

Eurosystem exploratory work on new technologies for settlement of wholesale financial transactions in central bank money:

Call for Expression of Interest

13 December 2023

Submission deadlines:

Wave 1: 31 January 2024

Wave 2: 30 April 2024

Executive summary

This call for expression of interest is for financial market stakeholders wishing to participate in the Eurosystem's exploratory work with new technologies for wholesale central bank money (CeBM) settlement. We are asking for responses by:

- 31 January 2024 for participants interested in taking part between May 2024 and November 2024 (wave 1)
- 30 April 2024 for participants interested in taking part between July 2024 and November 2024 (wave 2)

This document (i) outlines the conditions to consider before expressing interest including eligibility criteria to participate, (ii) explains how to express interest, (iii) describes the selection process, and (iv) provides further background information. Technical details¹ and the registration form² will be published on ECB's website.

The Eurosystem will review the responses to this call for expressions of interest, with participation being subject to an eligibility assessment and capacity constraints on the side of the Eurosystem.

This invitation follows an earlier [announcement](#) in April 2023 and a [survey](#) asking relevant financial market stakeholders to express preliminary interest in this Eurosystem effort in October 2023.

The practical exploratory work that financial market stakeholders are now invited to express their interest for consists of *Trials* (CeBM settlement in TARGET Services) and *Experiments* (mock settlement in test environments), both based on three distinct interoperability-type solutions enabling CeBM settlement of wholesale financial transactions recorded on distributed ledger technology (DLT) platforms. Exploratory work is conducted with the view to improve knowledge of new technologies and their potential application for central bank money settlement of wholesale financial transactions. Exploratory work also aims at supporting the market during their own pilot exercises with new technologies, under the EU DLT Pilot Regime Regulation for example³. It does not constitute a commitment by the Eurosystem to provide any solution in the future nor to make any related changes to its current infrastructure offering.

The work is part of the Eurosystem's broader efforts to ensure that developments in CeBM keep pace with and contribute to digital innovation in wholesale and retail payments, and that CeBM remains a monetary anchor that supports the stability, integration and efficiency of the European financial system.

¹ Service Descriptions: [Full DLT Interoperability Service Description](#); [TIPS Hash-Link Service Description](#); [Trigger Solution Description](#)

² [Registration form](#)

³ [Regulation \(EU\) 2022/858 of the European Parliament and of the Council of 30 May 2022 on a pilot regime for market infrastructures based on distributed ledger technology](#)

This document sets out:

- The envisaged scope and timeline of exploratory work (section 1)
- Requirements for participation (section 2)
- The registration process (section 3)
- Legal, technical and operational parameters under which exploratory work would be conducted (section 4)

Table of content

1. Envisaged scope and timeline of exploratory work	5
2. Requirements for participation	7
Eligibility criteria	7
Onboarding and signing of legal arrangements.	9
Reporting requirements and information sharing during exploratory work	10
3. Registration and selection process	11
Timeline to express interest	12
Selection process	12
4. Legal, technical and operational parameters for conducting Trials and Experiments	13
Settlement finality of operations in Trials	13
Escrow mechanism implemented during exploratory work	13
Availability of Trials and Experiments	14
Volumetric limits in Trials and Experiments	14
Possibility of value limits and liquidity implications of Trials	15
Costs of exploratory work	15
Intellectual property	15
List of annexes	15
Annex A – solutions of the Solution Provider Central Banks	16
Trigger Solution	17
TIPS Hash Link and Full-DLT Interoperability (with escrow mechanism)	18
Annex B – learning objectives of exploratory work	20

1. Envisaged scope and timeline of exploratory work

Use cases

Eurosystem exploratory work consists of Trials (CeBM settlement in TARGET Services is available) and Experiments (mock settlement in test settings), both during a limited period, by using three solutions based on interoperability between market DLT platforms and new central bank infrastructures (hereafter also referred to as Interoperability solutions): Trigger Solution provided by the Deutsche Bundesbank, TIPS Hash-Link solution provided by the Banca d'Italia and the Full-DLT interoperability solution by the Banque de France. These three national central banks are referred to as solution provider central banks (SPCBs). For the purpose and duration of the Eurosystem's exploratory work, these solutions will provide interoperability with eligible market DLT platforms and enable settlement of DLT-based transactions with the settlement of the euro CeBM leg in TARGET Services (See Annex A).

Participants in exploratory work can conduct Trials or Experiments or both for the exploration of the three solutions. The three solutions can be trialled and experimented with in parallel during exploratory work so that financial market stakeholders can gain insights into the solutions' relative merits.

The Eurosystem exploratory work will cover delivery-versus payment (DVP) in CeBM of DLT-based digital assets denominated in euro as well as a broad range of operations related to the securities' lifecycle management (primary market, secondary market, coupon payment).

Exploratory work could also cover, subject to an assessment by the Eurosystem, cross-currency and cross-border payments in CeBM as well as automated wholesale payments in CeBM (e.g. in relation to the use by commercial banks of "deposit tokens"⁴ with a need for CeBM wholesale settlement).

Through this call for expression of interest, financial market stakeholders are invited to detail their plans and proposal for Trials and Experiments, including choice of solutions, foreseen planning, volumes and use cases. Eligible participants are invited to build on these use cases to develop and explore their own business cases with new technologies as part of exploratory work.

Participants in exploratory work are expected to share the results of Trials and Experiments with the Eurosystem. Depending on the use cases chosen by financial market stakeholders, the Eurosystem will provide them with detailed reporting requirements based on the Eurosystem's learning objectives (See Annex B).

⁴ This term does not benefit from a legal and common definition yet but it is here understood as a liabilities of commercial banks issued and transferred on distributed ledgers.

Timeline

Experiments and Trials with the Eurosystem are planned to take place over a six month period, commencing in May 2024 and running until November 2024. This execution phase would consist of two waves:

1. a first wave of participants, ready to start execution of experiments and trials work in May 2024, which could conduct exploratory work during the 6-month period, and
2. a second wave of participants, starting in July 2024 during a 4-month period, completing exploratory work at the same time as the first wave, in November 2024.

The onboarding phase for wave 1 participants can start from December 2023 and must end by April 2024. Participants to the second wave could complete the onboarding process during an additional window by July 2024. Onboarding will comprise all activities to prepare for the execution of Trials and Experiments, including conducting the necessary tests and signing the legal framework before Trials or Experiments could start.

Financial market stakeholders that have not expressed their interest by 31 January 2024 or who have expressed interest but have not by then completed the onboarding and testing process by 30 April 2024 will not be able to participate in the first wave of exploratory work.

Financial market stakeholders that have not expressed their interest by 30 April 2024 or who have expressed interest but who have not completed the onboarding and testing process by 31 July 2024 will not be able to participate in the second wave of exploratory work.

Participation in any wave is subject to operational boundaries on the side of the Eurosystem. The Eurosystem will follow to the maximum extent possible an open approach but reserves the right to refer participants to the second wave of exploratory work or to reject their proposals in view of operational boundaries.

After November 2024, the Eurosystem will assess the results of Trials and Experiments conducted. No decision has been made on next steps.

2. Requirements for participation

Eligibility criteria

The Eurosystem is seeking expressions of interest from financial market stakeholders that meet either category of the below eligibility criteria. Interested financial market stakeholders should provide evidence that they meet these foreseen eligibility criteria at the latest by the time their respective wave begins. Interested financial market stakeholders are invited to provide this evidence as soon as possible via the attached registration form as a positive in-principle assessment of eligibility by the Eurosystem will be required for stakeholders to join the onboarding process and later participate to Trials and Experiments.

- I. **Eligible market participants** would be defined as those entities with access to TARGET, within the meaning of Article 4 of Annex 1 Part I and Article 7, Annex 1 Part I of the TARGET Guideline⁵, as amended from time to time. These Market Participants would be able to access the solutions of the Solution Provider Central Banks in both Trial (real settlement) and Experiment (mock settlement) configuration for the euro CeBM cash leg settlement during exploratory work; or
- II. **Eligible market DLT operators** would be able to connect a DLT platform to the interoperability solutions of the Solution Provider Central Banks to enable delivery-versus-payment (DVP), payment-versus-payment (PVP) or automated wholesale payments related to use cases to be experimented with (mock CeBM settlement) and trialled with (CeBM settlement in TARGET Services). Eligible market DLT operators would be:
 1. Central securities depositories (CSDs), authorised under the CSDR⁶ and NCB-run CSDs exempted from the CSDR authorisation procedure, operating a Securities Settlement System based on DLT / operating a DLT platform (including T2S central securities depositories subject to a derogation of the contractual and regulatory framework of T2S);⁷

⁵ [Guideline \(EU\) 2022/912 Of The European Central Bank of 24 February 2022 on a new-generation Trans-European Automated Real-time Gross Settlement Express Transfer system \(TARGET\) and repealing Guideline 2013/47/EU \(ECB/2012/27\) \(ECB/2022/8\)](#)

⁶ [Regulation \(EU\) No 909/2014 of the European Parliament and of the Council of 23 July 2014 on improving securities settlement in the European union and on central securities depositories](#)

⁷ T2S CSDs can register their interest to participate to trials and experiments. For trials, the Eurosystem has identified the need to grant a temporary and targeted derogation to the T2S Framework Agreement enabling T2S CSDs to settle DvP transactions under trials in CeBM in TARGET using any of the three Interoperability solutions. Such a derogation, if granted, would be for the duration and purpose of exploratory work only.

2. Operators of a DLT settlement system or a DLT trading and settlement system as authorised under the DLT Pilot Regime Regulation⁸;
3. Credit institutions, investment firms, market operators and other licensed financial institutions operating a DLT platform, as duly licensed under CRD IV, MiFID II and/or other relevant national legal frameworks subject to a case-by-case assessment to ensure proper risk management.

A market DLT operator must be for the purpose of the Eurosystem's exploratory work, a clearly identifiable entity, responsible and liable towards market participants for the activities occurring on the market DLT platform, including, but not limited to, the securities delivery as part of a Delivery-versus-Payment (DVP) settled with at least one of the Eurosystem's three solutions experimented or trialed with. The Eurosystem will not be liable for the settlement of the asset leg of any securities transactions occurring on market DLT platforms connected to any of the three solutions of the Solution Provider Central Banks.

Such responsibility and liability of the market DLT operator would also apply in the case of market DLT operators that rely on a permissionless or public DLT (or more generally, a *technical* platform provided by one or more other parties). Any potential risk of the usage of a permissionless DLT platform will fully reside with the responsibility of the market DLT operator. If a permissionless DLT platform is used, eligibility must be verified with an additional set of criteria addressing risks. The market DLT operator shall demonstrate that it has set up the necessary permissions and controls to meet the additional requirements. In particular, it shall ensure that the overall IT and cyber arrangements related to the use of DLT are proportionate to the nature, scale and complexity of their businesses. Those arrangements shall ensure the continuity and continued transparency, availability, reliability and security of their services and activities, including the reliability of smart contracts used on the DLT infrastructure.⁹

Based on the information provided by interested market participants and interested market DLT operators, the Eurosystem will assess their eligibility. The Eurosystem reserves the right to request changes or impose conditions for accepting a proposal of a market participant or market DLT operator.

Only entities that have obtained the relevant license (as referred to in II.1, II.2 and II.3 previously) on the basis of which they demonstrate eligibility and that have been positively assessed by the Eurosystem will be permitted to participate in Trials involving settlement of operations in euro CeBM in the TARGET

⁸ [Regulation \(EU\) 2022/858 of the European Parliament and of the Council of 30 May 2022 on a pilot regime for market infrastructures based on distributed ledger technology, and amending Regulations \(EU\) No 600/2014 and \(EU\) No 909/2014 and Directive 2014/65/EU](#)

⁹ This includes, for example: (1) The market DLT operator ensures the application of privacy rules and the highest protection levels of market participant's individual data, (2) Orderly and regular availability of the market DLT platform and contingency measures being in place, and (3) Cost and fee structures should be determined transparently and not due to validation processes.

production environment. Entities awaiting their license may be permitted to participate to Experiments at the discretion of the Eurosystem; this would involve settlement of test (mock) transactions only.

All types and categories of financial instruments, within the meaning of Article 4(1), point (15), of the MiFID¹⁰ and available on the eligible market DLT platforms will be eligible to be experimented with (mock settlement only) and trialled with (CeBM settlement in TARGET) using any of the three Interoperability solutions during the Eurosystem's exploratory work.¹¹ This includes listed or unlisted financial instruments, as native digital assets or as tokenised assets (i.e. representation on DLT of existing assets).¹²

All securities settlement in Trials shall occur in compliance with the relevant legal frameworks. In the case of listed securities, market DLT operators would not be able to offer settlement of securities admitted to trading or traded on trading venues¹³ (i.e. listed financial instruments) as part of Trials, if they are not entities duly authorised under CSDR (Art 3.2) or in specific situations under the DLT Pilot Regulation (Art. 5.2 & 6 of DLT PRR).

Onboarding and signing of legal arrangements

Market participants and market DLT operators shall successfully complete the onboarding process before taking part in Trials and Experiments.

Onboarding will include testing activities to be conducted by all market participants and market DLT operators jointly with the Eurosystem, from December 2023 until July 2024 at the latest:

- Phase 1 of testing and onboarding: market DLT operators and market participants will run connectivity, operational and functional tests with the chosen solution(s) they wish to Trial and Experiment with. Wave 1 participants are expected to complete phase 1 of testing and onboarding by 16 February 2024. Wave 2 participants are expected to complete phase 1 of onboarding by 24 May 2024.
- Phase 2 of testing and onboarding: eligible market DLT operators and eligible market participants will rehearse a full testing daily process for their desired use cases with the chosen solution(s) they wish to Trial and Experiment with. Wave 1 participants must complete phase 2 of testing and onboarding by 30 April 2024. Wave 2 participants must complete phase 2 of onboarding by 31 July 2024.

¹⁰ [Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments](#)

¹¹ Excluding Eurosystem credit operations.

¹² Market DLT platform operators are required to have an exit plan in place for the end of the Trial period, preparing for the CeBM settlement solutions offered in Trials to be discontinued.

¹³ 'Trading venue' means a regulated market, an MTF or an OTF.

Further information on the testing activities as part of the onboarding process are available in the service description of the Deutsche Bundesbank ([Trigger Solution Description](#)), the Banca d'Italia ([TIPS Hash-Link Service Description](#)) and the Banque de France ([Full DLT Interoperability Service Description](#))

Given the need to complete the onboarding process prior to starting Trials and Experiments, participants interested in participating to wave 1 are invited to submit evidence pertaining to their eligibility (see section 3 on the registration process and the attached registration form) as soon as possible to their local National Central Bank for a timely start of phase 1 onboarding.

The final approval of the eligibility of participants will be granted by the ECB's Governing Council which is envisaged for Q1 2024 for wave 1 and Q2 2024 for wave 2. Nevertheless, market DLT operators and their market participants can already start with the phase 1 of testing and onboarding activities following a positive in-principle eligibility assessment, while acknowledging the risk of not being able to participate in exploratory work due to capacity constraints or ineligibility. Only eligible market DLT operators and eligible market participants will move to phase 2 of testing and onboarding. Onboarding will also include signing of legal arrangements between National Central Banks and eligible market participants, as well as between National Central Banks and eligible market DLT operators. Such arrangements will be provided to market participants and market DLT operators subject to the ECB's Governing Council approving their eligibility and will need to be signed by them prior to taking part in Trials and Experiments.

Reporting requirements and information sharing during exploratory work

In line with the Eurosystem learning objectives for exploratory work (see Annex B), eligible market participants and market DLT operators will be required to regularly report on the results of the exploratory work via harmonised reporting templates collecting qualitative and quantitative data. Eligible market participants and market DLT operators will be required to ensure Eurosystem access to a predefined set of data and information needed for the analysis¹⁴. The Eurosystem may invite selected eligible market participants and market DLT operators to its own planned Experiments as part of exploratory work. Data collected would not be shared beyond the Eurosystem. Anonymised data in consolidated form may be shared publicly.

¹⁴ While the definition of the Eurosystem learning objectives is still work in progress, a preliminary example of the list of data to be made available by market participants and DLT operators include timestamp of the settlement of the asset leg in the market DLT (to perform performance testing), ID of the assets transacted for which a payment instruction is sent to the interoperability solutions (to perform reconciliation testing). As an example of qualitative data, market DLT operators could be expected to shed light on the techniques used to manage privacy and confidentiality on their platform. Individual pieces of data collected will remain confidential within the Eurosystem and will be used for the sole purpose of the assessment of the learning objectives. Data in aggregated and anonymised forms may be used for public communications.

3. Registration and selection process

Interested financial market stakeholders can express their interest in participating in the Eurosystem exploratory work by submitting registration forms to their local National Central Bank:

- In the case of market participants, the registration is submitted to the National Central Bank where they have opened or would be eligible to open accounts in TARGET Services' T2 service (RTGS DCAs) which they would use for Trials and Experiments.
- In the case of market DLT operators, the registration is submitted to the National Central Bank of the jurisdiction where they are licensed.

Interested financial market stakeholders are invited to register their interest to participate to exploratory work in a two-step process:

- Interested participants are invited to submit part I of the registration form as soon as possible enabling the Eurosystem to assess their eligibility in view of starting the onboarding process. The form shall be accompanied by the necessary documents to enable the Eurosystem to conduct an in-principle assessment of eligibility of the applicant (see the attached registration form, part I). In addition, this registration must contain information specific to the solution(s) they wish to use during Trials and Experiments (see the attached registration form, part II).
- By the deadlines for the call for interest, depending on the chosen wave, participants must submit detailed information on their proposals for Trials and Experiments, including the foreseen planning, the anticipated volumes of transactions as well as a comprehensive description of the use cases and expected learning outcomes (see the attached registration form, part III).

Timeline to express interest

Publication date of the call for expression of interest		13 December
Wave 1	Submit registration form parts I and II	As soon as possible (latest 31 January 2024)
	Deadline to submit questions to the Eurosystem	12 January
	Deadline for the Eurosystem to respond to questions	24 January
	Deadline to submit full proposal for participation (Parts I, II and III of the registration form)	31 January
Wave 2	Deadline to submit questions to the Eurosystem	29 March
	Deadline for the Eurosystem to respond to questions	10 April
	Deadline to submit full proposal for participation (Parts I, II and III of the registration form)	30 April

Selection process

The Eurosystem will strive to implement an open approach aiming at accommodating the proposed Trials and Experiments proposed by eligible market participants and eligible market DLT Operators. The Eurosystem may however face certain operational boundaries should the number of participants and volume of transactions be too high. In that case, the Eurosystem will assess the feasibility and suitability of participants' proposed use cases for the Eurosystem exploratory work. Should the need arise, the Eurosystem will prioritise expressions of interest which are assessed to provide superior learning opportunities for the Eurosystem. For example, participants proposing detailed and realistic use cases (e.g. beyond DVP settlement, also covering securities lifecycle management on DLT) could be prioritised for participation. Within the breadth of all expressions of interest received, the Eurosystem will aim that the prioritised expressions of interest retain a balanced participation from different geographical areas, market segments, equally covering the three proposed solutions.

Following the same prioritisation need, the Eurosystem could also assign market participants and market DLT operators to the second wave and a subsequently shorter window for exploratory work or reject their proposal for participation.

4. Legal, technical and operational parameters for conducting Trials and Experiments

This section provides an overview of the main envisaged parameters for exploratory work. The service description of each Solution Provider Central Banks details the operational and technical parameters for each of the three proposed solutions. Detailed and binding legal parameters will be provided to eligible market participants and eligible market DLT operators, after the ECB's Governing Council confirms their eligibility to participate, through the legal arrangements to be signed with National Central Banks as part of the onboarding process.

Settlement finality of operations in Trials

As regards the euro cash leg, settlement of the euro CeBM related financial transactions using any of the Interoperability solutions will occur in T2 in line with the existing rules on entry of cash transfer orders in T2 and their irrevocability. The settlement finality will apply as specified in Article 18 Annex 1 Part I of the TARGET Guideline.¹⁵ The settlement finality of the asset leg will be dependent on the rules applicable to the eligible market DLT operator.

Escrow mechanism implemented during exploratory work

Trials with the TIPS Hash Link and Full-DLT Interoperability solutions will require setting up an ad hoc escrow mechanism in T2. This mechanism is a temporary construct implemented for the purpose and duration of exploratory work only. Escrow accounts will be opened by the relevant central bank in the T2-RTGS component system of the national central bank of eligible market participants. Escrow accounts have to be prefunded by eligible market participants on a full transfer of ownership basis to the national central bank of the home jurisdiction in exchange for the provisioning of exploratory liquidity for the TIPS Hash-Link and Full DLT-interoperability solutions. This exploratory liquidity would be used specifically for Trials with those solutions during an intraday window. Eligible market participants will redeem exploratory liquidity at the end of each trial day and receive back in T2-RTGS the equivalent amounts. Annex A provides further details on the escrow mechanism.

¹⁵ [Guideline \(EU\) 2022/912 of the European Central Bank of 24 February 2022 on a new-generation Trans-European Automated Real-time Gross Settlement Express Transfer system \(TARGET\) and repealing Guideline ECB/2012/27 \(ECB/2022/8\).](#)

Availability of Trials and Experiments

Trials and Experiments could be conducted on all days T2 is processing payments,¹⁶ on a regular basis for Trials, and on specific days for Experiments. Eligible market participants and eligible market DLT operators are invited to provide proposals on the planning of operations for Trials and Experiments upon answering the call for expression of interest.

Settlement under Trials will occur on an intraday-basis during the 09:00 to 14:00 CET settlement window for the Trigger solution and 10:00 to 14:00 CET settlement window for the TIPS Hash Link and full-DLT Interoperability solutions. In coordination with the respective SPCB, Experiments will be conducted during specific windows tailored to the content of the proposed Experiments.

Volumetric limits in Trials and Experiments

Trials and Experiments will follow certain volumetric limits, including on the number of transactions and number of participants that would participate in any of the three solutions on a given day for Trials and Experiments. Such limits are not indicative of the technical capabilities of the SPCB solutions and the SPCB platforms. Instead, they reflect the need that the Eurosystem provides its Trials and Experiments service safely, properly and based on a level playing field. The table below indicates the maximum aggregate volumes *per solution* that could be settled during Trials and Experiments on a daily basis.

Eligible market participants and eligible market DLT operators are invited to provide the indicative volumes they propose to settle in Trials and Experiments.

Solution	Volumetric assumptions for Trials	Volumetric assumptions for Experiments
Trigger Solution	500 DVPs* & 25 eligible market participants / day**	500 DVPs* & 25 eligible market participants / day**
TIPS Hash Link	60 DVPs* & 12 eligible market participants/ day**	500 DVPs* & 25 eligible market participants / day** or lower**
Full-DLT Interoperability	120 DVPs* & 12 eligible market participants/ day**	500 DVPs* & 25 eligible market participants / day**

*or euro CeBM payments as part of other use cases

** This limit is applicable to the combined volumes settled for all market DLTs connected to each solution on any given day during exploratory work.

¹⁶ T2 is open for the processing of payments every working day. The system is closed on the dates specified [here on ECB's website](#).

Possibility of value limits and liquidity implications of Trials

The Eurosystem reserves the right to impose limits on the maximum value of transactions settled in T2 as part of Trials. Liquidity used for Trials should not be critical for participants to meet their obligations outside exploratory work.

Costs of exploratory work

The Eurosystem will not provide remuneration for participation in the exploratory work. Participants and DLT operators shall bear their own costs arising from participation. The standard pricing framework of TARGET Services for Trial-related operations in T2 will apply, according to Annex I, Appendix VI (fee schedule). No transaction fees will be charged for the activities in the new environments (Trigger solution, TIPS Hash Link, Full DLT Interoperability).

Intellectual property

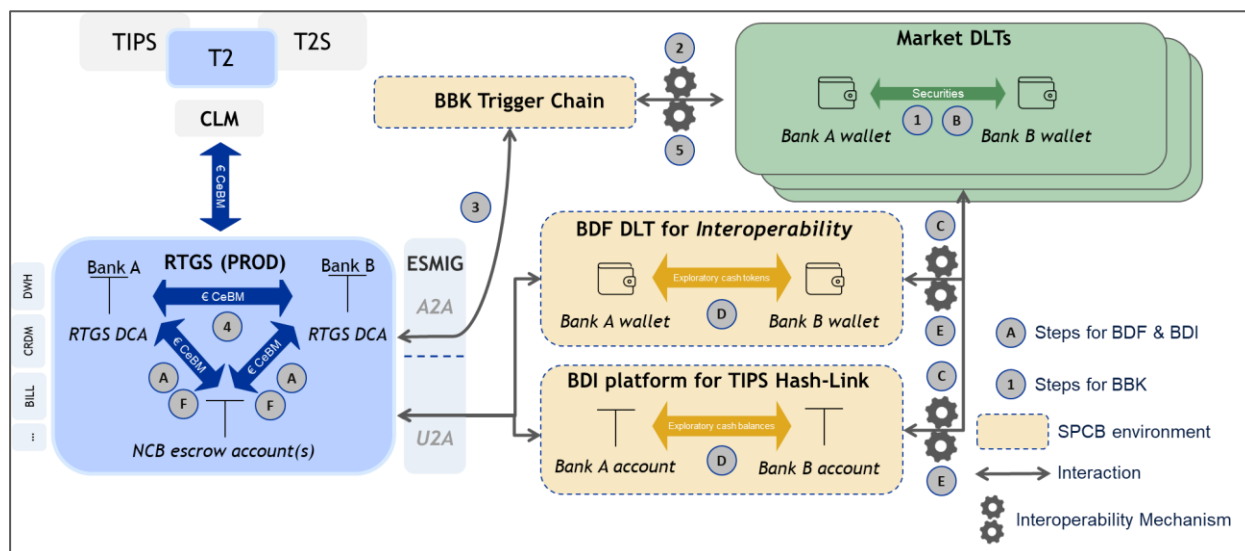
Each party would retain the intellectual property rights already owned by such party at the start of the Experiments and Trials. In general, the intellectual property rights related to further corrective, adaptive or evolving developments carried out over the course of the Experiments and Trials, will remain with the actor who has implemented and borne the costs for these further developments.

List of annexes

- Annex A - Detailed description of solutions
- Annex B - Learning objectives of exploratory work

Annex A – solutions of the Solution Provider Central Banks

Figure A1 – Interoperability solutions deployed during Trials and Experiments



Three technical environments will be used and will interact during the Eurosystem’s Trials and Experiments:

- **(blue) TARGET Services, mainly the T2 service – RTGS component** for *business-as-usual* payments (and final CeBM settlement) and liquidity transfers with ESMIG connectivity (A2A for Trigger, U2A by NCBs for TIPS HL and Full-DLT). Common components of TARGET Services (CRDM, ESMIG, DWH, BILL) will also be used here.
- **(yellow) SPCB platforms** used to (1) orchestrate the DVP process through an interoperability mechanism between SPCB platform and market DLT and (2a) forward payment instructions to T2 for settlement or (2b) provide a proxy of CeBM settlement relying on exploratory liquidity as part of the escrow process.
- **(green) Market DLTs for the settlement and delivery of tokenised or native digital assets (securities tokens)** would be operated by market DLT platform operators eligible to do so.

The next sub-sections detail at high level the settlement process envisioned and how these environments interact during the settlement of a representative DVP use case during Trials (settlement in CeBM in TARGET Services production environments) and Experiments (mock settlement in test environments).

The setup used for other use cases, mainly PVP and automated single interbank payments in CeBM (e.g. in relation to the use by commercial banks of deposit tokens with a need for CeBM interbank settlement), may be specific to each use case.

For Trials, the settlement process will take place during a reduced intraday window only and no CeBM funds shall remain on the T2-RTGS accounts used by NCBs overnight,¹⁷ neither in the case of the interim BBK account (for the Trigger) nor in the case of any NCB escrow account (for the TIPS Hash Link and Full-DLT Interoperability solutions).

Trigger Solution

For the Trigger Solution, a payment instruction related to a DvP transaction would be initiated during exploratory work by market participants and processed on the Trigger Chain (outside TARGET Services). Once this instruction is validated, the Deutsche Bundesbank introduces a regular payment instruction (direct debit) in TARGET Services (T2-RTGS) on behalf of the two participants through ESMIG.

The settlement process in this case involves the following steps (refer to figure A1 for numbers included on steps):

- a DVP with the Trigger Solution is initiated by a market participant on the market DLT (1);
- Once the asset on the market DLT is locked via a smart contract, the details of the corresponding payment transaction are forwarded to the Trigger Chain according to an Interoperability Mechanism. A smart contract specified and provided by the SPCB (Deutsche Bundesbank) enables the creation of a payment Instruction in the Trigger Chain (2);
- The SPCB's node (Deutsche Bundesbank - BBK node) on the Trigger Chain performs all the needed checks (e.g. validation, signature, etc.). Then, the Deutsche Bundesbank automatically converts the payment instruction in the Trigger Chain into ISO20022 messages and submits them in a two-step process to the T2-RTGS component of TARGET, via ESMIG (3), to debit and credit the relevant T2-RTGS DCAs. This is done automatically and requires A2A connectivity between the Deutsche Bundesbank environment and ESMIG.
- The payment process for the CeBM cash leg with the Trigger Solution takes place in the T2-RTGS in the form of two payments (4):

¹⁷ With no risk for the daily end-of-day processes in T2-RTGS, since exploratory work-related incidents would not (specifically) be treated as a TARGET Services incident with no delay to the cut-off possible (unless they are part of a more general incident affecting TARGET Services).

- A (direct) debit of the payer bank's T2-RTGS DCA and a credit of the interim BBK RTGS DCA via pacs.010 (4.1) and then,
- The debit of the interim BBK RTGS DCA and the credit of the payee bank's RTGS DCA via pacs.009 (4.2). To provide a blocking functionality for Interoperability Mechanisms like Hash Time Lock Contracts, the credit transfer does not necessarily immediately follow the successful direct debit but could be delayed until additional input has been provided in the Trigger Chain. There are rules and safeguards in place to limit this "blocking" functionality to intraday only.
- Once the response to each of the payment messages is received from T2/RTGS via ESMIG, the information on the successful or failed settlement in TARGET is propagated updating the Trigger Chain and the Interoperability Mechanism is responsible for finalising the delivery of the securities leg on the market DLT as per the smart contract which results in the release of the digital asset to the market participant on the market DLT (5).

TIPS Hash Link and Full-DLT Interoperability (with escrow mechanism)

For the TIPS Hash Link and Full-DLT Interoperability solutions, an escrow mechanism would be implemented where market participants would prefund accounts held and managed by their local Eurosystem National Central Bank (NCB) in TARGET Services (T2) in order to receive the same amount via the SPCB for use in the new environments.

The settlement process in this case involves the following steps (refer to figure A1 for letters included in the steps below):

- At the start of Trials, market participants fund their accounts in the TIPS Hash Link or their wallets in the full-DLT Interoperability (in yellow) in TARGET Services from their RTGS DCA to each participant's local NCB RTGS escrow accounts, thereby transferring ownership of these funds to their local NCB (A).
- Once confirmation is received that the funds have been credited to each of the participants' NCB RTGS accounts, the SPCBs (either the Banca d'Italia as provider of the TIPS Hash Link or the Banque de France and NCBs active on DL3S¹⁸ as part of the Full-DLT Interoperability) instruct the minting of the same amount to the market participant's account or wallet in the respective new environment (in yellow). Then, a DVP is initiated on the market DLT (B). Once the asset on the market DLT is locked via a smart contract, a payment instruction is submitted by the participant

¹⁸ DL3S is the name of the DLT platform provided by Banque de France as part of the Full-DLT Interoperability solution

either in the TIPS Hash Link or the DL3S Full-DLT via the solutions' own Interoperability Mechanisms (C).

- The SPCBs then perform all the needed checks (e.g. validation, signature, etc.) and gather all the needed information from the parties to the requested transaction before debiting and crediting the participants' accounts/wallets in their respective environments (D).
- Upon confirmation of the successful completion of this step, the TIPS Hash Link's or DL3S DLT's Interoperability Mechanism is responsible for finalising the notification that the cash leg was duly executed in the TIPS Hash Link or DL3S DLT which results in the release of the digital asset to the relevant correspondent on the market DLT (E).
- Steps B to E would be repeated for subsequent DVPs during the intraday settlement process.
- At the end of the Trial settlement period (equivalent of End of Day), or on an exceptional basis at the participant's request upon completion of the technical DVP process, SPCBs start an alignment process, then defunding of NCBs' escrow accounts takes place. This involves the burn of exploratory liquidity holdings of each participant and the transfer of an equivalent amount in T2 from NCB's escrow accounts to each participant' RTGS DCA (F).

In the case of Experiments with both solutions, only the steps B to E, without the escrow process, would be implemented.

Annex B – learning objectives of exploratory work

The Eurosystem seeks to improve its current knowledge and understanding of the solutions of the Solution Provider Central Banks (SPCBs) and to gain consistent and coordinated market feedback on the exploratory work conducted with them. In particular, Trials and Experiments by market participants will support the Eurosystem in its efforts to:

- Compare the three Interoperability-type solutions from a business, operational and technical perspective, and understanding their respective merits as potential solutions for providing wholesale settlement in central bank money with new technologies. By relying on the experience and input provided by market participants using the solutions during Trials and Experiments, the Eurosystem seeks to perform a comparative assessment of the three solutions;
- Understand concretely what added value new technologies such as DLT could bring to wholesale settlement and capital markets: for example, measure the potential gains (if any) expected in terms of efficiency, competition, access for investors compared to existing infrastructures and inversely gain insights into potential implications to look out for (e.g. on fragmentation, on lack of standardisation). Such considerations will be supported by the business cases explored by market participants in Trials and Experiments.

The Eurosystem has identified several themes on which it seeks to improve its current understanding which will be investigated directly via the Trials and Experiments that will be conducted. Other themes will progress mainly via in-depth desktop research and surveys with market participants and market DLT operators.

Different approaches will be combined:

- market participants will conduct their own Trials and Experiments and will be asked to share the results of their exploratory work with the Eurosystem.
- the Eurosystem will conduct its own Experiments as a complement to address specific questions (for example stress testing or performance testing). In some cases, specific market participants and/or market DLT platforms deemed relevant for the analysis may be invited to participate and contribute to these Experiments.
- In parallel to Trials and Experiments, the Eurosystem will continue its desktop research and policy analysis.

Themes investigated directly via Trials and Experiments:

- **Settlement efficiency and performance:** the capability of the solutions to perform transactions in line with the performance expectations of the Eurosystem and market feedback will be assessed. Some of the topics included in this theme are: latency, throughput, scalability, instant and atomic settlement.
- **Reliability and safety:** Trials and Experiments will be conducted to gain concrete insights into reliability, potential bottlenecks, resiliency, security requirements and risk associated to the usage of interoperability-type solutions. Specific Experiments will be executed for testing how the solutions cope in abnormal scenarios.
- **Information management, privacy, and confidentiality:** Trials and Experiments can provide an assessment of the solutions' features and capabilities with regards to privacy, transparency, ease of reconciliation. They can be complemented with feedback from market DLT operators on their own DLT's features and capabilities for information management, privacy, and confidentiality.
- **Automation features:** Trials and Experiments will explore a set of automation use cases (e.g. coupon payment) and inform on the capability of the solutions to support complex programmability and automation scenarios.
- **Integration of the solutions of the Solution Provider Central Banks with new environments (market DLTs):** this theme will assess whether the solutions will be capable of providing smooth interconnectivity with market DLTs (both technically and in terms of operative frictions) and to reach technological neutrality with different DLT protocols and technologies.
- **Energy consumption** of the different solutions.

Themes based on in-depth desktop research:

- **Liquidity management and settlement finality:** the theme would cover the capability of the solutions to implement Liquidity Saving Mechanism and the technical and business implications of potential 24/7 opening hours.
- **First qualitative analysis of the costs and time to market of the different solutions:** based on what is observed during the exploratory phase, provide indicative high-level estimates as to the potential impact on costs and complexities of connecting interoperability-type solutions to multiple different DLT platforms. Difference in cost and time for market players to connect to the solutions of the Solution Provider Central Banks will also be considered.

- **Integration of the solutions of the Solution Provider Central Banks with existing environments (TARGET Services):** research will be conducted to understand how the different solutions could potentially be integrated with TARGET Services and their potential product design in the steady state. Research can be complemented with the feedback from market DLT operators on their experience of interconnecting DLTs and traditional systems.

The listed learning objectives should not be considered as a conclusive list, as further development in the preparation of the exploratory work, market feedback and preliminary findings may contribute to refine the learning objectives. In particular, use case-specific questions may be included later.