowing the end-to-end settlement of transactions in wCBDC. The wCBDC design was based on requirements close to those for a production environment. The key design choices included the issuance of a wCBDC on a DLT platform that is operated and owned by a third party, while remaining convertible into traditional reserve balances.[3]

The setup raises a range of operational, legal and policy questions, as discussed in this report. It presumes that DLT-based systems and traditional systems will coexist, requiring interoperability. There is, of course, a range of possible alternative designs for settling tokenised assets in central bank money (eg via an RTGS link) or with privately issued settlement tokens (eg stablecoins), some of which are discussed conceptually in this report.

Project Helvetia is purely experimental and does not indicate that the SNB intends to issue wCBDC.

This report summarises the work carried out in Phase II. Section 2 explains the objectives, scope and design of the experiment. Operational findings and the legal assessment are presented in Sections 3 and 4. Section 5 discusses the policy considerations, focusing on monetary policy implementation with wCBDC, international settlements with wCBDC and alternative design options for settling cash legs of tokenised asset transactions. Section 6 concludes.

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[3] For this report, wCBDC is considered an alternative representation of traditional reserve balances. wCBDC is held in a tokenised form on a DLT platform, whilst traditional reserve balances (hereinafter simply "reserve balances") are held in settlement accounts in the RTGS system or in reserve accounts at the central bank.

2. The experiment ——

Project Helvetia was a joint experiment between the BISIH Swiss Centre, SIX and the SNB that explored the settlement of tokenised assets in central bank money. Phase II focused on settlement with wCBDC and involved five commercial banks: Citi, Credit Suisse, Goldman Sachs, Hypothekarbank Lenzburg and UBS. Citi participated with its London branch and is thus a non-resident bank, whereas all other banks participated with their Swiss entity and are thus resident banks. All five commercial banks are eligible to hold reserve balances at the SNB and have access to the SIC system.

The SNB defines the properties of wCBDC and its control and monitoring requirements on the SDX platform. The SNB, SIX and commercial banks prepared and executed the experiment. The BISIH Swiss Centre and the SNB were responsible for analysing the operational, legal and policy considerations related to the project, building on Phase I (BIS, SIX and SNB (2020)), Project Jura (Bank of France, BIS and SNB (2021)) and other wCBDC experiments.

2.1 Scope and objectives

In Helvetia Phase I, two experiments were conducted for the settlement of tokenised assets: (i) using a wCBDC issued on the SDX platform, and (ii) allowing SDX to instruct a cash settlement in the Swiss RTGS system.

The scope of Phase II was on wCBDC settlement and expanded the Phase I experiment in three dimensions. First, it involved five commercial banks – in addition to SDX, SIC and the SNB. Second, it tested the integration of wCBDC, issued and settled on the SDX platform, into the core banking systems of the central bank and the commercial banks (Graph 1).[4] Third, it explored end-to-end transactions, using the test environments of production systems.

The objectives of Phase II were threefold. First, to demonstrate the end-to-end settlement of "tokenised" financial transactions in wCBDC (ie from entering of the settlement instruction in the SDX web portal, via the matching and settlement on the SDX platform to booking and reconciliation in the respective core banking systems). Second, to identify realistic control and monitoring functions in order to fulfill operational, legal or regulatory requirements related to wCBDC on a platform operated and owned by a third party. Third, to discuss relevant policy considerations.

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[4] In this report, core banking systems are defined as bank-internal systems that record financial transactions for booking and reconciliation. Booking is understood as the updating of bank-internal systems to keep track of the different asset positions during the day. Reconciliation is defined as the processes to ensure the consistency of financial transaction recording across relevant internal and external sources.

Graph 1: Overview of wCBDC experiment in Phase I and II
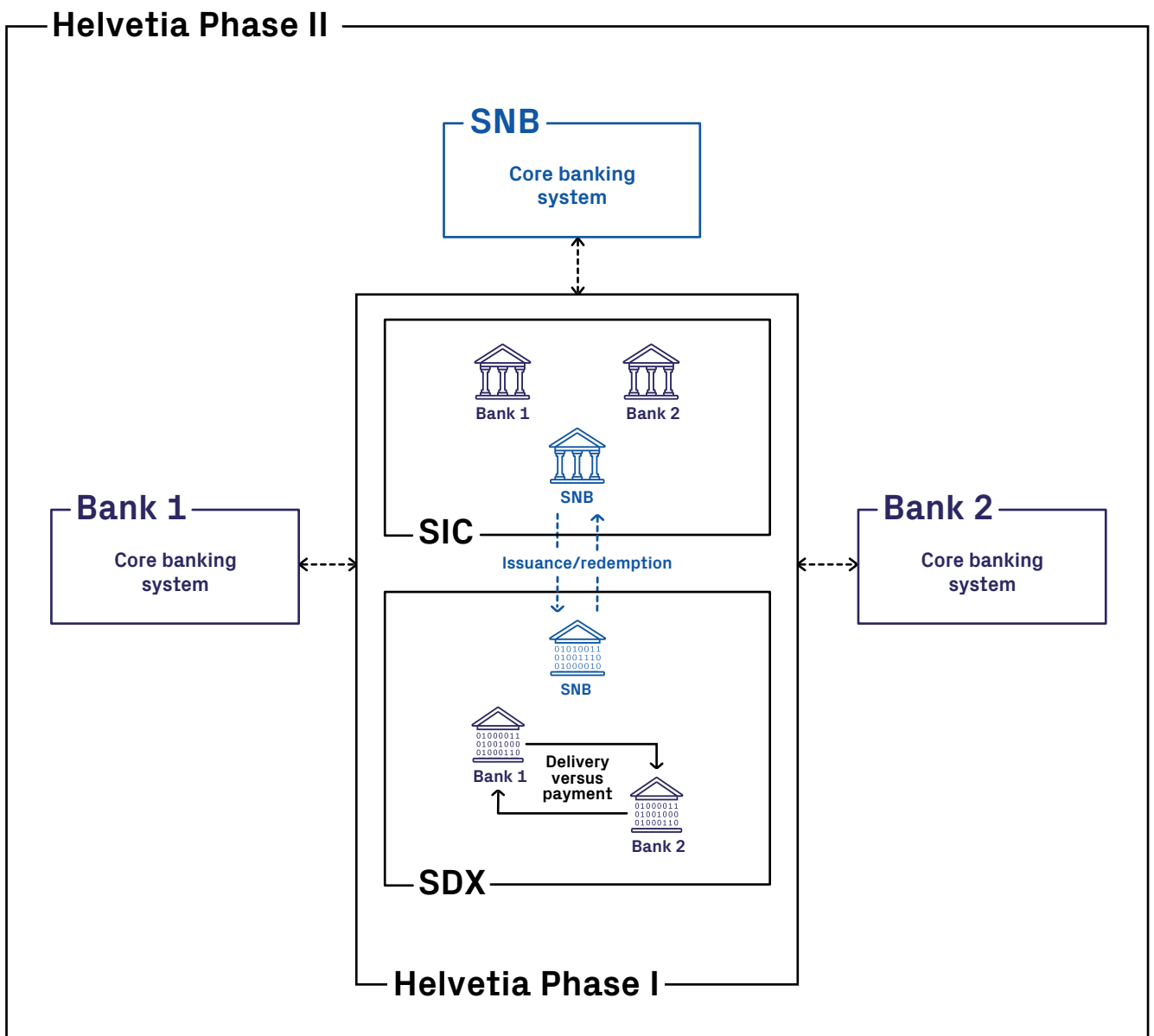
LEGEND

—— Value transfer

⬦---> Settlement instructions and confirmations

🏛 Account

⬠ Node on DLT

Several aspects were not part of this experiment and need further investigation. First, transaction processing was not fully automated (eg settlement instructions on the SDX platform were entered through a web portal and not via messages from the core banking systems). Second, the testing focused on the happy path, ie error handling was not within scope. Third, the experiment focused on the integration of wCBDC into the core banking systems and less on the integration of tokenised securities. Fourth, questions around accounting as well as statistical and regulatory reporting of wCBDC were out of scope. Lastly, questions related to technical performance (latency and throughput), privacy and cyber security were not investigated.

Setting up the test environment of Helvetia Phase II involved four steps: (i) specifying the tasks that the SDX, SIC and core banking systems need to perform to test settlement in wCBDC end to end (use cases); (ii) defining the requirements for the SDX, SIC and core banking systems while carrying out the tasks (business requirements); (iii) designing the processes within SDX, SIC and the core banking systems that allow for the tasks to be completed while complying with the requirements (solution design); and (iv) implementing and testing of the solution design. These steps are outlined below.

2.2 Use cases

Helvetia Phase II tested six use cases related to wCBDC settlement. Each use case described a sequence of steps for one or more parties to complete on the SDX test platform, in the SIC test system and/or in their respective core banking test systems. The use cases were:

I.   Issuance of wCBDC: one-to-one conversion of reserve balances into wCBDC.

II. Redemption of wCBDC: one-to-one conversion of wCBDC into reserve balances.

III. Delivery-versus-payment (DvP) settlement in wCBDC: delivery of tokenised assets against payment in wCBDC.

IV. wCBDC payment
     a. Transfer of wCBDC (free of delivery).
     b. wCBDC payment related to a corporate action (redemption of a tokenised bond).

V.   Booking and reconciliation of wCBDC settlement.

VI. Intraday control and monitoring of wCBDC settlement by the central bank.

The use cases can be split into transactional use cases (I to IV) and non-transactional use cases (V and VI). The transactional use cases apply to both the commercial banks and the central bank. The non-transactional use cases are the basis for the integration of wCBDC into the core banking systems of the commercial banks and the central bank (use case V) and the central bank's controls related to wCBDC (use case VI).

2.3 Business requirements

Business requirements describe the underlying characteristics of the proposed system. Phase II requirements build on those of Phase I (requirements 1 to 8) and take the current setup of the RTGS system including all related processes as given. Some of the Phase I requirements are detailed in Phase II (requirements a to g):

1. The central bank is the sole issuer of wCBDC.

2. The central bank's balance sheet size remains unaffected by the issuance and redemption of wCBDC against reserve balances.

3. Central bank reserve balances and wCBDC are convertible one-to-one.

4. The central bank controls access to wCBDC.
    a. The central bank grants access to wCBDC and may block specific participants from receiving or transferring wCBDC.

5. Transactions in central bank reserve balances and wCBDC have the same value date.

6. The central bank can control and monitor wCBDC settlement.
    b. The central bank controls issuance, transfer and redemption of wCBDC.
    c. The central bank monitors wCBDC balances and transactions intraday on a participant level.
    d. The central bank may trigger a wCBDC issuance, transfer or redemption upon request and on behalf of a participant.
    e. The central bank can generate an end-of-day statement of wCBDC balances for all participants.
    f. The central bank receives intraday settlement confirmations of its own wCBDC transactions. Commercial banks receive intraday settlement confirmations of their wCBDC transactions and end-of-day statements of their wCBDC balances.

7. Remuneration of central bank reserve balances also applies to wCBDC.

8. Issuance of and settlement with wCBDC must be effective and final under the applicable legal framework.
    g. The issuance of and settlement in wCBDC on a platform operated and owned by a third party is legally feasible.

The business requirements ensure central bank control over access, issuance, settlement and redemption of wCBDC (business requirements 1 and 6). They support frictionless and simple issuance and redemption of wCBDC by both the commercial banks and the central bank, ensuring one-to-one convertibility between wCBDC and reserve balances (business requirements 2 to 5 and 7). Requirement 8 ensures the legal effectiveness of wCBDC settlement and the delegation of responsibilities to the operator of a third-party platform.[5]

The outstanding amount of central bank money remains unchanged when reserve balances are converted into wCBDC, and vice versa, or when wCBDC is used to settle transactions between commercial banks (business requirement 2). The central bank, however, can increase (decrease) the amount of central bank money by issuing (redeeming) wCBDC coupled with a DvP as a wCBDC provider (taker).

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[5] The analysis of the legal effectiveness of wCBDC settlement was part of Project Helvetia Phase I. The legal analysis of the delegation of responsibilities to the operator of a third-party platform is part of Phase II (Section 4).
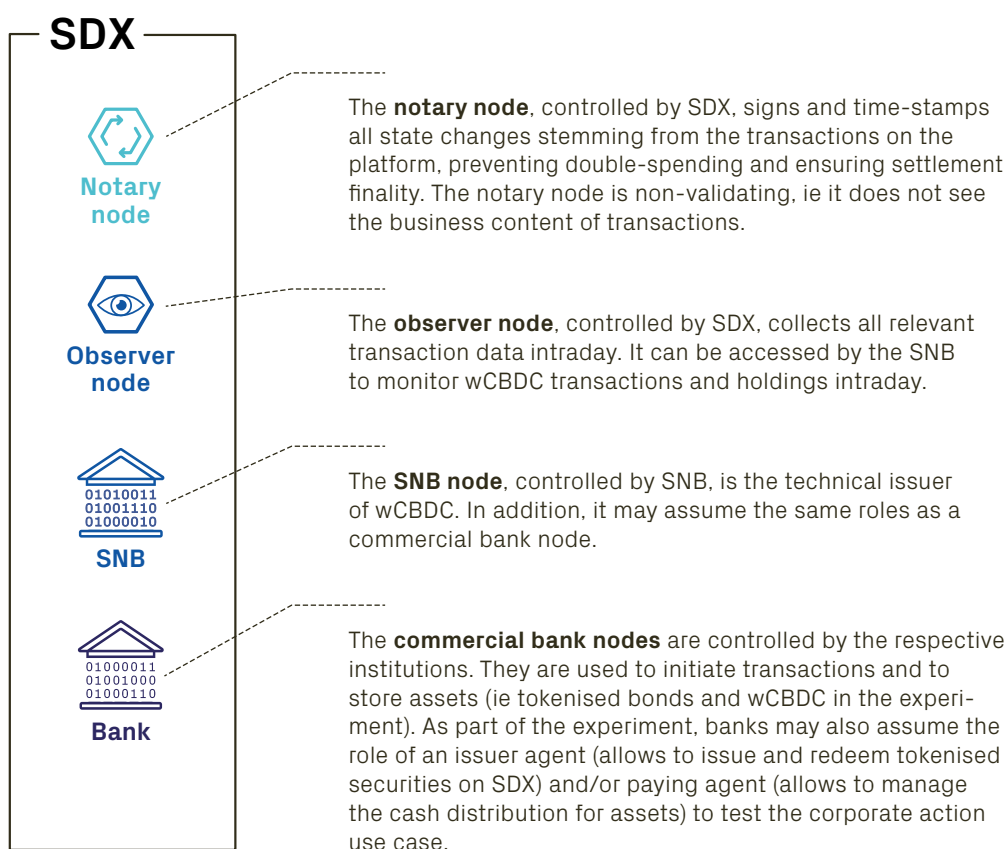
2.4 Solution design

The solution design sets out how the use cases are tested against the business requirements. The Phase II solution design builds on Phase I and includes three components: (i) the SDX test platform; (ii) the SIC test system; and (iii) the core banking test systems of commercial banks and that of the SNB. Compared with Phase I, the solution design is extended by core banking test systems and further expands on the roles and functionalities of the different node types in the SDX test platform.

SDX test platform

The SDX test platform, based on Corda by R3, includes different nodes with different roles, enabling the use cases on the platform (Section 2.2). Nodes both store and update states that make up a ledger. All nodes are hosted on a cloud-based infrastructure by SDX (Graph 2). As part of the solution design, the notary node and the observer node are controlled by SDX. Legal and governance considerations related to control mechanisms of the central bank on the SDX platform are discussed in Section 4.

Graph 2: Nodes on the SDX test platform

The **notary node**, controlled by SDX, signs and time-stamps all state changes stemming from the transactions on the platform, preventing double-spending and ensuring settlement finality. The notary node is non-validating, ie it does not see the business content of transactions.

The **observer node**, controlled by SDX, collects all relevant transaction data intraday. It can be accessed by the SNB to monitor wCBDC transactions and holdings intraday.

The **SNB node**, controlled by SNB, is the technical issuer of wCBDC. In addition, it may assume the same roles as a commercial bank node.

The **commercial bank nodes** are controlled by the respective institutions. They are used to initiate transactions and to store assets (ie tokenised bonds and wCBDC in the experiment). As part of the experiment, banks may also assume the role of an issuer agent (allows to issue and redeem tokenised securities on SDX) and/or paying agent (allows to manage the cash distribution for assets) to test the corporate action use case.

SIC test system

In the SIC test system, each commercial bank as well as the SNB have a settlement account, where reserve balances are held in order to make payments. For the issuance and redemption of wCBDC, the SNB uses a technical account.[6] The balance of this account reflects the aggregate amount of wCBDC issued on the SDX test platform.

Core banking test systems

In the SNB's core banking test system, the SNB maintains a reserve account for each commercial bank, where reserve balances are held overnight and transferred to the SIC system at the beginning of each value day.[7] To keep track of end-of-day wCBDC holdings, the SNB additionally maintains wCBDC mirror accounts for each commercial bank. The account structure for reserve balances and wCBDC holdings is used for booking and reconciliation purposes.

In their respective core banking test systems, commercial banks carry out bookings of wCBDC and reserve balance movements in mirror accounts and reconcile their wCBDC and reserve balance holdings.

Based on the three components, the solution design of Project Helvetia Phase II is presented in Graph 3.

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[6] The technical account is a settlement account held by the SNB in the SIC test system. The balance of this account mirrors the total amount of outstanding wCBDC. From an accounting perspective, reserve balances in the technical account are not reflected in the balance sheet of the SNB while the amount of wCBDC issued is.

[7] In the case of the SNB, there are operational differences between reserve balances held in the reserve account at the SNB (sight deposit account) and those in the RTGS system. Reserve balances in the reserve account fund the RTGS settlement accounts, through which payments are made and received during the day. Legally, the reserve account and the RTGS settlement account constitute a single account.

Graph 3: Helvetia Phase II solution design
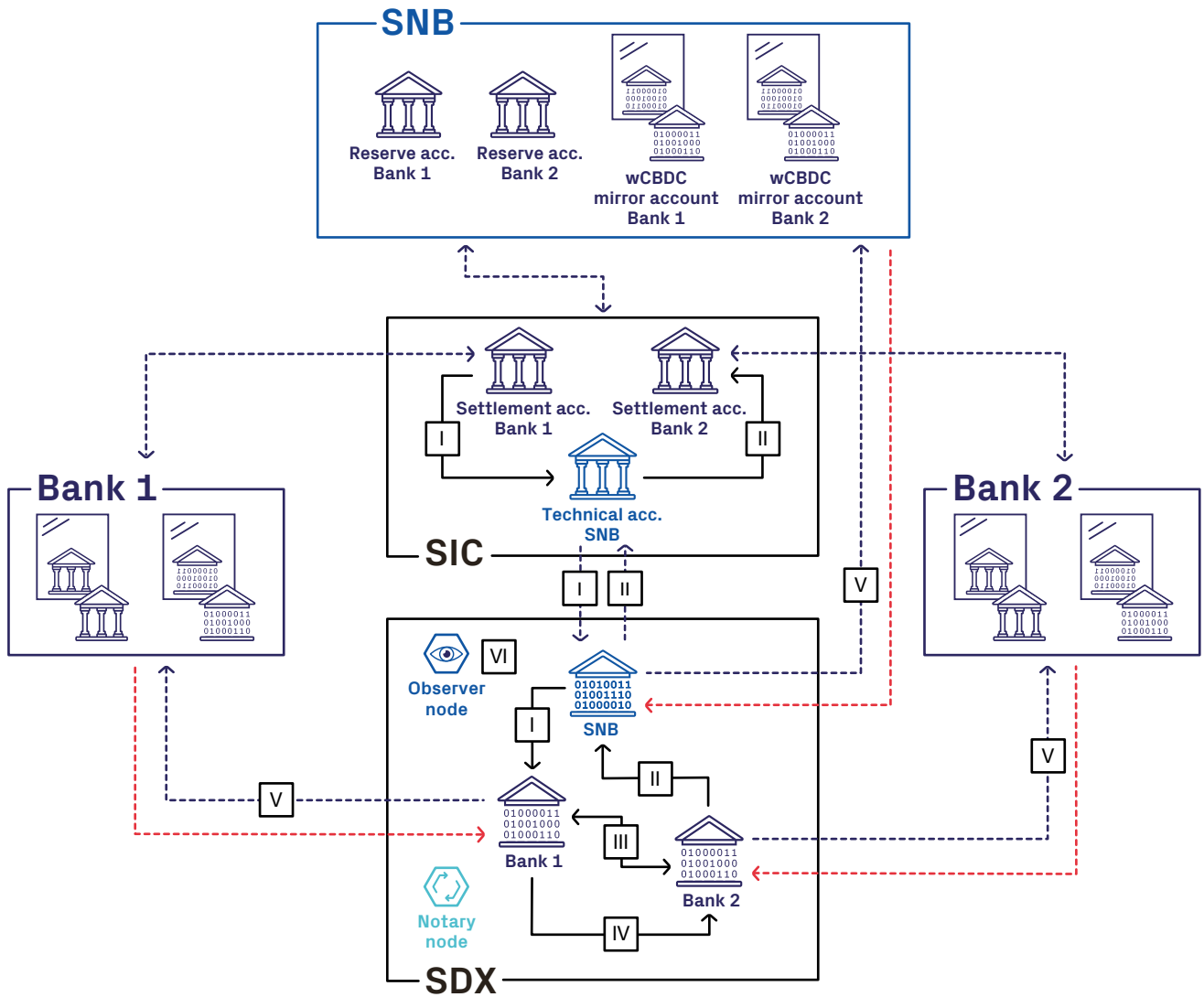
LEGEND

------	ISO message		Account	I	Issuance	IV	Payment
------	Portal instruction		Node on DLT	II	Redemption	V	Booking and reconciliation
——	Value transfer		Mirror account	III	DvP	VI	Intraday monitoring

At the start of a value day and reflecting today's process, the reserve balances of SIC participants are transferred by the SNB from the respective reserve accounts to their settlement accounts in the SIC system. There is no related process for wCBDC, as wCBDC balances may remain on the SDX platform overnight.[8]

During the day, the reserve balances available in settlement accounts can be used for payments in the RTGS system or converted into wCBDC (use case I). The latter is initiated with a transfer from a commercial bank's settlement account in the RTGS system to the SNB technical account. This triggers an ISO 20022 message from SIC to the SNB node on the SDX platform. An ISO gateway for the SNB node translates the message into SDX-specific language. Upon receipt of the translated message, the SNB node issues the equivalent amount of wCBDC to the respective bank node on the SDX platform, with the notary node signing the transaction. Once wCBDC is available, commercial banks can initiate DvP and payment settlement instructions as well as a wCBDC redemption (use cases II to IV) on the SDX platform through a web portal. Leveraging the observer node functionality, the SNB can monitor intraday balances and wCBDC transactions on a participant level (use case VI).

Following the same process as described for a commercial bank, the central bank can also trigger a wCBDC issuance and enter settlement instructions on the SDX platform as part of a monetary policy transaction. If the central bank acts as a wCBDC provider (taker) in a DvP transaction, the outstanding amount of central bank money is increased (reduced) (Box A).

At the end of each value day, settlement in reserve balances and wCBDC is stopped to switch to the next value day. Before settlement may recommence, the SNB has to verify that no central bank money has been unintentionally created or destroyed during the past value day (use case V). To do so, the SNB performs two sets of reconciliations. First, the SNB verifies that the balance on the technical account in the SIC system and the total amount of outstanding wCBDC are equal. Second, based on ISO messages from SIC, the SNB verifies that the net inflows and outflows of reserve balances across all settlement accounts cancel out.[9] If both reconciliations are successful, settlement in wCBDC and reserve balances can start in the new value day.

Day-end processing is extended in two dimensions. First, based on ISO messages from SDX, wCBDC balances per participant are updated in the respective mirror accounts. Second, the daily interest rate calculation is applied to wCBDC. Specifically, interest is calculated on the aggregate amount of wCBDC and reserve balances per participant and applied to the respective reserve account.

Commercial banks carry out reconciliation processes for their wCBDC and reserve balance holdings in their respective mirror accounts based on analogous ISO messages or manual bookings. They verify the consistency of bookings of wCBDC and reserve balance transactions with the relevant start-of-day and end-of-day balances and the SDX and SIC statements.

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[8] In Project Helvetia, wCBDC is overnight, ie as long as banks do not redeem wCBDC, it remains on the platform. An intraday wCBDC, by contrast, requires a compulsory conversion of wCBDC into reserve balances before the start of the end-of-day processing and the value date change in the RTGS system.

[9] ISO messages for booking and reconciliation purposes sent from SIC to the central bank and the commercial banks are not shown in Graph 3, as they build on established processes and are not directly related to wCBDC.

2.5 Implementation and testing

Use cases were tested over three value days based on the implemented solution design, demonstrating that the business requirements were met. Banks were allocated reserve balances, wCBDC and a short-term as well as a long-term tokenised bond at the start of the experiment. The short-term bond matured on the second testing day, triggering a corporate action event, ie the redemption of the bond with associated wCBDC payments to the bond holders. All transactions were settled at pre-defined prices and entailed transactions between resident and non-resident commercial banks. A video explaining the use cases, solution design and testing is available online.

Box A: Settlement of monetary policy transactions on a tokenised asset platform

As part of the experiment, the settlement of monetary policy transactions on a tokenised asset platform was tested. To do so, the central bank issued (redeemed) wCBDC linked with a DvP settlement of a tokenised asset purchase (sale). As a result, the central bank balance sheet expanded (reduced).

Established operational processes in the central bank's core banking system and the RTGS system were used to create central bank money with monetary policy transactions. To extend money creation to tokenised asset markets, the solution design re-uses the same processes as for the wCBDC issuance and DvP settlement on the SDX platform by commercial banks (Section 2.4).

Specifically, the central bank (i) issues wCBDC by transferring newly created reserve balances from its own settlement account to the technical account in the RTGS system, and (ii) expands the outstanding amount of central bank money through a subsequent DvP transaction by providing a commercial bank with wCBDC. This transaction is booked and reconciled at the end of the day in the core banking system (Graph A.1). It expands the central bank's balance sheet, with the central bank holding tokenised securities as part of its assets and the newly created wCBDC as a liability (Graph A.2).

A reduction of central bank money can be achieved by the central bank acting as a wCBDC-taker in a DvP transaction. If both the expansion and reduction of central bank money take place intraday and have the same size, it has no balance sheet effect.
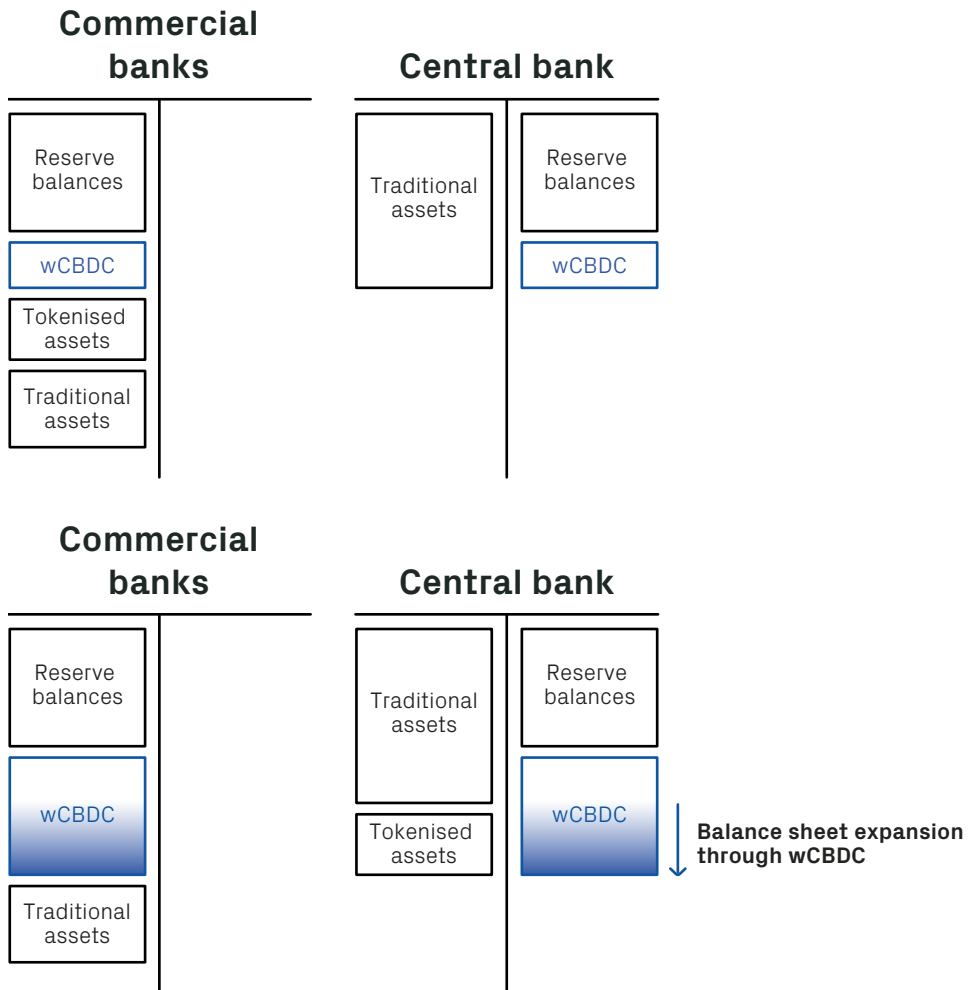
Graph A.1: Solution design for settlement of monetary policy transaction in wCBDC
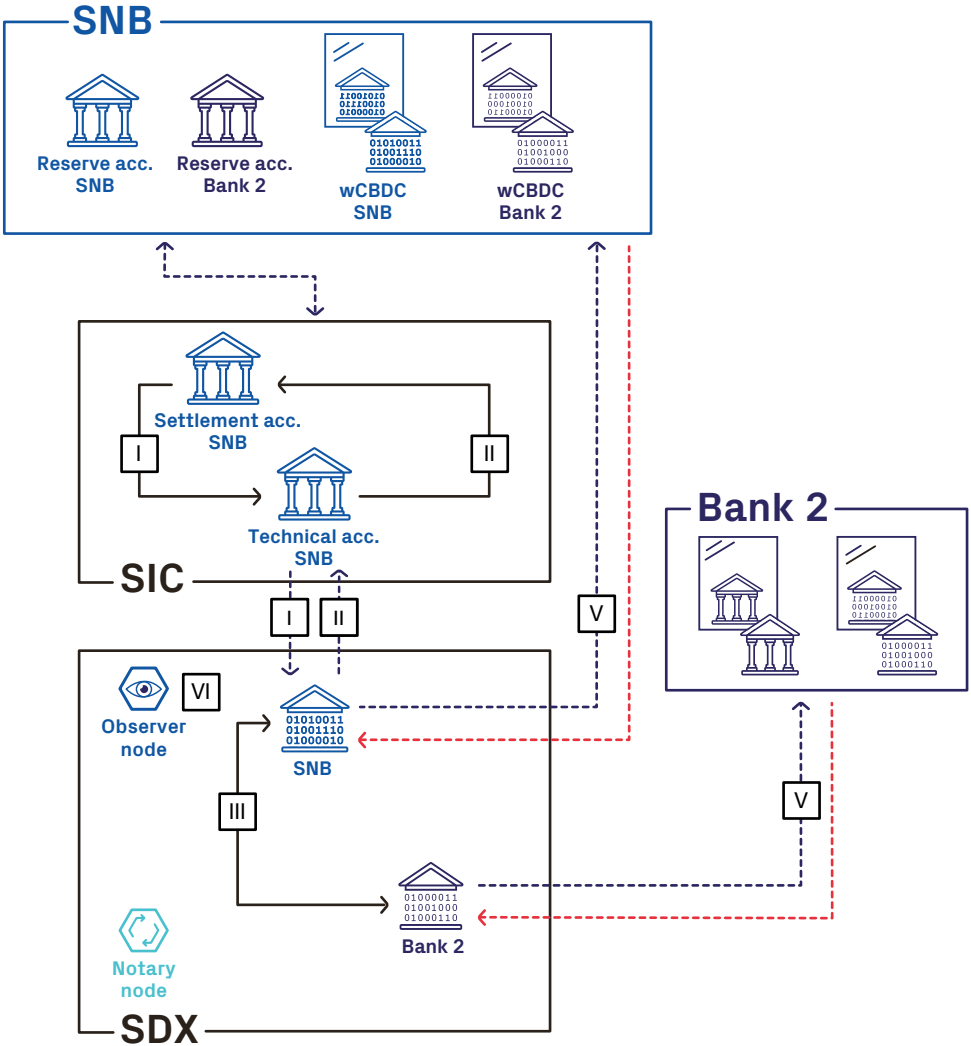
LEGEND

------	ISO message	🏦	Account	I	Issuance	V	Booking and reconciliation
------	Portal instruction	🏛	Node on DLT	II	Redemption	VI	Intraday monitoring
——	Value transfer	📄	Mirror account	III	DvP		

Graph A.2: Stylised balance sheets before and after the expansion of outstanding central bank money in wCBDC

Commercial banks

Reserve balances
wCBDC
Tokenised assets
Traditional assets

Central bank

Traditional assets	Reserve balances
	wCBDC

Commercial banks

Reserve balances
wCBDC
Traditional assets

Central bank

Traditional assets	Reserve balances
Tokenised assets	wCBDC

Balance sheet expansion through wCBDC

3. Operational findings ——

Project Helvetia Phase II shows the feasibility of settling tokenised assets in wCBDC end to end. The solution design allows the settlement of wCBDC transactions between commercial banks (resident and non-resident) and between commercial banks and the central bank. It demonstrates how an overnight wCBDC, issued on a tokenised asset platform, could be integrated into core banking systems of the central banks and commercial banks. Project Helvetia Phase II offers novel insights based on the following factors:

- The wCBDC design is determined by realistic requirements. Key design choices include the issuance of an overnight wCBDC on a platform operated and owned by a third party, while keeping eligibility criteria, remuneration and value date rules identical to those for traditional reserve balances.

- The solution design builds on the network topology of the live SDX platform, with SDX hosting all nodes and controlling the notary node as well as the observer node. However, the central bank keeps control over its wCBDC. Specifically, the central bank is the sole issuer of wCBDC and controls wCBDC issuance, transfer and redemption. Furthermore, it controls access to wCBDC and can monitor wCBDC transactions and balances intraday through the observer node.

- The experiment was conducted in the test environments of production systems of SDX, SIC, SNB and commercial banks. It extended existing processes and standards for booking and reconciliation to cover wCBDC, providing realistic insights into the complexities around establishing interoperability across traditional and DLT-based systems.

By leveraging existing ISO messaging and established processes, the solution design facilitates the integration into core banking systems. While this message-based integration is minimally invasive, it forces both the central bank and commercial banks to deal with a number of multifaceted issues involving the specification of interfaces and messages to establish interoperability between a DLT-based and traditional systems.

The solution design could be adapted to allow for deeper integration, potentially enabling further automation and streamlining of bank-internal processes and reducing reconciliation efforts. For instance, commercial banks and the central bank may host their node on own cloud-based infrastructures. Information could then be exchanged between the node and the core banking system through a proprietary application programming interface (API).

The experiments revealed operational insights and challenges as discussed below. Some insights and challenges are generic insofar as they arise from the integration of any new settlement platform with existing systems. Others are driven by the specific experimental setup and some relate specifically to DLT and asset tokenisation.

Generally, DLT and asset tokenisation could open up a number of opportunities for financial market infrastructures (FMIs). These opportunities are driven by new technological possibilities and also by setting up infrastructures with a "clean slate" (Box B). However, there are risks and costs that need to be carefully balanced against the opportunities.

Box B: Opportunities from DLT and asset tokenisation

DLT and asset tokenisation open up a range of opportunities. Some are directly related to the technology, others are driven by the opportunities of building new platforms without relying on existing systems, processes and market conventions (clean-slate approach). These opportunities need to be balanced against the risks and costs when transitioning to such novel technology and new systems. This box focuses on the opportunities that are brought forward in the public debate.

DLT-related opportunities for FMIs:

- Immutability: the (shared) ledger provides an immutable and transparent record of asset information (eg contractual terms and corporate action events), transactions and ownership ("single source of truth"). This may simplify or even eliminate certain back office processes (eg reconciliation) and may replace documentation for which an audit trail is required.

- Programmability: financial instruments, an entire asset lifecycle or the conditional execution of financial transactions may be written into contracts that are self-executing and possibly make use of external information feeds ("oracles"), with the potential to streamline processes and increase regulatory compliance.

- Distributed infrastructure: DLT can enhance technical resilience and enable high availability. DLT platforms may therefore be more robust against partial technical and operational outages. Additionally, DLT allows infrastructures to be distributed across different jurisdictions and institutions (see eg Bank of France, BIS and SNB (2021)).

- Platform interoperability: DLT-based platforms may be designed to interoperate with others, offering safe and efficient cross-platform settlement ("atomic swaps"), enhanced data portability and asset mobility (eg "token-wrapping").

- Non-fungible tokens: DLT can enable the creation of unique tokens, possibly facilitating the trading and settlement of otherwise illiquid assets.

Broader opportunities for new FMIs (clean slate):

- Multi-asset settlement platforms: new platforms may be designed to settle a variety of financial assets and instruments.

- Market conventions: with today's market conventions, financial transactions typically settle two value days after trading. New trading and settlement platforms may change this convention and move to instant or T+0 settlement, eliminating or reducing the need for clearing arrangements. Furthermore, new platforms could allow 24/7 operations, offering continuous trading and settlement of assets.

- Atomic and instantaneous settlement: multi-asset platforms may enable atomic and instantaneous settlement, mitigating settlement and replacement cost risk (Bech et al (2020)). Atomic and instantaneous settlement can be considered as DvP (or payment-versus-payment, PvP) model 1 settlement (CPMI-IOSCO (2012)).

- Asset issuance: the issuance processes of digital assets, involving a multitude of parties, can be streamlined and made more efficient compared with traditional assets. This is, however, dependent on the existence of an appropriate legal framework.

- International reach and wider participation: new platforms may have a larger international reach and serve a more diverse array of participants than today's largely domestic infrastructures. They may thus support faster, cheaper and more transparent international settlement.

Back office processes

For the central bank, the integration of wCBDC issued on a third-party platform into its core banking system can leverage existing back office processes. Complexity and reconciliation work increase with the number of wCBDC users and hence the number of accounts to manage. This would be amplified if wCBDC were to be issued on several platforms.

From a commercial bank perspective, wCBDC can be integrated into the existing core banking system and operational processes. In the experiment, commercial banks successfully booked wCBDC transactions (by processing ISO messages or manually reading in transactional data) and reconciled wCBDC transactions in their systems. This form of integration may, however, require parallel processes for DLT-based and traditional infrastructures, limiting possible efficiency gains offered by DLT. Also, the use of smart contracts – which could simplify bank-internal processes – may be limited as this would need to be translated and mapped to existing processes in traditional banking systems. This may not be possible or practical in all cases.

Overnight wCBDC

An overnight wCBDC would in principle allow for continuous 24/7 settlement. This would enable settlement in central bank money beyond the opening hours of RTGS systems, potentially facilitating international settlement across time zones.

To support continuous 24/7 operations in the Project Helvetia solution design, wCBDC settlement would have to continue during the end-of-day processing and before settlement in the new value day starts. To ensure value date consistency, reconciliation and accounting for wCBDC would be based on wCBDC balance snapshots taken at the value day switch (set to the start of end-of-day processing in the RTGS system). Continuous settlement may, however, require the central bank and commercial banks to adjust systems and operational processes, which was not part of the experiment. For example, the central bank may have to introduce a standing facility to make wCBDC available outside the RTGS's operating hours (eg offer 24/7 liquidity in wCBDC).

Overnight wCBDC could serve as a backup for the RTGS system, as it would not require compulsory redemption into reserve balances at the end of a business day. This may increase operational resilience. However, for a full backup, an alternative process for issuing and redeeming wCBDC without involving the RTGS system would be required.

Liquidity management

wCBDC on a DLT-based platform may potentially add complexity to liquidity management for commercial banks and central banks. The availability of central bank money in two or more systems could require commercial banks to manage central bank money on multiple systems. Furthermore, instant (gross) settlement as investigated in the experiment requires prefunding of trades, adding costs as well as complexity to the forecasting of liquidity needs.[10] T+0 end-of-day settlement could be viewed as an efficient alternative, as it may allow to net settlement obligations intraday. For a central bank, complexity would increase as it would have to manage liquidity in both traditional and tokenised markets, potentially requiring new liquidity facilities.

In Project Helvetia, the wCBDC design and the integration with the RTGS system and the core banking systems mitigates the complexity of liquidity management. Issuance and redemption of wCBDC through the RTGS system is as frictionless, fast and simple as possible to allow for one-to-one convertibility between reserve balances and wCBDC. It is reinforced by the equivalence between traditional reserve balances and wCBDC for (i) access; (ii) remuneration; and (iii) value date of transactions. Furthermore, wCBDC can remain in existence overnight on the platform, avoiding the compulsory redemption of wCBDC during end-of-day processing as in the case of an intraday wCBDC.

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[10] The settlement mechanism is a feature of the test platform and not related to wCBDC. Furthermore, it is not related to wCBDC, but is also true if a privately issued settlement asset is used. Other settlement mechanisms may be implemented and are currently under investigation by SDX.

4. Legal assessment ——

The legal assessment of Project Helvetia Phase II focuses on governance aspects of the central bank's role related to the issuance and circulation of wCBDC on an infrastructure operated and owned by a third party. It complements the legal analysis of Phase I which focused on the transfer of wCBDC on the SDX platform from a Swiss civil law perspective.

In the Helvetia Phase II solution design, the central bank is the sole issuer of wCBDC on the SDX platform, controls access to and settlement in wCBDC and books and reconciles wCBDC holdings in its systems. All other tasks related to the settlement of tokenised assets in wCBDC and wCBDC payments are entrusted to SDX. SDX not only carries out technical and operational services and tasks (such as hosting the central bank node and controlling the notary node), but also executes instructions by crediting and debiting the participants' wCBDC accounts when issuing, settling and redeeming wCBDC.

Box C: The SIC payment system – governance and roles[1]

The statutory basis for the SNB's activities related to electronic payments lies in the National Bank Act. Specifically, the bank's role includes facilitating and securing the operation of cashless payment systems as part of its payment policy mandate (Art. 5 para. 2(c)).

The SNB fulfils this mandate by acting as the system manager for the SIC system while SIX Interbank Clearing Ltd (SIC Ltd) has operational responsibility as the system operator. As system manager, the SNB defines the participation requirements, administers participants' accounts, issues settlement rules, sets the times when operations begin and end, steers the daily schedule, provides the liquidity necessary for payment settlement, and is responsible for crisis management in the event of disruptions or incidents.

The tasks delegated to SIC Ltd as system operator comprise the operation and the technical monitoring of day-to-day business, the development and maintenance of the pertinent software, management of the data files, the operation of the data centres and maintenance of the administrative rules of conduct.

The duties of SIC Ltd in the operation, maintenance and further development of the SIC system as well as the SNB's inspection and control rights are governed in a private law contract.

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[1] For details, see SNB (2021).

The legal assessment sought to explore if, and to what extent, such comprehensive delegation of tasks is possible. Furthermore, it investigated what legal concepts the collaboration and coordination between the central bank and the platform operator would follow. Existing governance arrangements of traditional payment systems may guide the development of such new arrangements (Box C).

The legal assessment confirms that, from a Swiss private and public law perspective, the central bank may delegate certain tasks to such an infrastructure. Under private law, the governance model foreseen by the Helvetia Phase II solution design would not give rise to issues, as it could follow the established rules of a mandate. The platform operator acts as the mandated party in relation to wCBDC and performs delegated tasks on behalf of the central bank based on contractual agreements. This includes the operation of nodes on behalf of the central bank.

However, public law imposes certain limitations on the delegation of tasks to the platform operator. From a legal perspective, the wCBDC as set up in Project Helvetia is not a new type of central bank money, but merely an alternative representation of traditional reserve balances. Under public law, the SNB must thus retain control and monitoring functions over wCBDC equivalent to those over traditional reserve balances through technical functionalities and contractual arrangements with the platform operator. These include for instance the suspension of individual participants from sending or receiving wCBDC or implementing a global wCBDC settlement stop. The Project Helvetia solution design affords the central bank such control and monitoring capabilities. However, associated technical and business processes would need to be refined.

5. Policy considerations ——

The Helvetia Phase II experiment expands on central bank policy considerations in three dimensions, as compared with Phase I. First, it tests a possible approach to increasing and decreasing the outstanding amount of central bank money directly on a tokenised asset platform. This is a step towards understanding how central banks could, if needed, expand monetary policy implementation to tokenised asset markets. Second, the project identifies different approaches to providing non-resident financial institutions with access to wCBDC, which would be required for international payments and settlements in wCBDC. Third, the project helped to identify and assess alternative design options for the settlement of tokenised assets.

5.1 Monetary policy implementation with wCBDC

Project Helvetia Phase II marks a step towards understanding how central banks could, if needed, extend monetary policy implementation to tokenised asset markets (Box A). This would be a way to offer standing facilities (eg intraday liquidity) and to conduct open market operations (eg purchases of tokenised assets or repo transactions) in wCBDC to influence conditions in tokenised asset markets.

As part of the testing, newly created wCBDC was exchanged against a tokenised bond between a commercial bank and the central bank on the SDX platform. The focus was on the settlement of such a monetary policy transaction, abstracting from front office (eg trading) and middle office processes (eg risk management). The transaction provides a basis for further exploring monetary policy instruments.

Further work would have to address a broad range of questions related to the shift towards tokenised asset markets, which may involve changing market conventions. For example, a shift may (i) change the liquidity demand by banks in case of shorter settlement cycles; (ii) affect the collateral policy of a central bank; (iii) require extended operational market coverage by the central bank (eg 24/7 standing facilities); and (iv) lead to the fragmentation of money markets, with possible negative effects on market liquidity and the formation of reference rates.

From a technical perspective, a question that needs further exploration is to what extent DLT might provide efficiency gains and enhance transparency and monitoring capabilities for central banks. Another topic that needs investigation is how the programmability of assets and smart contracts could impact the implementation of monetary policy, and whether they could be leveraged by central banks to simplify and automate processes.[11]

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[11] Bank of France, Euroclear, Agence France Trésor, Société Générale, BNP Paribas, Crédit Agricole CIB, HSBC and IBM (2021) have experimented with the settlement of French government bonds in wholesale CBDC using smart contracts.

5.2 International settlement with wCBDC

Tokenised asset platforms may have a wider international reach than today's largely domestic infrastructures, with the participation of both non-resident and resident banks.[12] Such new infrastructures could help overcome inefficiencies in international settlement, as financial transactions could be settled across borders and offshore on multilateral platforms (CPMI, BISIH, IMF and World Bank (2021)).[13]

Project Helvetia tests two approaches for the central bank to provide commercial banks with wCBDC. Presuming that the central bank allows (selected) non-resident banks to hold wCBDC, they enable international settlements in central bank money (Box D).[14]

The first approach builds on the RTGS system access criteria. In case of the Swiss RTGS system, eligible non-resident banks are also allowed to participate from abroad (Box E).[15] In the experiment, the participating non-resident bank triggered the issuance of wCBDC via its settlement account in SIC. Subsequently, it used its wCBDC to settle cross-border payments and cross-border DvP transactions.

In the second approach, the central bank issued wCBDC to commercial banks by exchanging tokenised assets against newly created wCBDC. This approach was tested as part of the settlement of monetary policy transactions that increased and decreased the outstanding amount of central bank money.[16] This approach would allow eligible non-resident banks without RTGS access to acquire wCBDC, which could subsequently be used for settling international transactions in wCBDC.

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[12] Resident banks have an authorised establishment within a domestic currency area, including banks with local branches but primarily regulated elsewhere. By contrast, non-resident banks have no such establishment (CPSS (2003)).

[13] The G20 initiative to enhance cross-border payments investigates the use of CBDC and of multilateral platforms to enhance international payments (CPMI (2020)). In this context, Project Jura (Bank of France, BIS and SNB (2021)) explores cross-border settlement of tokenised assets and foreign exchange transactions. Project Dunbar (BIS (2021)) and Project mBridge (BIS, Hong Kong Monetary Authority, Bank of Thailand, People's Bank of China and Central Bank of the United Arab Emirates (2021)) explore international settlements with digital currencies issued by multiple central banks.

[14] Eligible commercial banks may access wCBDC indirectly, eg by exchanging tokenised assets against wCBDC with another bank. The focus here is on direct wCBDC issuance channels by the central bank.

[15] Bech et al (2020) review existing cross-border and multi-currency systems, among them the SIC system.

[16] In the experiment, all participating commercial banks had access to the RTGS system. However, the approach could be extended to institutions without access to the RTGS system.

Box D: wCBDC: issuance channels and access criteria

Table D.1 presents a 2x2 taxonomy of the central bank's wCBDC issuance channels and access criteria. The business requirements for Project Helvetia mandated the same access criteria for wCBDC as for reserve balances in the RTGS system (left-hand column). While Phase I tested the issuance through the RTGS system only, Phase II additionally explored issuance of wCBDC through the settlement of a monetary policy transaction (bottom row). This would, in principle, allow the access criteria for wCBDC to be wider than for access to reserve balances in the RTGS system. Another approach where access criteria could differ, but where the issuance works through the RTGS system is by using a correspondent bank, as demonstrated by Project Jura (Bank of France, BIS and SNB (2021)).

Table D.1: Taxonomy of central bank issuance channels for wCBDC

		Access to wCBDC	
		Same as reserve balances	Wider than reserve balances
Issuance channel of wCBDC	Issuance/ redemption of wCBDC through RTGS system (cross-platform)	Eligible banks with RTGS access can acquire wCBDC by initiating a conversion of reserve balances into wCBDC.	Eligible banks without RTGS system access can acquire wCBDC by requesting a correspondent bank to initiate a conversion of reserve balances into wCBDC on their behalf and paid in commercial bank money (eg Project Jura).
	Issuance/ redemption of wCBDC in exchange for tokenised assets (intra-platform)	Eligible banks with access to reserve balances can acquire wCBDC through a monetary policy transaction.	Eligible banks without access to reserve balances can acquire wCBDC through a monetary policy transaction (no correspondent bank needed).

Tested as part of
Project Helvetia Phase II.

Box E: Domestic and international payments in the Swiss RTGS system

Switzerland's RTGS system, the SIC system, processed more than 728 million transactions with a value of almost CHF 45 trillion in 2020. Since 1998, it has been accessible to eligible non-resident financial market participants. To be admitted to the SIC system, participants must make a significant contribution to the fulfilment of the SNB's statutory tasks and their admission must not pose any major risks.[1] As a result, some of the Swiss franc transactions settled in the SIC system are so-called international where either one ("cross-border") or both ("offshore") payment counterparties are domiciled outside Switzerland.[2]

In 2020, around one quarter of the 321 SIC participants were non-resident and sent payment instructions to the SIC system via different access options.[3] Around 1.6% of SIC transactions were international transactions and, in value terms, they accounted for nearly 30% of all SIC transactions (Table E.1).

Table E.1: SIC transactions by volume and value in 2020 (as percentage of total)

	Volume (number of transactions)	Value (CHF turnover of transactions)
Domestic (onshore) transactions	98.4%	70.6%
International transactions	1.6%	29.4%
- cross-border	1.5%	28.9%
- offshore	0.1%	0.5%

[1] For an overview of the participation categories and conditions, see eg SNB (2019) and Kraenzlin and Nellen (2015).

[2] Note that a distinction between "domestic" and "international" transactions in the SIC system can be misleading, as all transactions in the SIC system are settled according to Swiss law. That is, the Swiss franc balances always remain in the Swiss jurisdiction and thus no SIC transaction "crosses a border".

[3] These non-resident participants are domiciled mainly in Germany (25), Austria (18) and the United Kingdom (10). The SIC system may be accessed via proprietary interfaces (Finance IPNet), the SWIFT network or the Secure Swiss Finance Network (SIX (2022)).

Most international transactions were cross-border (91%), with more non-resident participants being the payer rather than the payee. Some 9% of the international transactions were between two non-resident participants (Graph E.1, left-hand side).

In terms of value, outgoing and incoming international payments between non-resident and resident participants were equal. Offshore payments only amounted to 2% (Graph E.2, right-hand side).

The volume was dominated by (small-value) retail payments, the value by (large-value) interbank payments, often resulting from money market transactions.

Graph E.1: International transactions in the SIC system 2020
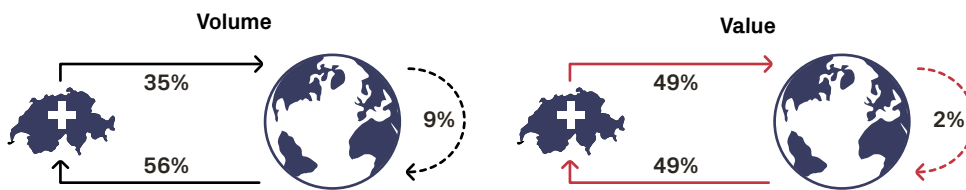
5.3 Alternative design options

Project Helvetia Phase II investigates the settlement of tokenised assets in wCBDC "on ledger" (ie on the same ledger as the tokenised assets), raising a variety of operational, legal and policy considerations. A different design of the cash leg for settling tokenised assets would raise different considerations. For example, as shown in Project Helvetia Phase I, an RTGS link – allowing the settlement of tokenised assets against payments in reserve balances – is operationally less complex and raises fewer policy and legal questions but also confers fewer benefits from a functional and efficiency perspective.

As part of Project Helvetia Phase II, four selected alternative design options for the cash leg of tokenised asset transactions were explored conceptually: (i) intraday wCBDC issued directly on a tokenised asset platform; (ii) an interoperable wCBDC settlement platform providing cross-platform (interfaced) settlement with different tokenised asset platforms; (iii) an RTGS link that allows the settlement of tokenised asset in traditional reserve balances; and (iv) stablecoins and (tokenised) commercial bank money.

Intraday wCBDC

From a central bank perspective, an intraday wCBDC is operationally less complex than an overnight wCBDC (eg remuneration policy would only apply to reserve balances). Central bank back office processes require fewer changes, as all wCBDC would be redeemed into reserve balances every day before end-of-day processing starts.

However, intraday wCBDC requires arrangements for redeeming and re-issuing wCBDC at the end of day and beginning of day. It may also limit the operating hours for settling in wCBDC, which may be particularly relevant for international transactions across time zones. Moreover, if wCBDC access criteria are wider than those of the RTGS system, intermediaries without access to the RTGS system would rely on correspondent banks and could thus be exposed to overnight credit risk.

Interoperable wCBDC settlement platform

A wCBDC may be issued onto a single DLT-based payment platform – potentially operated and owned by the central bank – that is interoperable with one or potentially multiple tokenised asset platforms. Compared with the wCBDC issuance on multiple platforms, this confers several benefits. First, operational costs and complexities of a wCBDC settlement platform are likely lower for a central bank (eg control and monitoring of wCBDC settlement and end-of-day processing are concentrated on one platform). Second, the circulation of wCBDC on a single platform may simplify liquidity management for commercial banks and the central bank. Third, a wCBDC settlement platform operated and owned by the central bank can be tailored specifically to operational, legal and policy requirements. The last argument holds true also in comparison with wCBDC issued on a single third-party platform.

A single wCBDC settlement platform requires interoperability between systems and potentially different protocols. This raises challenges, such as the need to synchronise data across platforms (eg for DvP and PvP settlement, smart contracts and liquidity-saving mechanisms), the implementation and adjustment of technical standards (eg message formats, data definitions, cryptographic techniques, processing logic, identities), dependencies between IT systems (eg for error handling) and potentially lower transaction processing speed. In addition, the setup of such a platform may require significant development effort.

RTGS link

A link to the RTGS system to settle tokenised assets would leverage existing infrastructure and concentrate central bank money in a single system. Such a link could be implemented in a relatively short time, as it could build on existing systems, interfaces and processes. In addition, an RTGS link could circumvent legal challenges potentially arising from the issuance of wCBDC in a jurisdiction. Like an interoperable wCBDC settlement platform, an RTGS link may be tailored to specific central bank requirements.

Project Helvetia Phase I and Trigger Solution (Deutsche Bundesbank (2021)) demonstrate the feasibility of an RTGS link. Both experiments took the functionalities of the current RTGS systems as given, possibly constraining the potential of DLT platforms in terms of efficiency and functionality. For example, current RTGS systems typically do not allow for the simultaneous blocking of balances across multiple parties and the parallel processing of settlement instructions. This functionality is a key component to enable cross-platform multilateral atomic DvP or PvP settlement.

However, RTGS systems may evolve to better support the settlement of tokenised assets on DLT platforms. For example, the Bank of England's RTGS renewal programme targets greater interoperability with other systems and the support of different settlement models, possibly based on DLT (Bank of England (2022)). More generally, instant payment systems, the latest generation of central bank payment systems, may allow parallel processing of settlement instructions and could potentially be leveraged for cross-platform multilateral settlement. In addition, programmable features may also be built on top of RTGS systems. The Trigger Solution experimented with a smart-contract layer added to the RTGS system that interacts with the tokenised asset platform.

Adding functionality comes at the price of additional complexity for today's RTGS systems. For a central bank, this may not be desirable, either from an operational (eg management and maintenance of several interfaces to other platforms) or a risk (eg extension of RTGS system functionality beyond payments) perspective. Furthermore, with the RTGS link, the DLT-platform could not serve as a backup for the RTGS system.

Stablecoins and (tokenised) commercial bank money

Privately issued settlement assets such as stablecoins and (tokenised) commercial bank money offer an alternative to central bank money for settling tokenised assets.[17] Technically, the settlement process might be the same as with wCBDC. However, such privately issued forms of money do not represent a liability of the central bank and may thus bear credit and liquidity risk, leading to a stricter regulatory treatment compared with central bank money.

International regulatory standards suggest that systemically important FMIs should settle in central bank money whenever practical and available (CPMI-IOSCO (2012), principle 9). A well designed arrangement for private settlement assets may, however, be an alternative to settlement in central bank money. CPMI-IOSCO (2021) have recently published for consultation a report on how certain aspects of the Principles for financial market infrastructures (PFMI) would apply to the novel features of stablecoin arrangements. This includes guidance on (i) governance arrangements; (ii) risk management frameworks; (iii) settlement finality; and (iv) money settlements with little or no credit risk.[18]

Central banks may actively support the use of privately issued settlement assets. For example, the Bank of England has published a policy for omnibus accounts in the RTGS system (Bank of England (2021)). An omnibus account allows an operator of a payment system to fund their participants' balances with central bank money. This could enable safe and innovative payment services, possibly building on DLT.

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[17] Stablecoins use a stabilisation mechanism to minimise fluctuations in the value relative to a specified asset or a pool or basket of assets. Tokenised commercial bank money is a digital representation of traditional commercial bank money using DLT or similar technology (BCBS (2021) and FSB (2020)).

[18] Guidance on money settlements includes (i) the clarity and enforceability of legal claims and rights; (ii) the design of the stabilisation mechanism; (iii) the stability and timeliness of the conversion arrangement; (iv) the robustness of the issue; (v) the regulatory and legal framework governing the issuer, reserve managers and or the custodians of the reserve assets; and (vi) additional controls to reduce the credit and liquidity risks.

6. Conclusion ——

Project Helvetia Phase II extended the exploration of tokenised asset settlement in wCBDC that started with Phase I. Specifically, Phase II established interoperability between the SDX test platform, the SIC test system and the core banking test systems of five commercial banks as well as that of the SNB. This allowed settlement in wCBDC to be investigated end to end. The experimental setup highlighted operational, legal and policy challenges.

Operationally, establishing interoperability between DLT-based and traditional systems raises a series of complex considerations for both central and commercial banks, covering the specification of interfaces, messaging standards as well as booking and reconciliation procedures. Phase II of Project Helvetia implemented an end-to-end solution design that was shown to be feasible.

Both public and private law questions arise when issuing wCBDC on a third-party DLT platform and when delegating tasks related to wCBDC to the operator of the infrastructure. The legal assessment for Switzerland confirms that a central bank can issue wCBDC on a third-party platform, if it retains control and monitoring functionalities related to wCBDC issuance, settlement and redemption.

Experimentation also confirms that the Helvetia Phase II solution design supports the settlement of international transactions and the settlement of monetary policy transactions on a tokenised asset platform. From a policy perspective, these capabilities may become important in an emerging tokenised financial ecosystem. Yet policy questions remain. Alternative design options for settling tokenised assets confront central banks with distinct opportunities and challenges, where a balance will need to be struck.

Beyond these immediate challenges for a central bank, a transition towards a tokenised financial ecosystem raises broader issues. For example:

- Increased market and settlement complexity. As a new tokenised ecosystem emerges, the number of platforms and settlement assets could multiply, increasing choice and competition but also fragmentation where interoperability is insufficient. Further exploration of interoperability between DLT-based and traditional systems as well as between different DLT platforms is thus crucial.

- Liquidity management challenges. Instant gross settlement, a mechanism often implemented on tokenised asset platforms, requires prefunding of the asset leg and the cash leg. This could alter market structures and require significant amount of liquidity for settlement while potentially fragmenting the supply of liquidity. This could increase the need for novel liquidity-saving mechanisms and the development of new money markets for immediate and intraday liquidity.

- Integration of trading and settlement. Project Helvetia focused on the settlement of financial transactions. Integration of trading and settlement could support the potential of DLT and tokenisation. For central banks, this could be crucial to further advancing their understanding of monetary policy implementation in a tokenised financial system.

At this stage, the tokenised ecosystem is still nascent. A safe and orderly transition to any such ecosystem will require financial market participants to coordinate and collaborate. If, where, when and how central bank money is offered for settling tokenised assets will depend on the central bank's policy objectives and legal constraints as well as its practical operational requirements.

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