



EUROPEAN CENTRAL BANK
EUROSYSTEM

TIPS Hash-Link Service Description

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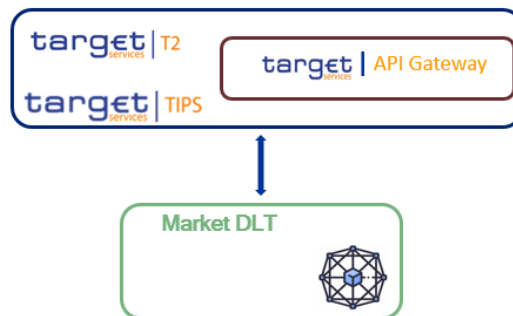
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1. Introduction to the TIPS Hash-Link

TIPS Hash-Link (TIPS H-L) solution offers an interoperability model between a generic Market DLT platform and a payment system, based on a DLT-agnostic Application Programming Interface (API) approach. As the name suggests, this solution has been successfully experimented by the Banca d'Italia with a platform based on the TARGET Instant Payment System (TIPS)¹, making an instantaneous DVP transaction possible on a 24/7 basis², but, more generally, through this protocol it would be possible to integrate a Market DLT platform with any real-time payment systems (e.g. the TARGET Services).

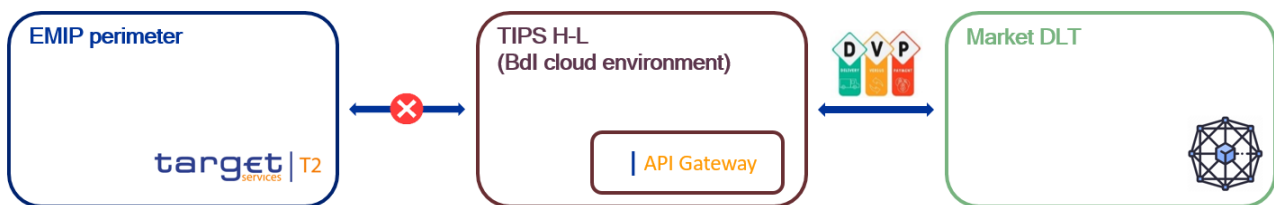
Figure 1: Interoperability model



TIPS H-L is also easy to integrate with multiple DLTs and does not require new development for supporting new DLTs; i.e. there is no need to have a wallet on DLTs (the API Gateway does not sign transactions). TIPS H-L solution provides services through APIs with business information carried-out by ISO20022 payload. Through the API gateway component, the Eurosystem acts as a “trusted third party” that securely generates the hashes and stores the corresponding secrets (pre-images), releasing them only when necessary and when disclosure conditions are met.

TIPS H-L is capable to process incoming requests continuously during the day, on a 24/7/365 basis without any scheduled service downtime. The TIPS H-L solution is offered by a centralised platform based on (but distinct from) the existing TARGET Instant Payment System (TIPS); it will be initially segregated from the TIPS production platform and it will be hosted and operated by Banca d'Italia, outside the Eurosystem’s Market Infrastructure Platform (EMIP).

Figure 2: Current connection situation



At the current stage, the lack of a direct connection to the TARGET Services platform entails that a number of Eurosystem’s common components are not available for trials/experiments.

¹ Dedicated instance of TIPS deployed in the Private Cloud infrastructure of Banca d'Italia

² Please refer to the Banca d'Italia publication “Integrating DLTs with market infrastructures: analysis and proof-of-concept for secure DvP between TIPS and DLT platforms”: <https://www.bancaditalia.it/pubblicazioni/mercati-infrastrutture-e-sistemi-di-pagamento/approfondimenti/2022-026/index.html>

During exploratory work, the TIPS H-L solution will be segregated from the TIPS production platform and will be hosted in a cloud environment owned and operated by Banca d'Italia, outside the Eurosystem's Market Infrastructure Platform (EMIP).

1.1 Technical Requirements

There are no specific requirements for DLT, except for the capability to conditionally lock an asset transfer to either a signature or to the provisioning of a secret (i.e. the pre-image of a hashed value, using the widely diffused SHA-256 standard).

2. TIPS Hash-Link operational framework

This section describes the operational framework adopted by Banca d'Italia as the provider to support the Eurosystem exploratory work taking place during 2024, which encompasses both experiments and trials using TIPS H-L.

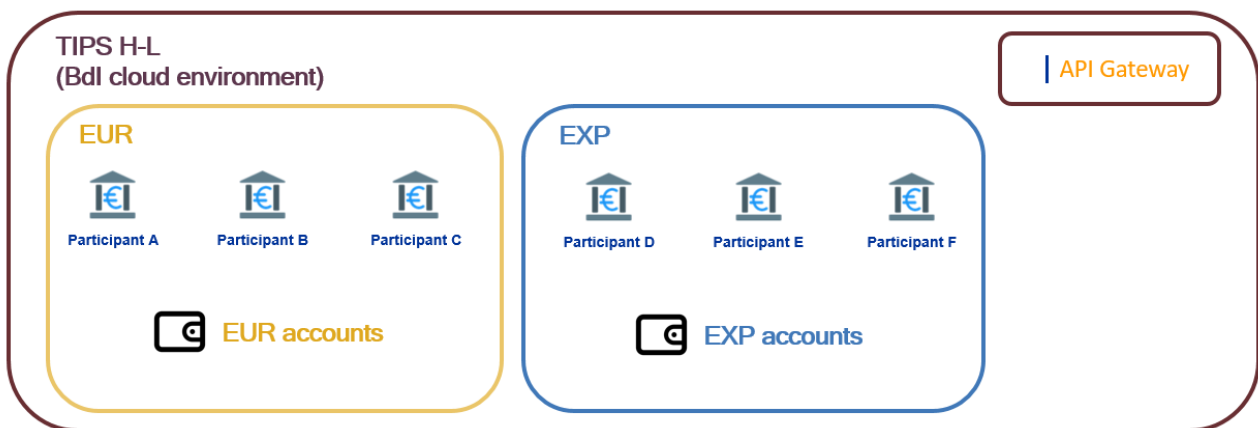
The TIPS H-L solution is offered by the Banca d'Italia to Eligible Market DLT Operators and eligible market participants according to the eligibility rules laid down by the Eurosystem for the exploratory work³.

2.1 Trials vs experiments

The TIPS H-L solution supports **segregation between trials and experiments** using a single infrastructure/API Gateway and **two logical environments** implemented via different currencies:

- “EUR”: to be used to send transactions to TIPS H-L in case of trials;
- “EXP”: to be used to send transactions to TIPS H-L in case of experiments.

Figure 3: TIPS H-L Environments



In the API invocation process, the currency might be directly set in the body of the xml message, as in the following examples:

- /v0/init (DvP Initiation Service):
 Content: application/xml:
 Schema: pain.009.001.06
 Tag: <ColltnAmt Ccy="EUR">10000</ColltnAmt>
 <ColltnAmt Ccy="EXP">10000</ColltnAmt>
- /v0/instruct-payment (Payment Service):
 Content: application/xml:
 Schema: pacs.008.001.02
 Tag: <TtlIntrBkSttlmAmt Ccy="EUR">10000</TtlIntrBkSttlmAmt>
 <TtlIntrBkSttlmAmt Ccy="EXP">10000</TtlIntrBkSttlmAmt>
 <IntrBkSttlmAmt Ccy="EUR">10000</IntrBkSttlmAmt>
 <IntrBkSttlmAmt Ccy="EXP">10000</IntrBkSttlmAmt>

Please refer to section “7. API Catalogue services specifications” for further details.

³ Please refer to the “Survey on Eurosystem plans for trials and experiments on new technologies for wholesale central bank money settlement”: https://www.ecb.europa.eu/paym/intro/news/ecb.dedocs231013_annex.en.pdf

2.2 TIPS Hash-Link cash account naming convention

Starting from the RTGS account name used by the eligible market participant in the T2-RTGS service, Banca d'Italia creates the corresponding account in TIPS H-L with a cash account name using the following rules:

RTGS account name structure R+IT+EUR+BIC12345678+FREETEXT (e.g. RITEURBITAITRRXXDCA)

- R: RTGS account
- IT: country code
- EUR: currency
- BIC12345678: party BIC11
- FREETEXT

TIPS H-L account name structure: H+IT+EUR+BIC12345678+FREETEXT (e.g. HITEURBITAITRRXXPRJ1)

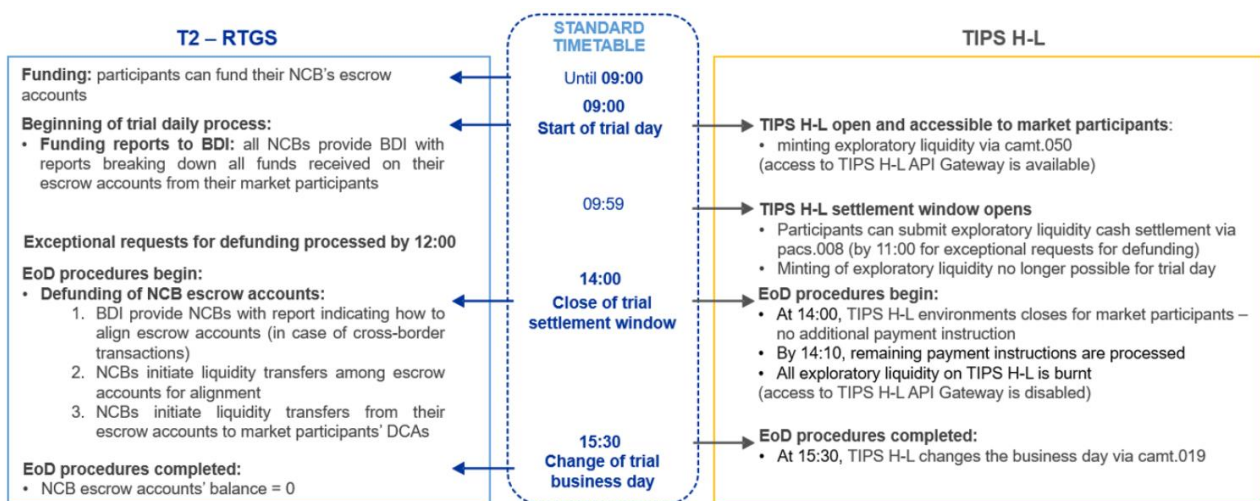
- H: TIPS Hash-Link account
- IT: country code
- EUR: currency
- BIC12345678: party BIC11
- FREETEXT: will be PRJx (e.g. PRJ1 to group all participants joining project1)

There is a strict 1-1 mapping between the RTGS account and the TIPS H-L cash account:
 RITEURBITAITRRXXDCA ↔ HITEURBITAITRRXXPRJ1

2.3 Opening hours for the exploratory work

The exploratory work will take place during business days. Settlement under trials will occur on an intraday-basis during the 10:00 to 14:00 CET window, while experiments will be conducted under windows planned in advance with ad-hoc daily processes and opening hours specific to each experiment.

Figure 4: Exploratory work timing (valid for trials)



Under the opening hours described in Figure 4:

- **Funding of escrow accounts would occur during a single daily window ending at 09:00** on the trial day. After that, eligible market participants could not request additional funding during the trial daily process. Under a specific window from 09:00 until 09:30, all NCBs in the Eurosystem would report to Banca d'Italia on the funding made by their respective eligible market participants in the RTGS. Based on these reports, the latter would mint exploratory liquidity, in the form of cash balances on TIPS HL, respectively, by 09:59.
- **Settlement with the TIPS Hash-Link would be available from 10:00 until 14:00.** During that time, eligible market participants' exploratory liquidity transfers could be processed on the TIPS Hash-Link (e.g. as part of DVP initiated on market DLTs).
 - Exceptional requests for early (gross) defunding could be processed during this window assuming:
 - That the eligible market participants issuing such a request notified both Banca d'Italia and their local NCB *at least 48 hours in advance*.
 - That the transfer of exploratory liquidity as part of the settlement process the eligible market participants wish to see reflected on a gross basis in T2-RTGS occurs *no later than 11:00*, for defunding to then take place *by 12:00*.
 - Banca d'Italia and the local NCB(s) of the eligible market participants issuing such a request reserve the right to reject this request in case of capacity constraints and may ask those participants to schedule their trial operations at another point in time or that they rely on the regular EoD procedure below.
- **From 14:00 until 15:30, the End of Day trial procedures would be conducted:** no new transactions in trials from eligible market participants would be processed then and access to the TIPS H-L would no longer be available to eligible market participants. The EoD process for TIPS H-L would involve burning all remaining⁴ exploratory liquidity issued in the morning and transferring CeBM funds held by NCBs on their escrow accounts to market participants (defunding). This process requires that all NCBs manually align their escrow accounts on the basis of the information provided by Banca d'Italia, before manually initiating liquidity transfers to each of their market participants involved with trials with either of the two solutions (*estimated end: by 15:30*).

2.4 Liquidity management in TIPS Hash-Link

The Figure 5a represents all the steps executed by the actors (Banca d'Italia as Solution Provider CB, local NCBs, participants) related to the liquidity management between T2-RTGS and TIPS H-L during the trials phase.

Prior to trials:

- the local NCB has to send the form 0.a (registration of NCB escrow account) to Banca d'Italia with the details of the RTGS CB account or the RTGS DCA that intends to use for implementing the escrow process;
- the participant has to send to the local NCB the details of the RTGS DCA account that intends to use for implementing the escrow process. The information is provided via the "Form II. Solution-specific registration form – participant registration" included in the "Call for expression of interest in experiment and trials" document.

⁴ Where some exceptional requests for defunding have been processed by 12:00, some exploratory liquidity issued in the morning will have already been burnt by SPCBs.

Figure 5a – settlement process including escrow mechanism for TIPS Hash-Link

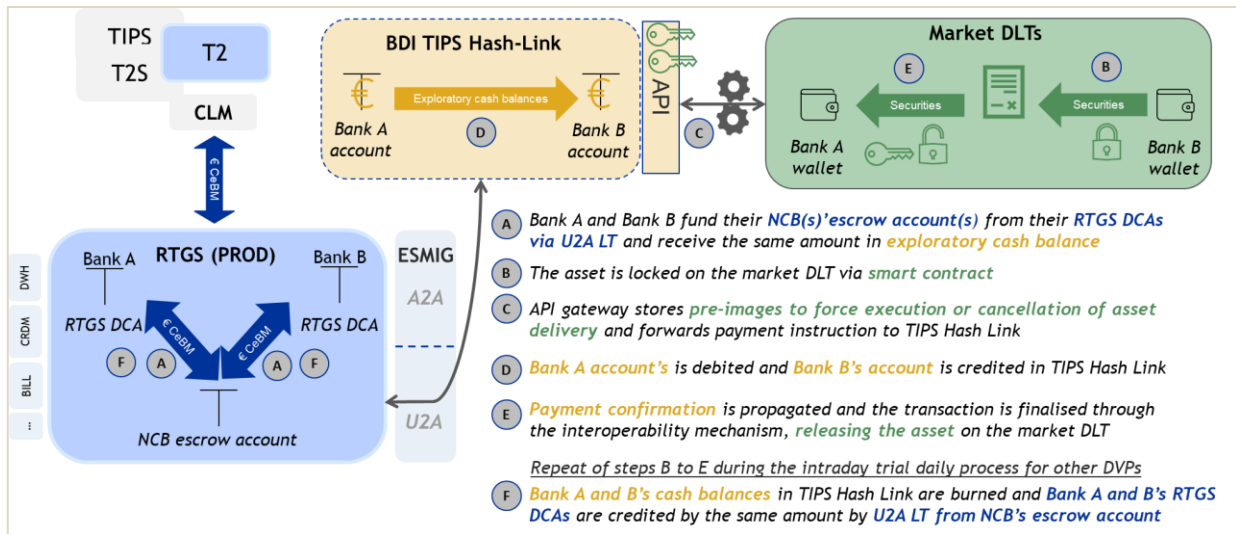
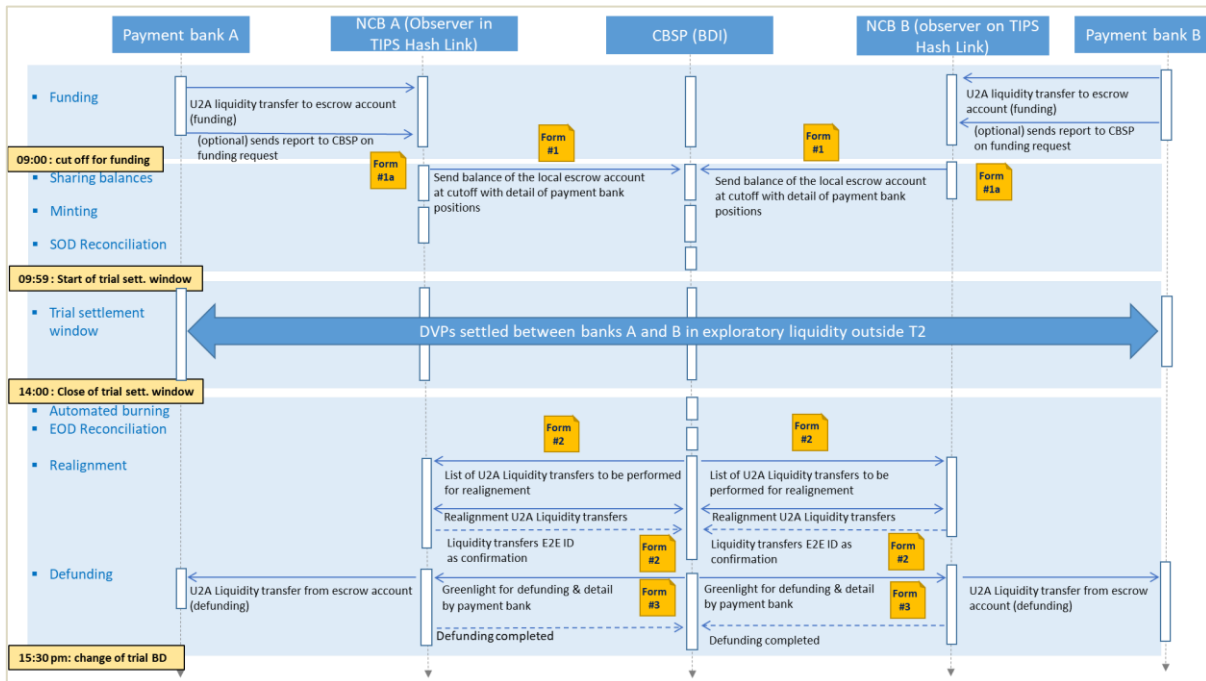


Figure 5b – communication flows related to escrow process with TIPS Hash-Link



During trials, the settlement process with the TIPS H-L solution involves the following steps (letters on figure 5a) and the following communications between market participants, NCBs and SPCBs (figure 5b):

- A. Funding of escrow accounts via U2A Liquidity Transfer:** eligible market participants will interact with their *local NCB* and each participant will fund their NCB's RTGS escrow account. Funds held in escrow on NCB RTGS escrow accounts belong to the NCBs, bear no interest, and will not be counted for compliance with minimum reserves requirements. Optionally, eligible market participants can also send a report to their local NCBs to inform them of their funding request (form 1a). Funding requests are then validated. This involves checking that (i) it was addressed in the proper format – e.g. via liquidity transfer, (ii) received on time before 09:59 (per the entry timestamp, not the settlement timestamp – bearing in mind that LTs cannot partially settle) and (iii) its' E2E ID matches the agreed prefix. NCBs will reject all funding requests from participants above the value restriction decided by the Eurosystem. If a funding request is rejected, NCBs will transfer the funds back to the market participant via U2A liquidity transfer. Then, the local NCBs report to Banca d'Italia their overall balance from their escrow account and the breakdown of funds held from their different payment banks

participating to trials (form 1). Based on the information received from forms 1, Banca d'Italia mints the equivalent amount funded by payment banks and credits their accounts in TIPS Hash-Link by that equivalent amount in exploratory cash balances. Reconciliations and checks are performed by Banca d'Italia to ensure that the total amount held in escrow in T2 matches the total amount of exploratory cash balances minted in TIPS Hash-Link.

- B. A DVP with the TIPS Hash-Link solution is initiated by a market participant on the market DLT with the asset being locked.**
- C. Once the asset on the Market DLT is locked via a smart contract, the API Gateway stores two pre-images** to respectively force the execution of securities on the market DLT or force the cancellation of the securities delivery and return them to the payee.
- D. Settlement in exploratory cash balances for the cash leg of the technical DVP occurs in TIPS Hash-Link**, with the payer's account in TIPS Hash-Link being debited and the payee's account in TIPS Hash-Link being credited.
- E. Following payment confirmation, the payee unlocks the asset** and finalises the delivery to the payer (cooperative execution case). In the event of an uncooperative case, (i) the buyer can request the forced execution of the technical DVP (e.g. after payment confirmation and a timeout for receiving the securities expires) through requesting the forced execution pre-image in the API Gateway, and use the pre-image to unlock the asset on the market DLT platform. Alternatively (ii), the seller can request the forced cancellation as per the pre-image in the API Gateway (e.g. after locking securities and the timeout for receiving the payment in exploratory cash balances expires) and, use the pre-image to unlock the asset on the market DLT platform.

Steps B to E can be repeated during the trial intraday process for the settlement of other technical DVPs.

- F. At the end of the intraday settlement window, the EoD is initiated including burning, alignment and defunding.** First, all exploratory cash balances on TIPS Hash-Link are burnt by Banca d'Italia. Then, alignment occurs to transfer CeBM between the different NCB escrow accounts (unless all transactions during the trial day are between eligible market participants of the same jurisdictions). This is needed in case of exploratory cash balance transactions on TIPS Hash-Link between eligible market participants of different jurisdictions (given that each participant funds their local NCB escrow account). To perform the alignment, Banca d'Italia sends a report to all NCBs (form 2) with a breakdown of the U2A liquidity transfers between NCB RTGS accounts to be performed in the alignment. The updated balances on the NCB RTGS accounts correspond to the total amount of CeBM that each NCB will defund for their market participants. Then, Banca d'Italia provides NCBs with the breakdown of funds to be defunded for each of their market participants (form 3) and each escrow account is defunded by the relevant NCB by U2A liquidity transfer.

- F.bis In exceptional cases and on request from the participant notified to the local NCB and to Banca d'Italia 48h in advance, defunding can occur on a gross basis for a specific DVP.** Then, Banca d'Italia burns only that participant's exploratory liquidity and provides the form 3 with the details of funds to be defunded to the market participant.

Step F / Fbis materialise final CeBM settlement during trials with the TIPS Hash-Link solution.

Forms 0.a, 1a, 1, 2 and 3 are provided in the Annex.

2.5 Operations in abnormal situations

This section lists possible abnormal situations that could happen on TIPS H-L side during the business day and shows how they could be handled in order to solve the issue.

2.5.1 Insolvency of a trial's participant

In case of an insolvency proceedings, if the insolvent participant is involved in a trial with the TIPS H-L solution, Banca d'Italia in its role of solution provider CB, suspends the activity of the participant in TIPS H-L with immediate effect ⁵, by blocking the account for credit and debit transactions.

This is in line with the T2 MOP procedure for the suspension and extraordinary termination of participants.

2.5.2 Contingency procedures during the business day

[To be completed in next revision of the document]

This section lists potential operational issues (non-exhaustive list) and provides the applicable operational procedures to be applied in case of API Gateway connectivity issues (A2A channel disturbances), Dashboard connectivity issues (U2A disturbances), issues with minting/burning of exploratory liquidity or potential inconsistencies in reports.

2.6 Communication and support

Where an eligible market participant or eligible market DLT platform operator encounters any issue while using TIPS H-L during trials or experiments, it will:

1. Contact its local NCB describing the issue;
2. The local NCB will either (i) identify that the issue is not specific to exploratory work and independently affects TARGET Services (e.g. unavailability of RTGS GUI), or (ii) identify that the issue is specific to the TIPS H-L solution and notify Banca d'Italia as Service Provider which shall endeavour to fix it in a timely manner;
3. Where Banca d'Italia cannot address the issue in time (e.g. by the next trial or experiment testing day), it will communicate to market participants that it cannot provide its solution for that trial or experiment testing day;
4. Banca d'Italia may extraordinarily terminate the experiments and trials without advance notice in the event of an emergency, which cannot be resolved with reasonable efforts, if continuing could involve:
 - i. unacceptable risks to TARGET Services and/or any of the TARGET component systems and/or the new solutions/Solution Provider Central Banks, or
 - ii. serious reputational risk for the Eurosystem, the Solution Provider Central Bank or TARGET services.

In the event of an extraordinary termination of the experiments and trials, eligible market participants and eligible market DLT platform operators may only be informed after such termination has occurred.

⁵ The conditions under which a Central Bank shall or may suspend or terminate a participant are laid down in the relevant legal documentation (Annex II – Part I Art. 7, Annex II – Part II Art. 4(1)). The term “immediate” has to be intended as the shortest reasonable time possible after central bank is aware of the insolvency event, considering also its role of local central bank in the TARGET Service’s context.

3. TIPS Hash-Link APIs features

TIPS H-L APIs are based on ReST-like Services without involving the Network Service Providers (NSPs). Nevertheless, they are suitable for future usages, even in case of connectivity through NSPs.

These APIs are compliant with the standard defined by “The Berlin Group” and compliant with the standardization approach defined by Financial Stability Board (FSB) Stage 3 Roadmap for Enhancing Cross-border Payments – Building Block 15 Harmonising API protocols for data exchange.

Moreover, they are in line with the APIs currently in place in the financial world.

4. Access and onboarding to TIPS Hash-Link

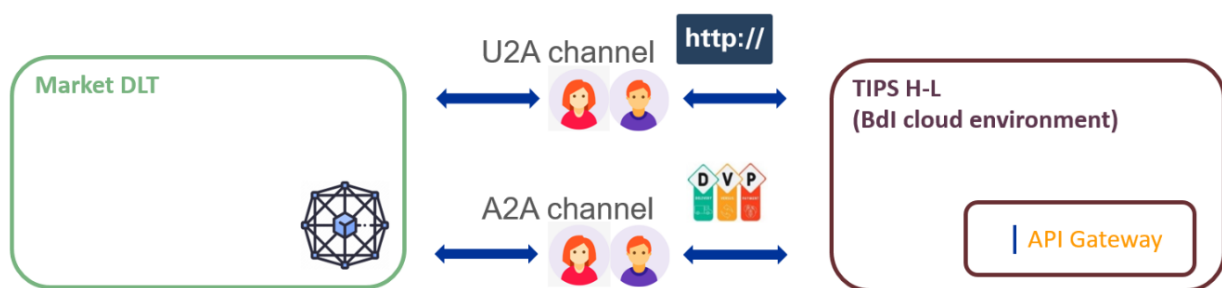
This section describes the basic connectivity features of TIPS H-L.

4.1 Connectivity

The Market DLT operator and the eligible market participants interact with TIPS H-L in two ways:

- via **A2A channel** to use the services offered by the API Gateway (e.g. submit transactions);
- via **U2A channel** for monitoring purposes and information tools (see section 4.4).

Figure 6: Channels



4.2 TIPS Hash-Link security and authentication

The actors who want to interact with TIPS H-L (both via A2A and U2A channel) have to communicate to Banca d'Italia a set of public IP addresses to enable the communication.

Moreover, the access to the dashboard via U2A channel is secured using Basic Authentication over HTTPS protocol. Before starting the exploratory work, Banca d'Italia will provide each group of participants with login credentials (group id and password). Credentials are used to identify the group and grant its specific rights, in order to guarantee the access to information related only to its trials/experiments.

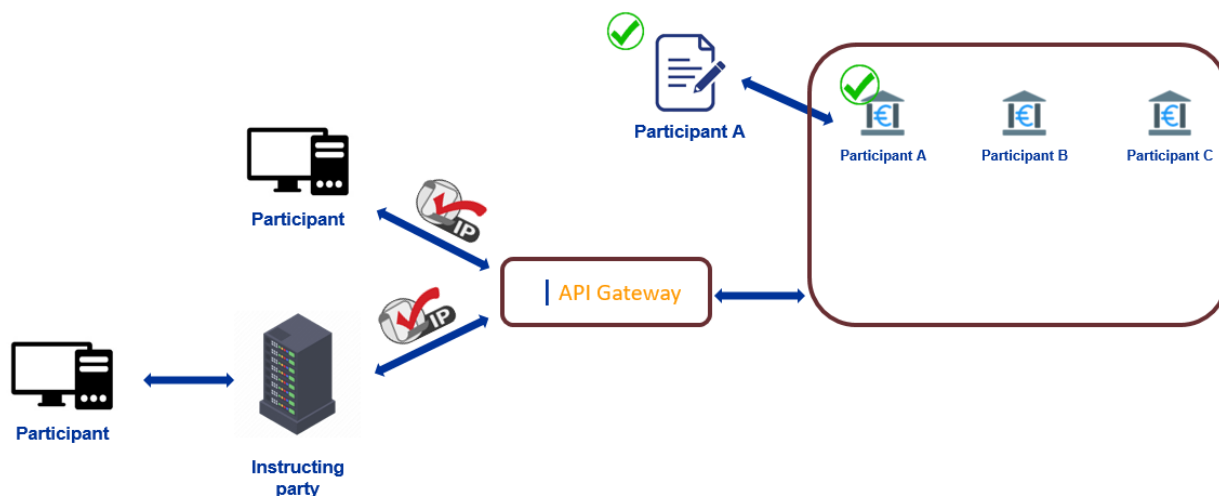
Also the A2A channel between the participant/instructing party and the API Gateway will be secured. The solution is under investigation; further details will be provided.

4.3 TIPS Hash-Link technical on-boarding

The TIPS H-L technical on-boarding process foresees that eligible market participants have to fill the "Form II. Solution-specific registration form – participant registration" included in the "Call for expression of interest in experiment and trials" document in order to be allowed to operate with TIPS H-L during the trial phase.

The responsible NCB will forward the form to Banca d'Italia in order to proceed with the proper configuration (creation of the party, opening of the TIPS H-L account, public IPs configuration for the API Gateway communication).

Figure 7: on-boarding process



In case the eligible market participant delegates the technical connectivity to TIPS H-L to an “instructing party” (e.g. to the market DLT operator), the instructing party has to fill the “Form II. Solution-specific registration form – instructing parties registration”. Banca d’Italia will proceed with the proper configuration in order to enable the instructing party to communicate with the API Gateway to manage the participant’s TIPS H-L cash account(s). The same process applies in case an eligible market participant decides to modify any technical details of its instructing party, or to cease such a delegation⁶.

4.4 TIPS Hash-Link and information and monitoring tools

The TIPS Hash-Link solution is also accessible in user-to-application (U2A) mode for monitoring purposes and information tools.

4.4.1 Swagger

Following the url below, there is the description of both the endpoints provided by the TIPS H-L API Gateway to be invoked by the caller (e.g. buyer and seller for DvP use cases) and the endpoints that have to be provided by the caller, that will be called by the TIPS H-L API Gateway in order to send responses. At the same link there are also examples with successful and failure scenarios.

- <https://tipsgateway-ext-cert.bancaditaliatest.it/api/swagger/>

4.4.2 Dashboard details

The following url, instead, provides cash account balances during the settlement day and the details of all transactions settled in TIPS H-L solution.

- <https://tipsgateway-ext-cert.bancaditaliatest.it/api/dashboard/<PRJ-ID>>


⁶ As laid down in the relevant legal documentation (Annex II – Part II Art.5, Annex III – Part II Art. 4), Banca d’Italia shall operate the change within the shortest reasonable time possible. Banca d’Italia shall not be liable to any extent for any loss or damage suffered by the delegating eligible market participant, as a consequence of the actions of the delegated instructing party.

TIPS Hash-Link - Service description

The dashboard is dedicated to a single trial/experiments <PRJ-ID> and is accessible with a *shared user/password* associated to the project. It provides an interface to:

- select the report to visualize (cash account balances or statement of accounts)
- visualize the selected report data in a tabular format
- change the date the report refers to (for each day last version of data is saved)
- filter the data rows based on a search text
- order the data by a single column
- copy or export the data in csv format

The following screenshots show an example of the dashboard interface relative to the two reports mentioned above.

TIPS HL REPORTING - PRJ1 


Choose a version: 2023-08-29 15:30 ▾

CASH ACCOUNT BALANCES STATEMENT OF ACCOUNTS

Copy CSV Search:

PARTY BIC	PARTY ACCOUNT	OPENING BALANCE	BALANCE	CURRENCY	BUSINESS DATE
BENTAE1XXX	ITEXPBENTAE1XXXDCA	0	10000	EXP	2023-07-03
BENTAR1XXX	ITEURBENTAR1XXXDCA	4000	8000	EUR	2023-08-15
BITAITRRXXX	EUR Transit Account	-5000	-9000	EUR	2023-08-15
BITAITRRXXX	EXP Transit Account	-10000	-10000	EXP	2023-07-13
ORITAR1XXX	ITEURORITAR1XXXDCA	5000	1000	EUR	2023-07-13

Showing 1 to 5 of 5 entries Previous Next

TIPS HL REPORTING - PRJ1 

Choose a version: 2023-08-29 15:30 ▾

CASH ACCOUNT BALANCES STATEMENT OF ACCOUNTS

Copy CSV Search:

MESSAGE TYPE	DEBTOR BIC	DEBTOR ACCOUNT	CREDITOR BIC	CREDITOR ACCOUNT	CURRENCY	AMOUNT	VALUE DATE	STATUS	DEBIT ACCOUNT BALANCE	CREDIT ACCOUNT BALANCE	SETTLEMENT TIME
camt.050	BITAITRRXXX	N/A	BENTAR1XXX	ITEURBENTAR1XXXDCA	EUR	4000	2023-08-15	SETTLED		-9000	8000 2023-08-15 15:35:10.241
paces.008	ORITAR1XXX	ITEURORITAR1XXXDCA	BENTAR1XXX	ITEURBENTAR1XXXDCA	EUR	500	2023-08-15	SETTLED		500	8500 2023-08-15 15:54:52.334

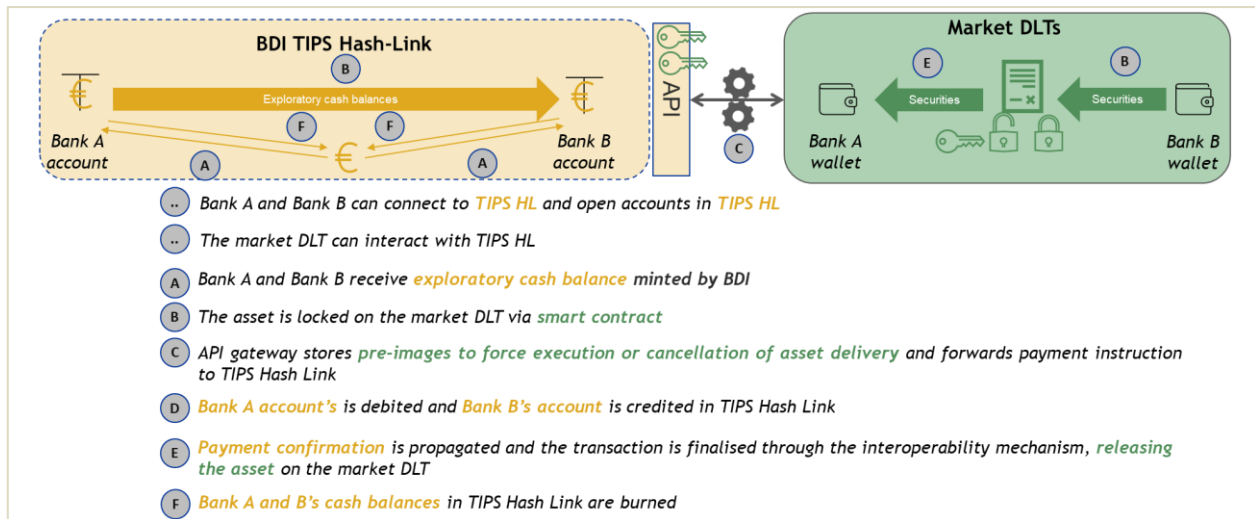
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5. Planned activities for testing phase of exploratory work

As described in the “Call for Expression of Interest” document, the on-boarding process with market participants and market DLT operators will take place in two testing phases.

Phase 1 – connectivity, operational and functional tests

Figure 8 – high-level setup for testing phase 1 with TIPS Hash-Link



Testing phase 1 would ensure that the necessary connections can be established between market participants' software applications or market DLTs (acting as Instructing Parties) and the API Gateway to conduct trials or experiments. This includes market participants as well as Banca d'Italia implementing all required steps to use the TIPS H-L solution, and market participants being onboarded on the TIPS H-L platform. The necessary configurations will have to be completed prior to the beginning of these tests.

Moreover, the tests will cover the “close of trial settlement window”, simulating the behaviour of the TIPS Hash-Link when the cut-off would be reached at 14:00.

Finally, the tests could cover specific functionalities and processes that participants to trials and experiments would use during the execution phase.

Below are reported the list of activities to be completed for the phase 1:

- the participant has to submit the TIPS H-L registration form (cfr. Section 4.3);
- Banca d'Italia configures the participant' static data and enable the communication line with the API Gateway;
- the participant tests the U2A access (cfr. Section 4.4);
- the participant tests the A2A access sending the “DvP initiation service” API (cfr. Section 8.1).

After the completion of these preliminary steps, Banca d'Italia mints the exploratory liquidity on the participant's cash account in order to test the required business case. At the end-of-day, Banca d'Italia burns the exploratory liquidity and the participant can check in the dashboard the execution of this step.

Phase 2 - dress rehearsal

Testing phase 2 would consist of rehearsing a full trial day. These tests would include, jointly and simultaneously:

- Testing all steps including in the daily trial process as described in the Section 2.4;
- (optional) Testing the contingency procedures for failure scenarios identified in the Section 2.5.

For participants only interested in conducting experiments, the content of testing phase 2 may be defined on an ad hoc basis depending on the content of the experiments.

Onboarding and testing deadlines

As described in the “Call for Expression of Interest” document, the execution phase would consist of two waves as follows: a first wave of participants, ready to start exploratory work in May 2024 and a second wave of participants, starting in July 2024, completing exploratory work in November 2024.

Wave 1:

- Participant on-boarding: **by January 31, 2024**
- Connectivity, operational and functional tests with the market DLTs platforms: **by February 16, 2024 – (phase 1)**
- Dress rehearsal: **by April 30, 2024 – (phase 2)**
- Start of exploratory work: **01 May, 2024**

Wave 2:

- Participant on-boarding: **by 30 April, 2024**
- Connectivity, operational and functional tests with the market DLTs platforms: **by May 23, 2024 – (phase 1)**
- Dress rehearsal: **by June 31, 2024 – (phase 2)**
- Start of exploratory work: **01 July, 2024**

Please note that participants joining the second wave can carry out the on-boarding activity and the connectivity, operational and functional tests according to the first wave deadlines.

6. Use Cases

In this section it is described a list of use cases related to wholesale transactions in the fields of payments and assets that might benefit from settlement of the Euro cash leg in central bank money, via the use of TIPS H-L.

6.1 Delivery-versus-Payment

Delivery-versus-Payment (DvP) is the basic settlement process for financial assets. It synchronizes a transfer of a certain amount of an asset and a funds transfer so that the delivery occurs IFF (if and only if) the corresponding payment occurs. In this sense, the execution of DvP is “atomic”. With regard to cardinality of ledgers, conceptually two categories of DvP emerge:

1. *single-ledger DvP*, where both cash and assets reside on the same ledger;
2. *cross-ledger DvP*, where cash and asset are on two separate ledgers.

TIPS H-L has been specifically designed to guarantee the correct execution of DvPs falling in category (2). It should be noted that, for category (1), efficient solutions are already in place guaranteeing atomicity (both in a centralised environment, like T2S, and in a decentralised/blockchain based environment). Therefore, atomic execution of cash payment (on TIPS H-L) and asset delivery (on the Market DLT) is provided: the asset-is locked until the funds transfer is completed, while liquidity is not locked.

From a conceptual perspective, the interoperability model proposed is called “API-based DvP with Hash-Link Contract”. It draws upon the well-known Hash-Time Locked Contracts (HTLC)⁷ approach and overcomes some limitations of the latter in terms of safety of DvP transactions, which is paramount in defining an interoperability model with central bank money settlement systems, while at the same time imposing minimum technical requirements on the asset-managing DLT.

The “API-based DvP with Hash-Link Contract” relies on an API gateway to simplify the DvP definition and settlement. It builds upon the primitives of an HTLC, but introduces a trusted oracle that solves possible disputes between Buyer and Seller.

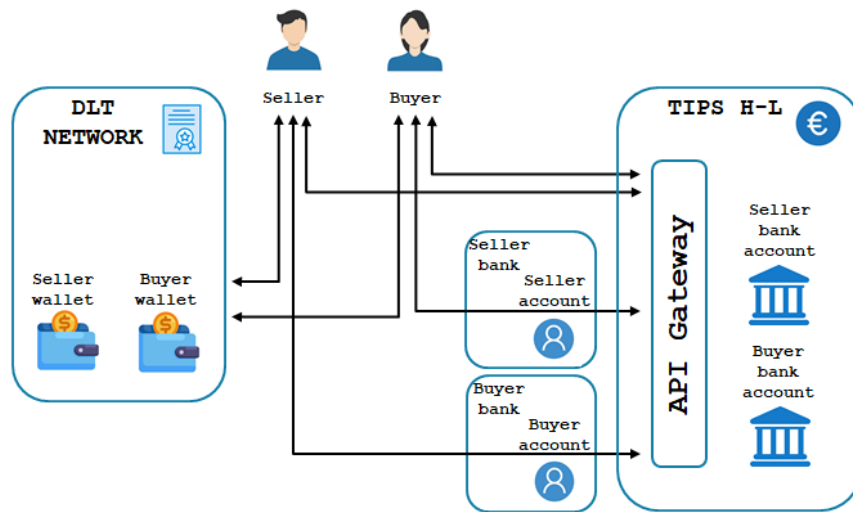
The involved actors can be summarized as follows:

- a **Payment System** (e.g. a dedicated instance of TIPS for this exploratory work phase) that guarantees the execution of payments (funds transfers) in central bank money;
- an **Asset chain**, that is the DLT/blockchain where tokenized assets are issued and transferred. It can be any DLT/blockchain that is capable of basic programmability properties;
- a trusted oracle which acts (1) as the generator and the keeper of secrets used to manage the DvP transaction lifecycle and (2) as an “Oracle of Time”, unambiguously verifying that a payment has (or has not) been executed within a pre-agreed timeframe. In our implementation, this role is played by an **API Gateway**, exposing its functionalities as ReST-like web services implementing Berlin Group standard XML messages;
- a **Buyer**, which agrees to buy a certain amount of asset for a certain amount of funds within a predefined timeframe;
- a **Seller**, which, for converse, agrees to sell the aforementioned assets for the agreed funds, within the agreed timeframe.

The Buyer and the Seller must be able to access: (1) the Asset Chain, for smart contracts initialization and interaction and for tokenized asset transfer; and (2) the API Gateway, for requesting secrets needed for smart contract initialization, for the payment execution and for dispute resolution. In the context of current exploratory work, the Buyer and the Seller, are identified by Eligible Market Participants. Therefore, they must be entities with access to T2 (either directly or indirectly) within the meaning of Article 4 of Annex 1 Part I and Article 7, Annex 1 Part I of the TARGET Guideline, as amended from time to time.

⁷ Hash-Time Locked Contracts: https://en.bitcoin.it/wiki/Hash_Time_Locked_Contracts

Figure 9: Actors involved in a DvP with TIPS H-L



The involvement of a trusted oracle allows guaranteeing the safety of DvP transactions, also in case of temporary unavailability of one of the involved actors (and, in particular, of the API Gateway itself). The API Gateway plays the role of trusted DvP oracle.

This model defines a Hash-Link Contract (HLC) on the DLT that locks assets in an escrow and only unlocks them when some specific conditions are met. From a business perspective, these conditions are the following: (i) the Buyer agrees on the return of assets to the Seller, or (ii) the Seller agrees on the transfer of assets to the Buyer, or (iii) if there is a dispute between the Buyer and the Seller then the oracle unambiguously knows who has to receive assets.

The knowledge of the two preimages, namely cancellation preimage and execution preimage, is used to show the decision of the oracle, as the latter has exclusive knowledge of two preimages. If the DvP oracle decides to solve the dispute in favour of the Seller, i.e., because the payment did not occur within an agreed timeframe, then it reveals the cancellation preimage to the Seller, which in turn uses it to get back the assets from the HLC. On the contrary, if the oracle solves the dispute in favour of the Buyer, i.e. because the corresponding payment did already occur, then it reveals the execution preimage to the Buyer, which uses it to claim the assets from the HLC.

6.2 Redemption - “push-mode”

Basic idea: asset redemption modelled as a modified DvP between security owner and security issuer.

Preconditions

- Asset maturity date \geq Today
- Asset owner = asset issuer
- Asset owner is informed (off-chain) and knows the “redemption address” prepared by the asset issuer

Additionally, the asset smart-contract does not allow any other token transfer rather than token redemption if Asset maturity date \geq Today

Post conditions

- Asset ownership transferred from owner to issuer
- Asset nominal amount (plus interests) paid from issuer to owner
- The assets on the “redemption address” will be burned by the issuer

High level flow

- Preparation
 - A smart contract is created by the owner and the asset is locked in the HLC smart contract. In DvP terms, the Owner acts as the Seller.
 - The issuer (buyer) address is set to the "redemption address".
 - When requesting secrets generation from the API Gateway, the maturity date is sent along other request's data.
 - API Gateway stores Contract ID, Maturity Date, Secrets R and R'; hash(R) and hash(R') are sent to smart contract creator.
 - HLC Smart contract is created and deployed on the blockchain by the Owner.
- Execution
 - Unlocking conditions:
 - Cooperative execution:
 - Issuer [buyer] executes payment to expected payment address.
 - Owner [seller] signs, acknowledging receipt of payment from Issuer [buyer]
 - Forced execution:
 - Issuer [buyer] receives secret R from API Gateway; R is provided if Date/Time \geq Maturity Date and Payment has been executed by Issuer [buyer]
 - Unlock of the asset to the Issuer [buyer] is forced using R
 - Forced rollback:
 - Owner [seller] receives secret R' from API Gateway; R' is provided if Payment has not been executed (*)
 - Unlock of the asset to the Owner [seller] is forced using R'

(*) The reimbursement of the asset cannot be enforced by the protocol. Nevertheless, in such a condition, the owner can have back the asset (even if the asset is expired and cannot be negotiated anymore), supposedly for further legal actions.

7. TIPS Hash-Link protocol description

Since, at the current stage, has been agreed to evaluate TIPS Hash-Link protocol based on DvP operations, the next sections will take this use case as the basis of the discussion.

This section describes the actors, their interactions and all the phases of a DvP use case following the TIPS H-L protocol in which the cash leg is settled in TIPS H-L and the asset leg is settled in a DLT platform.

The involved actors are:

- The *Seller*, an entity that wants to sell an asset that resides on a DLT Platform against a payment in CeBM. It will interact with the API Gateway (and the Payment System) through its bank.
- The *Buyer*, an entity that wants to purchase an asset that resides on a DLT Platform against a payment in CeBM. It will interact with the API Gateway (and the Payment System) through its bank.
- The *API Gateway* acts as a trusted third party. It offers services via APIs and it directly interacts with the Payment System in order to settle the cash leg via a message exchange (A2A communication).

The TIPS H-L scheme, only looking at the DLT interactions, can be seen as a two-step protocol. The first step involves the smart contract creation, its funding and the locking of the asset. This step is always performed by the Seller. The second step, instead, can be executed in a cooperative or a forced way between the parties. It is guided by the smart contract, created at the previous step, through the implemented unlocking conditions of the asset:

- transaction with Seller signature → *cooperative execution*, asset transferred to the Buyer
- transaction with Buyer signature → *cooperative cancellation*, asset transferred back to the Seller
- transaction with Buyer signature and execution pre-image → *forced execution*, asset transferred to the Buyer
- transaction with Seller signature and cancellation pre-image → *forced cancellation*, asset transferred back to the Seller

Each of these phases will be deeply described in the following sections.

7.1 Actor Interactions

In this section it is provided a description of all the types of communications in which the API Gateway is involved in the TIPS H-L protocol in various scenarios. Namely, all the interactions between Buyer/Seller and the API Gateway and all the interactions between TIPS H-L and the API Gateway.

Note that the interactions between the Buyer and the Seller and between the DLT and Buyer/Seller are out of the scope of this document and therefore not reported.

Communication between the API Gateway and the Buyer/Seller is based on a *client/server* paradigm. This type of interaction is performed through the invocation of procedures exposed within the APIs by both the API Gateway and the Buyer/Seller actors. Such an interaction model entails a client initiating the invocation of procedures exposed by a server. In our context, the Buyer/Seller, acting as client, invokes the procedures offered by the API Gateway, which operates as server. This communication is characterized by asynchronous HTTP requests: the Buyer/Seller submits requests to the API Gateway, which, on turn, processes them and delivers the responses when available; the latter step involves the API Gateway invoking callback procedures on Buyer/Seller side.

The body of each HTTP request sent in these interactions is composed by an ISO20022-compliant XML message used to store the information required by the TIPS H-L protocol.

On the contrary, communication between the API Gateway and TIPS H-L is performed via the exchange of ISO20022-compliant messages. Such messages are provided by the Buyer/Seller in the body (i.e. the information transferred) of the corresponding HTTP request sent to the API Gateway or vice-versa. In this case, the actors exchanging the messages are called *sender* and *receiver*.

7.2 Protocol Phases Description

Trade phase. Buyer and Seller reach an agreement on the amount to be exchanged against the asset transfer on the DLT and a timeout within which the Buyer will pay. This phase happens *off-chain* and does not involve an interaction with the API Gateway. For this reason, it is out of the scope of this document.

DvP initialization phase. The aim of this phase is to set up the escrow account (smart contract - HLC), transferring to it the asset and the funds necessary to operate.

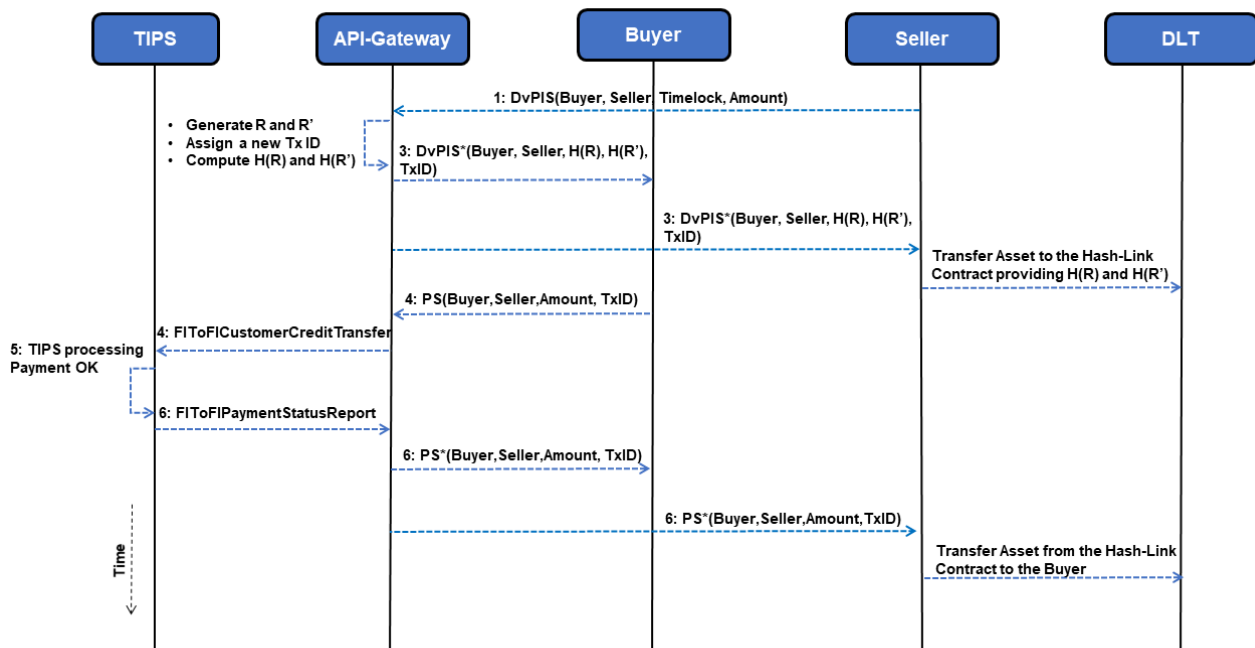
The Seller sends an initial request to the API Gateway triggering the asynchronous generation of a transaction ID (TxID) and two pre-images, execution pre-image R and cancellation pre-image R', that will be used in the next phases. The preimages will be securely stored while their hashed values, H(R) and H(R'), together with the TxID are then sent to both Seller and Buyer. With this information the Seller publishes the HLC on the DLT that locks the asset. At this point the Buyer has to verify that the HLC owns the expected funds, asset and DvP parameters (the same contained in the API Gateway response)⁸.

Payment phase. The Buyer instructs the payment (using TxID) to the API Gateway, which routes it to the Payment System. The result of the payment is sent to both Seller and Buyer.

At this point, four alternative terminating scenarios are possible.

Cooperative Execution phase. once the cash leg has been settled, the Seller, by itself, is able to settle the asset leg, publishing a signed transaction to the DLT that transfer the asset to the Buyer. The DvP executed successfully.

Figure 10: Cooperative Execution



The star symbol (*) is used for callbacks

Cooperative Cancellation phase. If something goes wrong with the payment⁹ or, for any reason, Buyer and Seller agree to cancel or abort the DvP, they are able to unlock the asset without involving the API Gateway.

⁸ This operation could be performed by the buyer asking the HLC address to the seller or using DLT tricks, e.g. in Algorand the address could be computed by the buyer compiling the HLC in the same way the seller does during the prepare phase.

⁹ In case of negative response of the settlement for the payments both a Cooperative Cancellation and a Forced Cancellation phase can be used to unlock the asset and transfer it back to the seller.

In this case the Buyer can publish a signed transaction to the DLT that transfer the asset back to the Seller. The DvP is cancelled successfully.

Figure 11: Cooperative Cancellation

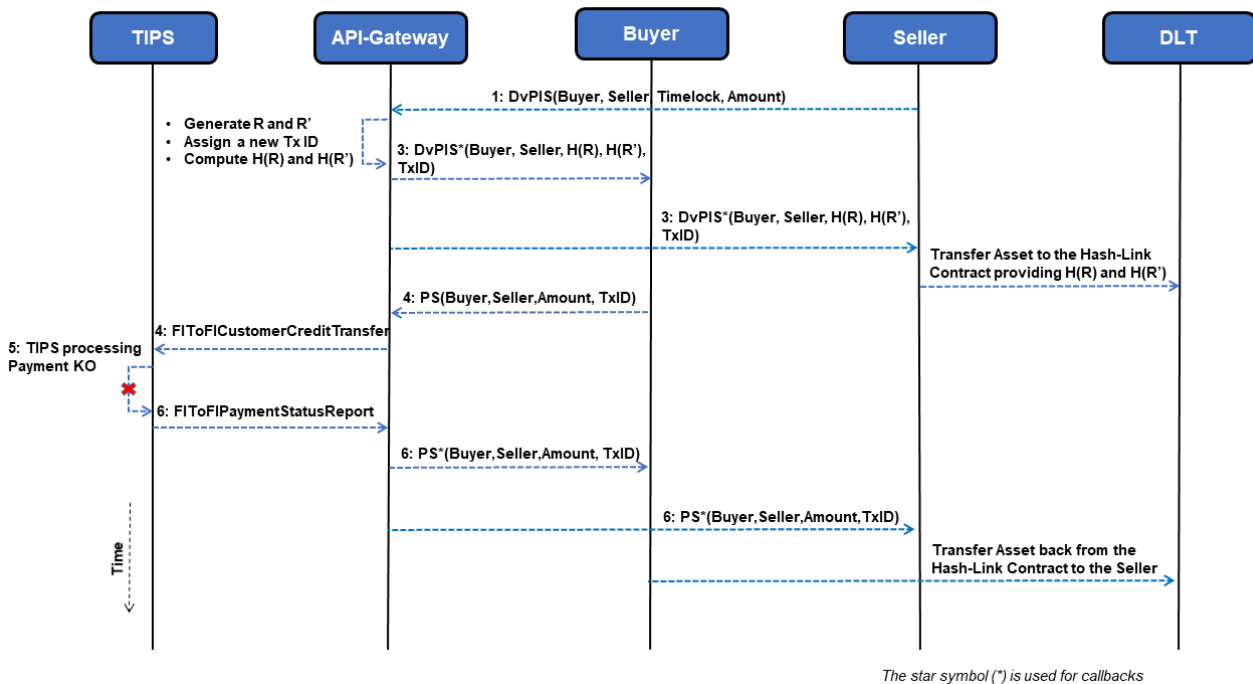


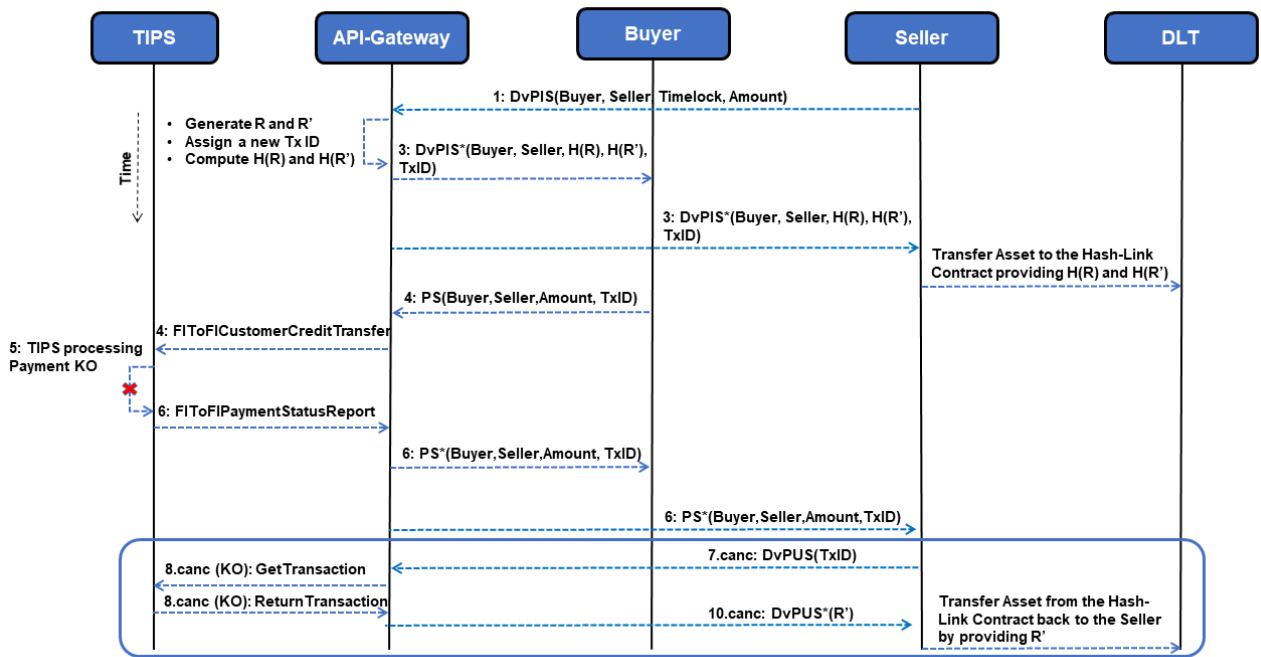
Table 1: TIPS Hash-Link protocol steps for cooperative execution/cancellation

Step	API	XML Body (ISO20022 message)	Involved actors	Description
1	DvP Initiation Service (DvPIS)	MandateInitiationRequest	Seller as client API Gateway as server	The API Gateway receives a request of starting a new Delivery vs Payment (DvP) from the Seller with a timeout value and the transaction amount.
2			API Gateway	The API Gateway initializes the DvP transaction generating two preimages (execution preimage and cancellation preimage) and assigning to the DvP a new transaction ID (TxID).
3	DvP Initiation Service (DvPIS) – Callback	MandateAcceptanceReport	API Gateway as client Buyer, Seller as server	The API Gateway responds to the Buyer and Seller (via callback) with the cryptographic hash of the preimages and the transaction id (TxID) of the DvP.
4	Payment Service (PS)	FIToFICustomerCreditTransfer	Buyer as client API Gateway as server and sender	The Buyer sends a request containing a Payment transaction to the API Gateway that, on turn, sends it to TIPS. The timeout of the DvP has not expired.

			TIPS as receiver	
5			TIPS	Internal TIPS processing of the payment.
6	Payment Service (PS) – Callback	FItoFIPaymentStatusReport	TIPS as sender API Gateway as receiver and client Buyer, Seller as server	TIPS generates a positive/negative Payment status report and sends it to the API Gateway, that, on turn, responds to the Buyer and the Seller (via callback).

Forced Cancellation phase. if the Seller does not receive a payment response from the API Gateway within the agreed time (as said before, Buyer and Seller agreed upon a time interval within which the Buyer has to pay. This value is shared with the API Gateway in the initialization phase.), then he can ask to the API Gateway to disclose the cancellation pre-image R'. The API Gateway checks on the Payment System for the status of the payment and discloses the secrets only if it has not been settled. With the pre-image, the Seller can publish a signed transaction that includes the secret R' to the DLT in order to trigger the smart contract to unlock and transfer back to him the ownership of the asset. The DvP is cancelled successfully.

Figure 12: Forced Cancellation



The star symbol (*) is used for callbacks

Table 2: TIPS Hash-Link protocol steps for forced cancellation

Step	API	XML Body (ISO20022 message)	Involved actors	Description
1	DvP Initiation Service (DvPIS)	MandateInitiationRequest	Seller as client API Gateway as server	The API Gateway receives a request of starting a new Delivery vs Payment (DvP) from the Seller with a timeout value and the transaction amount.

TIPS Hash-Link - Service description

2			API Gateway	The API Gateway initializes the DvP transaction generating two preimages (execution preimage and cancellation preimage) and assigning to the DvP a new transaction ID (TxID).
3	DvP Initiation Service (DvPIS) – Callback	MandateAcceptanceReport	API Gateway as client Buyer, Seller as server	The API Gateway responds to the Buyer and the Seller (via callback) with the cryptographic hash of the preimages and the transaction ID (TxID) of the DvP.
4	Payment Service (PS)	FItoFICustomerCreditTransfer	Buyer as client API Gateway as server and sender TIPS as receiver	The Buyer sends a request containing a Payment transaction to the API Gateway that, on turn, sends it to TIPS. The timeout of the DvP has not expired.
5			TIPS	Internal TIPS processing of the payment.
6	Payment Service (PS) – Callback	FItoFIPaymentStatusReport	TIPS as sender API Gateway as receiver and client Buyer, Seller as server	TIPS generates a positive/negative Payment status report and sends it to the API Gateway, that, on turn, responds to the Buyer and the Seller (via callback).
7.canc	DvP Unilateral Services (DvPUS)	CreditorPaymentActivationRequest	Seller as a client API Gateway as server	The API Gateway receives the request of forced cancellation (cancel) of the DvP from the Seller. The request contains the original id (TxID) of the DvP transaction.
8.canc		GetTransaction	API Gateway as sender TIPS as receiver	The API Gateway queries TIPS to verify the Payment Transaction status.
9.canc (OK)		ReturnTransaction	TIPS as sender API Gateway as receiver	TIPS sends a message to the API Gateway with a positive response (Payment Transaction settled correctly).
9.canc (KO)		ReturnTransaction	TIPS as sender API Gateway as receiver	TIPS sends a message to the API Gateway with a negative response (Payment Transaction not settled).
10.canc (OK)	DvP Unilateral Services (DvPUS) -- Callback	CreditorPaymentActivationRequestStatusReport	API Gateway as client Seller as server	The API Gateway responds to the Seller (via callback) notifying that the Payment Transaction has been settled in TIPS and the refund is not possible.

10.canc (KO)	DvP Unilateral Services (DvPUS) -- Callback	CreditorPaymentActivationRequestStatusReport	API Gateway as client Seller as server	The API Gateway responds to the Seller (via callback) with the cancellation preimage generated in Step 2.
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Forced Execution phase. If the Buyer, after the payment, does not see any transaction on the DLT that unlocks and transfers the asset to itself, then, the Buyer can ask to the API Gateway to disclose the execution pre-image R. The API Gateway checks on the Payment System for the status of the payment and discloses the secrets only if the payment has been settled with the known attributes. With the pre-image, the Buyer can publish a signed transaction that includes the secret R to the DLT in order to trigger the smart contract to unlock and transfer to him the ownership of the asset. The DvP executed successfully.

Figure 13: Forced Execution

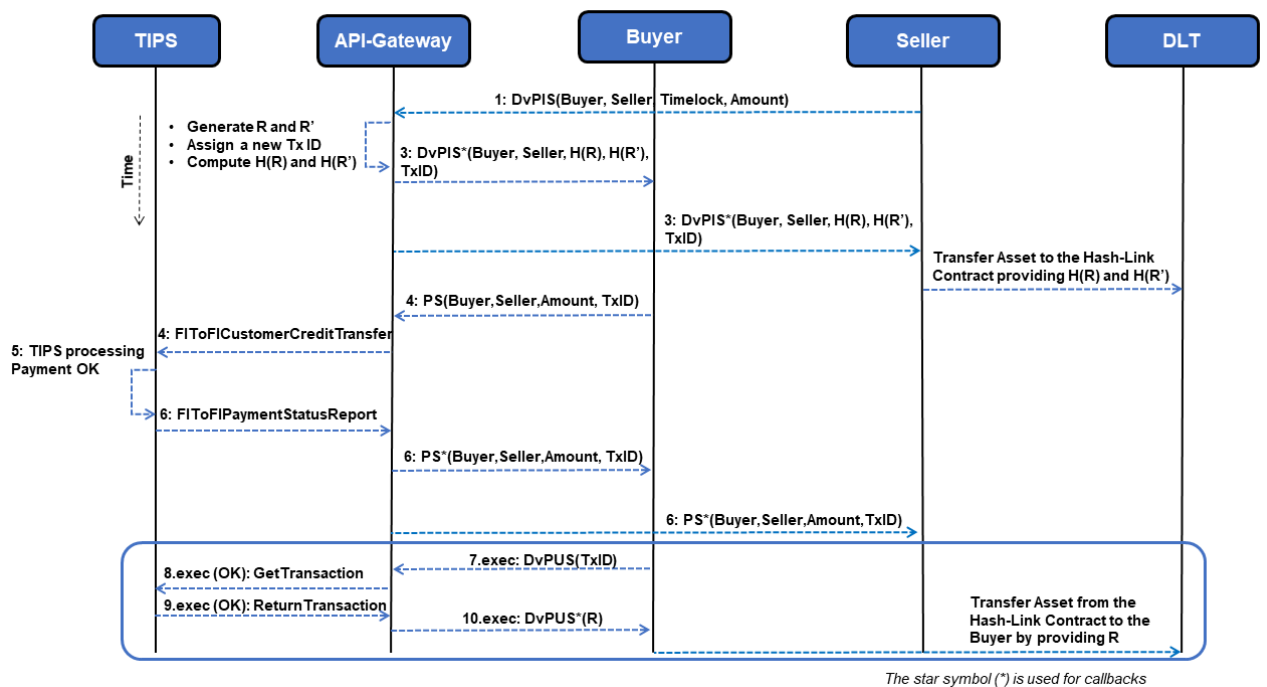


Table 3: TIPS Hash-Link protocol steps for forced execution

Step	API	XML Body (ISO20022 message)	Involved actors	Description
1	DvP Initiation Service (DvPIS)	MandateInitiationRequest	Seller as client API Gateway as server	The API Gateway receives a request of starting a new Delivery vs Payment (DvP) from the Seller with a timeout value and the transaction amount.
2			API Gateway	The API Gateway initializes the DvP transaction generating two preimages (execution preimage and cancellation preimage) and assigning to the DvP a new transaction ID (TxID).

TIPS Hash-Link - Service description

3	DvP Initiation Service (DvPIS) – Callback	MandateAcceptanceReport	API Gateway as client Buyer, Seller as server	The API Gateway responds to the Buyer and the Seller (via callback) with the cryptographic hash of the preimages and the transaction id (TxID) of the DvP.
4	Payment Service (PS)	FItoFICustomerCreditTransfer	Buyer as client API Gateway as server and sender TIPS as receiver	The Buyer sends a request containing a Payment transaction to the API Gateway that, on turn, sends it to TIPS. The timeout of the DvP has not expired.
5			TIPS	Internal TIPS processing of the payment.
6	Payment Service (PS) – Callback	FItoFIPaymentStatusReport	TIPS as sender API Gateway as receiver and client Buyer, Seller as server	TIPS generates a positive/negative Payment status report and sends it to the API Gateway, that, on turn, responds to the Buyer and the Seller (via callback).
7.exec	DvP Unilateral Services (DvPUS)	CreditorPaymentActivationRequest	Buyer as client API Gateway as server	The API Gateway receives the request of forced-execution of the DvP from the Buyer. The request contains the original id of the DvP transaction.
8.exec		GetTransaction	API Gateway as sender TIPS as receiver	The API Gateway queries TIPS to verify the Payment Transaction status.
9.exec (OK)		ReturnTransaction	TIPS as sender API Gateway as receiver	TIPS sends a message to the API Gateway with a positive response (Payment Transaction settled correctly).
9.exec (KO)		ReturnTransaction	TIPS as sender API Gateway as receiver	TIPS sends a message to the API Gateway with a negative response (Payment Transaction not settled).
10.exec (OK)	DvP Unilateral Services (DvPUS) – Callback	CreditorPaymentActivationRequestStatusReport	API Gateway as client Buyer as server	The API Gateway responds to the Buyer (via callback) with the execution preimage generated in Step 2.
10.exec (KO)	DvP Unilateral Services (DvPUS) – Callback	CreditorPaymentActivationRequestStatusReport	API Gateway as client Buyer as server	The API Gateway responds to the Buyer (via callback) notifying that the Payment Transaction has not been settled in TIPS.

8. API Catalogue services specifications

The APIs for the DvP use case are available and can be invoked via the A2A channel to the following URL:

<https://tipsgateway-ext-cert.bancaditaliatest.it/api/public/dvp/thl>

In the rest of the document this is referenced as {Server URL}.

These APIs are asynchronous. For this reason, the Buyer and the Seller need to provide, each one, an endpoint in order to receive responses by API Gateway (referenced in the document as {Callback Server URL}). These endpoints must be provided in the body of the DvP initiation Service, as also described in the swagger dashboard "Gateway API", and must respect the rules described in the swagger dashboard "Participant API" (See Section 4.4.1).

Moreover, as anticipated in Section 4.2, in order to interact with TIPS H-L it is needed to communicate to Banca d'Italia a set of public IP addresses to enable the communication.

8.1 DvP Initiation Service (DvPIS)

Request type: HTTP POST

Parameters: no parameters

Procedure Endpoint: {Server URL}/v0/init

Description: it enables the Seller to initialize a Delivery versus Payment (DvP) process. Specifically, it asynchronously triggers the generation of a TIPS H-L transaction ID and two preimages (or secrets) R and R' that will be used in the next phases. The hashed preimages H(R) and H(R') and Transaction ID (txID) will be sent to Creditor/Seller and Debtor/Buyer via pain.012 message.

The API requires a mandatory request body containing an XML message based on the ISO20022 message *pain.009.001.06 - MandateInitiationRequestV06*.

Response Code: 202

Response Description: request accepted. The result, when ready, will be sent via callback URLs.

Request Body (MandateInitiationRequest)			
Reference Name	XML path	Mand.	Usage
Creation Date Time	/Document/MndtInitnReq/GrpHdr/CreDtTm	yes	Used to specify a UTC timelock: the timeout value within which the buyer will pay.
Mandate Request Identification	/Document/MndtInitnReq/Mndt/MndtReqId	yes	Identification of the Initialization Request, which will be reported in the outbound pain.012.
Collection Amount	/Document/MndtInitnReq/Mndt/ColltnAmt	no	The amount to be exchanged in cash leg.

Creditor name	/Document/MndtInitnReq/Mndt/Cdtr/Nm	yes	Seller callback URL.
Creditor BIC	/Document/MndtInitnReq/Mndt/Cdtr/Id/OrgId/AnyBIC	no	Creditor/Seller BIC.
Debtor name	/Document/MndtInitnReq/Mndt/Dbtr/Nm	yes	Buyer callback URL.
Debtor BIC	/Document/MndtInitnReq/Mndt/Dbtr/Id/OrgId/AnyBIC	no	Debtor/Buyer BIC.
Debtor BIC	/Document/MndtInitnReq/Mndt/DbtrAgt/FinInstnId/BICFI	no	Copy of the Debtor/Buyer BIC.

8.2 DvP Initiation Service (DvPIS) – Callback

Request type: HTTP POST

Parameters: no parameters

Procedure Endpoint: {Callback Server URL}/v0/init-answer

Description: This callback sends to the Buyer and the Seller the details of the Delivery versus Payment initialization previously initialized.

The API requires a mandatory request body containing an XML message based on the ISO20022 message *pain.012.001.06 - MandateAcceptanceReportV06*.

This message is used as answer to the pain.009 to provide the result of the initialization request and include also the following information:

- Transaction ID (txID)
- the hashed version of the two generated preimages (or secrets) R and R'.

This API supports both scenarios of success and failure.

The API Gateway notifies both the Buyer and the Seller endpoints.

Response Code: 204

Response Description: message received.

Request Body (MandateAcceptanceReport)			
Reference Name	XML path	Mand.	Usage
Acceptance Result	/Document/MndtAccptncRpt/UndrlygAccptncDtls/AcceptncRsIt	yes	Provides detailed information on the acceptance result.
Mandate Request Identification	/Document/MndtAccptncRpt/UndrlygAccptncDtls/OrgnlMndt/OrgnlMndt/MndtId	yes	TIPS Transaction Identification, to be used in pacs.008 message for payment, in case of success. Value NOTPROVIDED returned in case of reject.

Mandate Request Initialization	/Document/MndtAccptncRpt/UndrlygAccptncDtIs/OrgnlMndt/OrgnlMndt/MndtReqId	yes	Identification of the original initialization request.
Tracking indicator	/Document/MndtAccptncRpt/UndrlygAccptncDtIs/OrgnlMndt/OrgnlMndt/TrckgInd	yes in case of success	Not used.
Creditor BIC	/Document/MndtAccptncRpt/UndrlygAccptncDtIs/OrgnlMndt/OrgnlMndt/Cdtr/Id/OrgId/Any BIC	yes in case of success	Creditor/Seller BIC.
Identification	/Document/MndtAccptncRpt/UndrlygAccptncDtIs/OrgnlMndt/OrgnlMndt/CdtrAcct/Id/Othr/Id	yes in case of success	Not used. Value NONREF returned.
Identification	/Document/MndtAccptncRpt/UndrlygAccptncDtIs/OrgnlMndt/OrgnlMndt/CdtrAcct/Prxy/Id	yes in case of success	Hashed value H(R') of the cancel preimage.
Debtor BIC	/Document/MndtAccptncRpt/UndrlygAccptncDtIs/OrgnlMndt/OrgnlMndt/Dbtr/Id/OrgId/Any BIC	yes	Debtor/Buyer BIC in case of success. Value NOTPROVIDED returned in case of reject.
Identification	/Document/MndtAccptncRpt/UndrlygAccptncDtIs/OrgnlMndt/OrgnlMndt/DbtrAcct/Id/Othr/Id	yes in case of success	Not used. Value NONREF returned.
Identification	/Document/MndtAccptncRpt/UndrlygAccptncDtIs/OrgnlMndt/OrgnlMndt/DbtrAcct/Prxy/Id	yes in case of success	Hashed value H(R) of the execution preimage.
Debtor BIC	/Document/MndtAccptncRpt/UndrlygAccptncDtIs/OrgnlMndt/OrgnlMndt/DbtrAgt/FinInstnId /BICFI	yes in case of success	Copy of the Debtor/Buyer BIC.

8.3 Payment Service (PS)

Request type: HTTP POST

Parameters: no parameters

Procedure Endpoint: {Server URL}/v0/instruct-payment

Description: it allows the API Gateway to instruct TIPS H-L for a Payment transaction indicating the amount of cash to be transferred from the Debtor/Buyer participant account to the Creditor/Seller participant account in TIPS H-L.

The API requires a mandatory request body containing an XML message based on the ISO20022 message *pacs.008 - FIToFICustomerCreditTransferV02*.

Response Code: 202

Response Description: asynchronous request accepted. The result will be send via callback URL.

Request Body (FIToFICustomerCreditTransfer)			
Reference Name	XML path	Mand.	Usage
Transaction Id	/Document/FIToFICstmrCdtTrf/CdtTrfTxInf/PmtId/TxId	yes	The Transaction Reference used to identify the Payment transaction and perform the duplicate check.

IntraBank Settlement Amount	/Document/FIToFICstmrCdtTrf/CdtTrfTxInf/IntrBkSttlmAmt	yes	The currency of the settlement amount (that must be the same of the Creditor and Debtor Accounts).
Acceptance Date Time	/Document/FIToFICstmrCdtTrf/CdtTrfTxInf/AccptncDtTm	no	The Acceptance Timestamp is used as a starting point in time for the Payment transaction processing at Originator Bank level. The Acceptance Timestamp shall be expressed in UTC.
Financial Institution Identification	/Document/FIToFICstmrCdtTrf/CdtTrfTxInf/DtrAgt/FinInstnId	yes	The Distinguished Name of the sender must be authorised to instruct for the Originator BIC. The Originator BIC must be stored as an Account Authorised BIC.
Financial Institution Identification	/Document/FIToFICstmrCdtTrf/CdtTrfTxInf/CdtrAgt/FinInstnId	yes	The Beneficiary BIC must be linked with at least one Distinguish Name for outbound message routing.

8.4 Payment Service (PS) – Callback

Request type: HTTP POST

Parameters: no parameters

Procedure Endpoint: {Callback Server URL}/v0/instruct-payment-answer

Description: After processing a payment instruction, this API is called by the API Gateway to respond to the Buyer and/or the Seller with the result of the payment.

The API requires a mandatory request body containing an XML message based on the ISO20022 message *pac.002 - FIToFIPaymentStatusReportV03* (further details can be found in the [TIPS User Detailed Functional Specifications](#)).

Response Code: 204

Response Description: message received.

Request Body (FIToFIPaymentStatusReport)			
Reference Name	XML path	Mand.	Usage
Original Message Identification	/Document/FIToFIPmtStsRpt/OrgnlGrpInfAndSts/OrgnlMsgId	yes	This field matches with the Identification of the original message.
Reason Code	/Document/FIToFIPmtStsRpt/OrgnlGrpInfAndSts/StsRsnInf/Rsn/Cd	yes in case of failure	This field is used for negative confirmation message only.
Status Identification	/Document/FIToFIPmtStsRpt/TxInfAndSts/StsId	yes	For positive confirmation it is the Beneficiary Bank's reference of the SCT ^{Inst} Transaction. For negative confirmation it is the specific reference of the party initiating the Reject.
Original Transaction Identification	Document/FIToFIPmtStsRpt/TxInfAndSts/OrgnlTxId	yes	Reference of the Payment Transaction to which the PaymentStatusReport refers.

Originator	/Document/FIToFIPmtStsRpt/OrgnlGrplnfAndSts/StsRsnInf/Orgtr	yes in case of failure	This field is used for negative confirmation message only.
Originator	/Document/FIToFIPmtStsRpt/TxInfAndSts/StsRsnInf/Orgtr	yes in case of failure	This field is used for negative confirmation message only.
Reason Code	/Document/FIToFIPmtStsRpt/TxInfAndSts/StsRsnInf/Rsn/Cd	yes in the case of failure	This field is used for negative confirmation message only.

8.5 DvP Unilateral Services (DvPUS) – Forced Execution

Request type: HTTP POST

Parameters: no parameters

Procedure Endpoint: {Server URL}/v0/execute

Description: it allows the Buyer to ask the API Gateway to disclose the secret R.

The API requires a mandatory request body containing an XML message based on the ISO20022 message *pain.013 CreditorPaymentActivationRequestV08*.

As trusted third party, the API Gateway discloses the preimage only if the transaction (with txID identification) for the Buyer has been settled in TIPS H-L.

Response Code: 202

Response Description: asynchronous request accepted. The result will be sent via callback URLs.

RequestBody (CreditorPaymentActivationRequest)			
Reference Name	XML path	Mand.	Usage
Number of transactions	/Document/CdtrPmtActvtnReq/GrpHdr/NbOfTxs	yes	Value fixed to 1.
AnyBIC	/Document/CdtrPmtActvtnReq/GrpHdr/InitgParty/Id/OrgId/AnyBIC	yes	BIC of the party who sent the message: Debtor/Buyer, in case of forced execution.
Payment method	/Document/CdtrPmtActvtnReq/PmtInf/PmtMtd	yes	Not used.
Proprietary	/Document/CdtrPmtActvtnReq/PmtInf/PmtTpInf/CtgyPurp/Prtry	yes	Requested action: EXE, for forced execution.
Date	/Document/CdtrPmtActvtnReq/PmtInf/ReqdExctnDt/Dt	yes	Not used.
Debtor BIC	/Document/CdtrPmtActvtnReq/PmtInf/Dbtr/Id/OrgId/AnyBIC	yes	Debtor/Buyer BIC.
Debtor BIC	/Document/CdtrPmtActvtnReq/PmtInf/DbtrAgnt/FinInstnId/BICFI	no	Copy of the Debtor/Buyer BIC.

Instruction Identification	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/PmtId/InstrId	yes	TIPS Transaction ID.
End to End Identification	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/PmtId/EndToEndId	yes	Not used. To be filled with NONREF.
Instructed Amount	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/Amt/InstdAmt	yes	Not used.
Charge Bearer	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/ChrgBr	yes	Not used.
Creditor BIC	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/Cdtr/Id/OrgId/AnyBIC	yes	Creditor/Seller BIC.
Creditor BIC	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/CdtrAgt/FinInstnId/BICFI	no	Copy of the Creditor/Seller BIC.

8.6 DvP Unilateral Services (DvPUS) – Forced Execution Callback

Request type: HTTP POST

Parameters: no parameters

Procedure Endpoint: {Callback Server URL}/v0/execute-answer

Description: the Buyer receives the answer of the forced execution request via callback.

The API requires a mandatory request body containing an XML message based on the ISO20022 message *pain.014 - CreditorPaymentActivationRequestStatusReportV08*. This message is sent to the Debtor/Buyer as answer to the forced execution request.

This API supports both scenarios of success and failure.

In case of success, the Buyer receives the execution preimage R which will be provided to the Hash-Link contract to unlock the asset and transfer it to the Buyer.

Response Code: 204

Response Description: message received.

RequestBody (CreditorPaymentActivationRequestStatusReport)			
Reference Name	XML path	Mand.	Usage
Original Message Identification	/Document/CdtrPmtActvtnReqStsRpt/OrgnlGrpInfAndSts/OrgnlMsgId	yes	Message Identification of original pain.013 request.
Original Message Name Identification	/Document/CdtrPmtActvtnReqStsRpt/OrgnlGrpInfAndSts/OrgnlMsgNmId	yes	FixedValue: pain.013.001.08.
Original Payment Information Identification	/Document/CdtrPmtActvtnReqStsRpt/OrgnlPmtInfAndSts/OrgnlPmtInfId	yes	Not used. Filled with NONREF.

Proprietary (Status Reason Information)	/Document/CdtrPmtActvtnReqStsRpt/OrgnlPmtInfAndSts/TxInfAndSts/StsRsnInf/Rsn/Prtry	yes	Result of the request: <ul style="list-style-type: none"> • ACCP for accepted; • RJCT for rejected.
Additional Information (Status Reason Information)	/Document/CdtrPmtActvtnReqStsRpt/OrgnlPmtInfAndSts/TxInfAndSts/StsRsnInf/AddtlInf	yes (in the case of success)	Execution preimage value (R).

8.7 DvP Unilateral Services (DvPUS) – Forced Cancellation

Request type: HTTP POST

Parameters: no parameters

Procedure Endpoint: {Server URL}/v0/cancel

Description: it allows the Seller to ask the API Gateway to disclose the secret R'.

The API requires a mandatory request body containing an XML message based on the ISO20022 message *pain.013 - CreditorPaymentActivationRequestV08*.

As trusted third party, the API Gateway discloses the preimage R' only if the transaction (with txID identification) for the Buyer has not been settled in TIPS H-L and the timeout has not expired.

Note that, in case of preimage disclosure, TIPS H-L will not accept future payment for the transaction txID.

Response Code: 202

Response Description: asynchronous request accepted. The result will be sent via callback URLs.

RequestBody (CreditorPaymentActivationRequest)			
Reference Name	XML path	Mand.	Usage
Number of transactions	/Document/CdtrPmtActvtnReq/GrpHdr/NbOfTxs	yes	Value fixed to 1.
BIC of Initiating Party	/Document/CdtrPmtActvtnReq/GrpHdr/InitgParty/Id/OrgId/AnyBIC	yes	BIC of the party who sent the message: Creditor/Seller in case of cancellation request.
Payment method	/Document/CdtrPmtActvtnReq/PmtInf/PmtMtd	yes	Not used.
Type	/Document/CdtrPmtActvtnReq/PmtInf/PmtTpInf/CtgyPurp/Prtry	yes	Requested action: REF, for forced cancellation.
Date	/Document/CdtrPmtActvtnReq/PmtInf/ReqdExctnDt/Dt	yes	Not used.
Debtor BIC	/Document/CdtrPmtActvtnReq/PmtInf/Dbtr/Id/OrgId/AnyBIC	yes	Debtor/Buyer BIC.

Debtor BIC	/Document/CdtrPmtActvtnReq/PmtInf/DbtrAgt/FinInstnId/BICFI	no	Copy of the Debtor/Buyer BIC.
Instruction Identification	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/PmtId/InstId	yes	TIPS Transaction ID (TxID).
End to End Identification	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/PmtId/EndToEndId	yes	Not used. To be filled with NONREF.
Instructed Amount	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/Amt/InstdAmt	yes	Not used.
Charge Bearer	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/ChrgBr	yes	Not used.
Creditor BIC	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/Cdtr/Id/OrgId/AnyBIC	yes	Creditor/Seller BIC.
Creditor BIC	/Document/CdtrPmtActvtnReq/PmtInf/CdtTrfTx/CdtrAgt/FinInstnId/BICFI	no	Copy of the Creditor/Seller BIC.

8.8 DvP Unilateral Services (DvPUS) – Forced Cancellation Callback

Request type: HTTP POST

Parameters: no parameters

Procedure Endpoint: {Callback Server URL}/v0/cancel-answer

Description: the Seller receives the answer of the forced cancellation request via callback.

The API requires a mandatory request body containing an XML message based on the ISO20022 message *pain.014 - CreditorPaymentActivationRequestStatusReportV08*. This message is sent to the Creditor/Seller as answer to the forced cancellation request.

This API supports both scenarios of success and failure.

In case of success, the Seller receives the forced cancellation preimage R' which will be provided to the Hash-Link contract to unlock the asset and transfer it back to the Seller.

Response Code: 204

Response Description: message received.

RequestBody (CreditorPaymentActivationRequestStatusReport)			
Reference Name	XML path	Mand.	Usage
Original Message Identification	/Document/CdtrPmtActvtnReqStsRpt/OrgnlGrpInfAndSts/OrgnlMsgId	yes	Message Identification of original pain.013 request.
Original Message Name Identification	/Document/CdtrPmtActvtnReqStsRpt/OrgnlGrpInfAndSts/OrgnlMsgNmId	yes	FixedValue: pain.013.001.08.

Original Payment Information Identification	/Document/CdtrPmtActvtnReqStsRpt/OrgnlPmtInfAndSts/OrgnlPmtInfId	yes	Not used. Filled with NONREF.
Proprietary (Status Reason Information)	/Document/CdtrPmtActvtnReqStsRpt/OrgnlPmtInfAndSts/TxInfAndSts/StsRsnInf/Rsn/Prtry	yes	Result of the request: <ul style="list-style-type: none"> • ACCP for accepted; • RJCT for rejected.
Additional Information (Status Reason Information)	/Document/CdtrPmtActvtnReqStsRpt/OrgnlPmtInfAndSts/TxInfAndSts/StsRsnInf/AddtlInf	yes (in the case of success)	Cancellation preimage value (R').

8.9 Examples of ISO20022 messages used in TIPS Hash-Link

8.9.1 Pacs.008 (FIToFICustomerCreditTransferV02)

```

<Document xmlns="urn:iso:std:iso:20022:tech:xsd:pacs.008.001.02"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <FIToFICstmrCdtTrf>
    <GrpHdr>
      <MsgId>MSID432388</MsgId>
      <CreDtTm>2018-07-30T10:00:52Z</CreDtTm>
      <NbOfTxs>1</NbOfTxs>
      <TtlIntrBkSttlmAmt Ccy="EUR">50</TtlIntrBkSttlmAmt>
      <IntrBkSttlmDt>2018-07-30</IntrBkSttlmDt>
      <SttlmInf>
        <SttlmMtd>INDA</SttlmMtd>
      </SttlmInf>
      <PmtTpInf>
        <SvcLvl>
          <Cd>SEPA</Cd>
        </SvcLvl>
        <LclInstrm>
          <Cd>INST</Cd>
        </LclInstrm>
      </PmtTpInf>
    </GrpHdr>
    <CdtTrfTxInf>
      <PmtId>
        <EndToEndId>E2EITMRID000301</EndToEndId>
        <TxId>MSID432388</TxId>
      </PmtId>
      <IntrBkSttlmAmt Ccy="EUR">50</IntrBkSttlmAmt>
      <AcptncDtTm>2018-07-30T10:00:52Z</AcptncDtTm>
      <ChrgBr>SLEV</ChrgBr>
      <Dbtr>
        <Nm>DebtorName</Nm>
      </Dbtr>
      <DbtrAcct>
        <Id>
          <IBAN>IT60X0542811101000000654321</IBAN>
        </Id>
      </DbtrAcct>
      <DbtrAgt>
        <FinInstnId>
          <BIC>PBBKITRRXXX</BIC>
        </FinInstnId>
      </DbtrAgt>
      <CdtrAgt>
        <FinInstnId>
          <BIC>PBBKITRR002</BIC>
        </FinInstnId>
      </CdtrAgt>
    </CdtTrfTxInf>
  </FIToFICstmrCdtTrf>
</Document>

```

```

        <Cdtr>
            <Nm>BeneficiaryName</Nm>
        </Cdtr>
        <CdtrAcct>
            <Id>
                <IBAN>IT60X0542811101000000123456</IBAN>
            </Id>
        </CdtrAcct>
    </CdtTrfTxInf>
</FIToFICstmrCdtTrf>
</Document>

```

8.9.2 Camt.019 (ChangeOfBusinessDate) – used by solution provider

```

<Document xmlns="urn:iso:std:iso:20022:tech:xsd:DRAFT1camt.019.001.06">
    <RtrBizDayInf>
        <MsgHdr>
            <MsgId>txid</MsgId>
            <CreDtTm>2023-08-15T13:33:46+00:00</CreDtTm>
        </MsgHdr>
        <RptOrErr>
            <BizRpt>
                <SysId>
                    <MktInfrstrctrId>
                        <Cd>T2</Cd>
                    </MktInfrstrctrId>
                </SysId>
                <BizDayOrErr>
                    <BizDayInf>
                        <SysDt>2023-08-15Z</SysDt>
                        <SysSts>
                            <Sts>
                                <Prtry>
                                    <Id>CHBD</Id>
                                </Prtry>
                            </Sts>
                        </SysSts>
                    </BizDayInf>
                </BizDayOrErr>
            </BizRpt>
        </RptOrErr>
    </RtrBizDayInf>
</Document>

```

8.9.3 Camt.050 (LiquidityTransfer) – used by solution provider

```

<Document xmlns="urn:iso:std:iso:20022:tech:xsd:DRAFT1camt.050.001.04"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="urn:iso:std:iso:20022:tech:xsd:DRAFT1camt.050.001.04">
    <LqdttyCdtTrf>
        <MsgHdr>
            <MsgId>txid</MsgId>
        </MsgHdr>
        <LqdttyCdtTrf>
            <LqdttyTrfId>
                <InstrId>DRNLQREie89sm</InstrId>
                <EndToEndId>ENDTOEND001</EndToEndId>
            </LqdttyTrfId>
            <Cdtr>
                <FinInstnId>
                    <BICFI>BITAITRRXXX</BICFI>
                </FinInstnId>
            </Cdtr>
        <CdtrAcct>
            <Id>

```

```

        <Othr>
            <Id>extAccount</Id>
        </Othr>
    </Id>
    <Tp>
        <Cd>SACC</Cd>
    </Tp>
</CdtrAcct>
<TrfdAmt>
    <AmtWthCcy Ccy="EUR">120.00</AmtWthCcy>
</TrfdAmt>
<Dbtr>
    <FinInstnId>
        <BICFI>BENITAR1XXX</BICFI>
    </FinInstnId>
</Dbtr>
<DbtrAcct>
    <Id>
        <Othr>
            <Id>IITEURBENITAR1XXXDCA</Id>
        </Othr>
    </Id>
    <Tp>
        <Cd>CASH</Cd>
    </Tp>
</DbtrAcct>
<SttlmDt>2023-07-13</SttlmDt>
</LqdtuCdtTrf>
</LqdtuCdtTrf>
</Document>

```

8.9.4 Camt.025 (Receipt) – used by solution provider

```

<Document xmlns="urn:iso:std:iso:2002:tech:xsd:DRAFT2camt.025.001.04"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:iso:std:iso:2002:tech:xsd:DRAFT2camt.025.001.04">
    <Rct>
        <MsgHdr>
            <MsgId>txid</MsgId>
            <CreDtTm>2023-07-13T13:28:57+00:00</CreDtTm>
        </MsgHdr>
        <RctDtls>
            <OrgnlMsgId>
                <MsgId>7XeijjyrzE</MsgId>
            </OrgnlMsgId>
            <OrgnlPmtId>
                <ShrtBizId>
                    <TxId>DRNLQREie89sm</TxId>
                    <IntrBkSttlmDt>2023-07-13</IntrBkSttlmDt>
                    <InstgAgt>
                        <FinInstnId>
                            <BICFI>BENITAR1XXX</BICFI>
                        </FinInstnId>
                    </InstgAgt>
                </ShrtBizId>
            </OrgnlPmtId>
            <ReqHdlg>
                <StsCd>RCON</StsCd>
            </ReqHdlg>
        </RctDtls>
    </Rct>
</Document>

```

Annex: forms for escrow process

0. Forms for the RTGS escrow process

0a - Registration of NCB escrow account to CBSPs: this template defines the details of the RTGS CB account or the RTGS DCA that each NCB intends to use for implementing the escrow mechanism. NCBs will not be required to set a new dedicated account in the RTGS for the purpose of exploratory work and may rely on an existing account to implement the escrow mechanism.

	Escrow account for BDF	Escrow account for BDI
NCB		
NCB BIC		
NCB Account Number ¹⁰		
RTGS DCA ^{11 12} /RTGS CB account		

0b - Registration of market participant's RTGS DCA for escrow process: this template defines the details of the RTGS DCA that each market participants intends to use for implementing the escrow mechanism. Market participants are not required to set a new dedicated account in the RTGS for the purpose of exploratory work and may rely on an existing account to implement the escrow mechanism.

	RTGS DCA used for BDF	RTGS DCA used for BDI
Market participant		
Market participant party BIC		
RTGS DCA account number		

¹⁰ Please consider the T2 naming convention for the setup of new accounts for the escrow mechanism

¹¹ Each NCB with an RTGS DCA registered for the escrow process in trials can search the LTGs for the two solutions and add their RTGS DCA to the relevant LTG.

¹² Each NCB will manage Liquidity Transfer Groups comprised of eligible market participants' RTGS DCAs registered for the escrow process and, where applicable, NCB's RTGS DCA(s) and registered for the escrow process in their jurisdiction.

1. Forms to be used during the funding process/Start of Day (SoD) processes

1a (optional) – Market participants’ funding requests to their local NCB:

NCBs choosing to rely on a single existing account may opt for this optional form to

- (i) keep track of the specific funding requests made by their market participants and
- (ii) where their market participants participate to trials with BDF and BDI solutions, identify for which solution the funding request is made.

NCBs relying on two segregated escrow accounts can directly query the balance of their escrow accounts and directly identify the funding requests made the solutions of relevance (although the form could still be used if deemed useful).

	Funding used for BDF	Funding used for BDI
Date		
Market participants name		
Market participant BIC		
RTGS DCA		
Amount funded on NCBs escrow account = amount of Exploratory Liquidity		

1b (mandatory) – minting requests: NCBs provide this form to BdF and/or Bdl including the overall amount received during funding on their escrow account and the breakdown of funds received and held from each payment bank for all valid funding requests. On that basis, BdF/Bdl will mint exploratory cash tokens/make available the balances on Full-DLT interoperability solution/TIPS HL accounts.

In the case of NCBs that are active on the Full-DLT interoperability solution, they have to submit form 1b to inform on the overall amount received during funding.

From: a local National Central Bank having received funds before 09:00 am from one or several market participants participating in trials

To: the Central Bank acting as SPCB for the trials

Purpose:

- (i) trial SoD reconciliation between funds escrowed and Exploratory liquidity
- (ii) for the reporting CB not performing the minting to specify the amount to be minted for each market participant in the wallet/accounts

Business date	
Reporting NCB entity [Party BIC]	
Solution Provider	
Total amount escrowed = Exploratory liquidity to be minted	

Details per market participants (for DL3S: not necessary if local NCB is active in DL3S)	
Payment Bank (PB) [Party BIC]	Amount escrowed by PB on NCBs escrow account

2. Realignment transfer form for End of Day procedures

2a (mandatory) – alignment procedures: BDF and BDI provide this form to NCBs including the amount(s) to transfer to escrow accounts of other NCBs via liquidity transfers prior to defunding.

From: the Central Bank acting as SPCB for the trial (BDF or BDI)
To: a local National Central Bank with one or several payment bank(s) participating in the trials
Purpose: request to perform some inter-NCB realignment transfers as prerequisites for the defunding process.

Business date	
Instructing Solution Provider	
NCB entity involved in the realignment process (Party BIC)	
transfers to perform (Y/N)	

Details of the liquidity transfers to be performed			
Account to be credited (RTGS Account Number of the credit NCB)	BIC of the credit NCB	Amount	transfer settled (Y/N)

2b (mandatory) – defunding launch after successful alignment: BdF/BDI provide this form to NCBs including the breakdown of funds to defund to each of the NCBs' participants. In the case of NCBs being active on DL3S, form 2b serves only as the greenlight to defund.

From: the Central Bank acting as solution provider for the trial
To: a Central Bank with one or several payment bank(s) participating in the trials but with no access to the positions of its participants at the end of the settlement day
Purpose: provide the details of the defunding liquidity transfers to be performed, which will credit the RTGS DCA of the domestic payment banks and leave the local escrow account empty

Business date	
Instructing Solution Provider	
NCB entity requested to defund (Party BIC)	

Details of the liquidity transfers to be performed		
Payment bank to be credited (Party BIC)	Amount	transfer settled (Y/N)

3. Form sent 48h in advance of the trial process – special request for early defunding

3 - request for defunding before the standard EoD process during the trial settlement window: this template details the request made by a market participant to benefit from early defunding during the trial intraday process. This request can be accepted subject to the following:

- That the participants issuing such request notified both BdF / BDI and their local NCB at least 48 hours in advance,
- That the transfer of exploratory liquidity as part of the settlement process that the participants wish to see reflected on a gross basis in T2-RTGS occurs no later than 11:00, for defunding to then take place by 12:00.
- BdF / BDI and the local NCB(s) of the participants issuing such a request reserve the right to reject this request in case of capacity constraints limitations and may ask those participants to schedule their trial operations at another point in time or that they rely on the regular EoD procedure.

Business date (at least 48 hours before)	
Instructed Solution Provider	
NCB entity requested to defund (Party BIC)	

Details of the liquidity transfers to be performed		
Payment bank to be credited (Party BIC)	Amount	transfer settled (Y/N)

Glossary and abbreviations

Application-to-Application (A2A): A connectivity mode that enables the exchange of information between the applications of the TARGET Services and the software application(s) of the connected actors¹³.

Application Programming Interface (API): mechanisms that enable two software components to communicate with each other using a set of definitions and protocols. In the context of APIs, the word Application refers to any software with a distinct function. Interface can be thought of as a contract of service between two applications. This contract defines how the two communicate with each other using requests and responses. Their API documentation contains information on how developers are to structure those requests and responses.

API Gateway: see **Interoperability mechanism: API Gateway for the TIPS Hash Link solution**,

Asset: A digital representation of value, recorded on a distributed ledger, be it a native digital asset or a tokenised asset.

Asset Chain: see Market DLT platform definition.

Atomic settlement: The use of programmable logic (e.g. a smart contract) to synchronize the two legs of a financial transaction (e.g. the “asset leg” and the “cash leg” of a DvP) to ensure that both occur simultaneously¹⁴. This implies settling transactions on a gross, transaction by transaction basis, and by means of a DvP, PvP or DvD procedure.

Callback: asynchronous, out-of-band requests that a service will send to some other service (on a given callback URL) in response to certain events¹⁵.

Central Bank Money (CeBM): Liabilities of a central bank, in the form of either banknotes or bank deposits held at a central bank, which can be used for settlement purposes. In the context of this framework document, CeBM refers to bank deposits held at Eurosystem central banks in TARGET Services.

Central Bank Solution Provider, or solution provider central bank, or solution provider – CBSP: Banca d’Italia as one of the three National Central Banks providing the solutions used in trials and experiments under the Eurosystem exploratory work framework.

Dashboard: A data dashboard is a tool many businesses use to track, analyse, and display data—usually to gain insight into the overall wellbeing of an organization, department, or specific process¹⁶.

Distributed ledger: an information repository that keeps records of transactions and that is shared across, and synchronised between, a set of DLT network nodes using a consensus mechanism.¹⁷

Distributed Ledger Technology (DLT): a technology that enables the operation and use of distributed ledgers.¹⁸

DLT Protocol: set of technical rules which govern how the DLT works, including the consensus mechanisms. The main differences between DLT protocols are in the construction of the consensus mechanism.

Eligible Market DLT Operator (or Market DLT Operator): According to the eligibility criteria defined by the Eurosystem, and without prejudice to existing access rules to the TARGET Services and for the duration of Eurosystem trials and experiments only, Market DLT Operators could be: CSDs, authorised under the CSDR, operating a Securities Settlement System based on DLT / operating a DLT platform (including T2S CSDs subject to a derogation of the contractual and regulatory framework of T2S). Operators of a DLT settlement system or a DLT trading and settlement system as authorised under the DLT Pilot Regime Regulation

¹³ See T2 Glossary, https://www.ecb.europa.eu/paym/target/consolidation/profuse/shared/pdf/2021-04-01_t2_glossary_v2-2.pdf

¹⁴ Adapted from BIS glossary: https://www.bis.org/publ/qtrpdf/r_qt2003c.pdf

¹⁵ See OpenAPI definition: <https://swagger.io/docs/specification/callbacks/>

¹⁶ Definition from Microsoft, <https://powerbi.microsoft.com/en-us/data-dashboards/>

¹⁷ Definition from DLT Pilot Regime Regulation

¹⁸ Definition from DLT Pilot Regime Regulation

(Regulation 2022/858). Investment firms and market operators and other licensed financial institutions operating a DLT platform, as duly licensed under the national law transposing MiFID II or under other relevant national legal frameworks subject to a positive assessment by the Eurosystem.

Eligible market participant: any entity with access to TARGET, within the meaning of Articles 4 and Articles 7, Annex 1 Part I of the TARGET Guideline, and participating to exploratory work in that capacity.

Escrow account: RTGS account set by a National Central Bank to support their market participants in trials with the TIPS H-L solution provided by the Banca d'Italia. Participants fund those accounts via liquidity transfer (i.e. transfers of CeBM from the participant's RTGS account), to request minting of exploratory liquidity in the TIPS H-L. Funds held on the escrow account belong to the NCB and will be held on an intraday only basis. This temporary construct would not be considered for implementing in the "steady state" solution as in that case, liquidity would stem directly from CLM.

Experiment: exploratory activity consisting of mock settlement relying on the UTEST environment (test transactions) of TARGET Services and the interoperability-based solutions made available to eligible market participants (or exceptionally to market DLT platform operators awaiting the necessary licenses) at specific dates and times agreed with the Eurosystem. In the event that market DLT platform operators have applied for but have yet to be granted their respective licenses under national legal frameworks, upon a recommendation by the local NCB and acceptance by the NCB Solution Providers, such entities may be permitted to participate in experiments on an exceptional basis. The local NCB, on behalf of the respective market DLT operator, will need to demonstrate a clear rationale for requesting this exception.

Hash, or hash value: A fixed-length fingerprint of variable-size input, produced by a hash function¹⁹.

Hash function: cryptographic hash function is a one-way hash function that maps data of arbitrary size to a fixed-size string of bits. The "one-way" nature means that it is computationally infeasible to recreate the input data if one only knows the output hash. The main properties of cryptographic hash functions are (i) determinism, meaning that given input message always produces the same hash output, (ii) verifiability, meaning that computing the hash of a message is efficient (linear complexity), (iii) non correlation, meaning that a small change to the message (e.g. a 1-bit change) should change the hash output so extensively that it cannot be correlated to the hash of the original message, (iv) irreversibility, meaning that computing the message from its hash is infeasible, equivalent to a brute-force search through all possible messages, (v) collision protection, meaning that it should be infeasible to calculate two different messages that produce the same hash output²⁰.

HTTP: Hypertext Transfer Protocol²¹

ISO 20022: International standard for financial services messaging, maintained by the International Organization for Standardization (ISO)²².

Interoperability mechanism: the technical or legal compatibility that enables a CBSP platform to be used in conjunction with a market DLT platform to coordinate the settlement across the two platforms.²³ The mechanisms are namely:

- **API Gateway for the TIPS Hash Link solution:** Application Programming Interface (API) which plays the role of trusted oracle transaction to enable counterparties orchestrating transactions with Hash-Lock Contracts, preventing counterparties of a transfer to claim the intended assets without fulfilling the conditions stated in the transaction agreement.

Market DLT platform: DLT platform provided by an eligible market DLT operator where assets are settled and delivered during exploratory work.

¹⁹ Definition from Ethereum Glossary, <https://ethereum.org/en/glossary/>

²⁰ Definition from O'Reilly, <https://www.oreilly.com/library/view/mastering-ethereum/9781491971932/ch04.html>

²¹ See T2 Glossary

²² See T2 Glossary

²³ Adapted from BIS glossary: <https://www.bis.org/cpmi/publ/d00b.htm>

Native digital asset: a digital asset that is originally issued, recorded and kept in a DLT-based system.²⁴

Network Service Provider (NSP): Business entity, licensed – in this case - by the Eurosystem, which provides the technical infrastructure, including hardware and software, to establish a secure and encrypted network connection permitting the exchange of information between actors²⁵.

Oracle: Trusted third-party which acts (1) as the generator and the keeper of secrets used to manage the transaction lifecycle (one allowing execution of the transaction and one allowing to roll it back) and (2) as an “Oracle of Time”, unambiguously verifying that a payment has (or has not) been executed within a pre-agreed timeframe. In TIPS H-L implementation; this role is played by the API Gateway.

Programmability: the ability to automate processes by pre-programming actions to be taken if a specific event occurs.²⁶

ReST-like Application Programming Interface (API): API that implements some features of ReST but don't fully fulfils its constraints.

Secure Hash Algorithm (SHA): A family of cryptographic hash functions published by the National Institute of Standards and Technology (NIST). SHA256 is an algorithm that produces an output string (or hash, or hash value) of 256 bits²⁷.

Smart contract: Automatable, ‘contractual-type’ arrangements embedded in computer software, which the latter can validate, execute and record automatically, on a DLT platform, as soon as certain pre-programmed/pre-defined conditions have been met, based on information fed into the distributed ledger itself or received from a pre-defined (external) source.²⁸

Swagger Specification, or Swagger: OpenAPI Specification (formerly Swagger Specification) is an API description format for APIs. An OpenAPI file allows you to describe your entire API, including (i) available endpoints and operations on each endpoint, (ii) operation parameters Input and output for each operation, (iii) authentication methods (iv) contact information, license, terms of use and other information. API specifications can be written in YAML or JSON²⁹.

TIPS Hash Link (HL) platform: a centralised platform operated and hosted by the Banca d'Italia and based on (but distinct from) the existing TARGET Instant Payment System (TIPS), underlying the deployment of the TIPS Hash Link solution for trials and experiments.

Tokenised asset: a digital representation in a DLT-based system of an asset not native to that system.³⁰

Trial: exploratory activity consisting of real-life settlement in central bank money relying on TARGET Services (for the cash leg) and on the interoperability-based solutions provided by the CBSPs (for connectivity to market DLT platforms) made available to eligible market participants on a regular basis during exploratory work under an intraday settlement window.

²⁴ *Advisory Groups on Market Infrastructures for Securities and Collateral and for Payments, ‘The use of DLT in post-trade processes’, April 2021*

(https://www.ecb.europa.eu/pub/pdf/other/ecb.20210412_useofdltposttradeprocesses-958e3af1c8.en.pdf)

²⁵ See T2 Glossary

²⁶ See: CPMI, ‘Wholesale digital tokens’, December 2019 (<https://www.bis.org/cpmi/publ/d190.pdf>).

²⁷ Definition from Ethereum Glossary

²⁸ See: *Advisory Groups on Market Infrastructures for Securities and Collateral and for Payments, ‘The use of DLT in post-trade processes’, April 2021*

(https://www.ecb.europa.eu/pub/pdf/other/ecb.20210412_useofdltposttradeprocesses-958e3af1c8.en.pdf); D. Bullmann, J. Klemm and A. Pinna, ‘In search for stability in crypto-assets: are stablecoins the solution?’, *ECB Occasional Paper no. 230*, August 2019; M. Bech, J. Hancock, ‘On the future of securities settlement’, *BIS Quarterly Review March 2020* (https://www.bis.org/publ/qtrpdf/r_qt2003i.pdf)

²⁹ See OpenAPI definition: <https://swagger.io/docs/specification/about/>

³⁰ *Adapted from: Advisory Groups on Market Infrastructures for Securities and Collateral and for Payments, ‘The use of DLT in post-trade processes’, April 2021*

(https://www.ecb.europa.eu/pub/pdf/other/ecb.20210412_useofdltposttradeprocesses-958e3af1c8.en.pdf)

User-to-Application (U2A): A connectivity mode for the exchange of information between a user and a software application through a Graphical User Interface³¹.

Use case: A list of actions or event types that a system needs to perform to meet its objectives.³²

URL: Uniform Resource Locator³³

Wallet: Software that holds private keys. Used to access and control accounts on a DLT platform and interact with smart contracts. Keys need not be stored in a wallet, and can instead be retrieved from offline storage (i.e. a memory card or paper) for improved security. Despite the name, wallets never store the actual coins or tokens³⁴.

XML: eXtensible Markup Language³⁵.

³¹ See T2 Glossary

³² See: *Bank for International Settlements, SIX Group AG and Swiss National Bank, 'Project Helvetia: Settling tokenised assets in central bank money', December 2020* (<https://www.bis.org/publ/othp35.pdf>).

³³ See T2 Glossary

³⁴ Definition from Ethereum Glossary

³⁵ See T2 Glossary