



Trigger Solution Documentation

13 December 2023

Process Description Document v1.1

User Requirements Document v1.1

Onboarding Guide v1.1

Onboarding Guide - Technical Annex v1.1



Trigger Solution

Process Description Document

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Table of contents

	Seite
Versions	2
Table of contents	3
How to read this document	4
1 Ecosystem and Process flow	5
2 Description of a <i>Delivery-versus-Payment</i> process	8
Step 1: Agreement on the trade in the Eligible Market DLT Platform	8
Step 2: Initialisation of the trade in the Eligible Market DLT Platform and blocking of the assets	8
Step 3: Creation of a payment instruction in the Trigger Solution	9
Step 4: Approval of the payment instruction in the Trigger Solution	12
Step 5: BBk-node receives the created and approved payment instruction and validates the payment instruction	12
Step 6: The Trigger Solution sends the direct debit (pacs.010) to T2	13
Step 7: The Trigger Solution sends the credit transfer (pacs.009) to T2	14
Step 8: Status change of the payment instruction	16
Step 9: Transfer the status of the payment instruction to the Eligible Market DLT Platform and transfer of the assets	17
3 Operational day schedule for Trigger Solution	18
4 Communication and support	20
Annex 1 “Message details for participants”	21
I pacs.010 – direct debit	21
II pacs.009 – credit transfer	22
III pacs.004 – payment return	24

How to read this document

This document provides further details on the Trigger Solution. Chapter 1 provides an overview on the ecosystem of the Trigger Solution and an example how a DVP transaction could be settled using the Trigger Solution. Chapter 2 provides a deep dive into the various process steps of a delivery-versus-payment process. Chapter 3 contains a description of the Operational Day Schedule for the Trigger Solution.

1 Ecosystem and Process flow

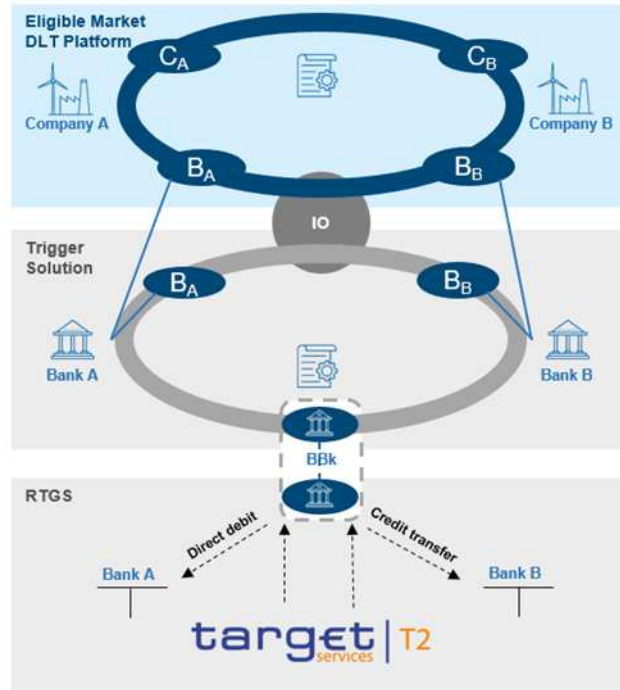
The Eligible Market DLT Platform will be operated by an Eligible Market DLT Operator (as defined by the Eurosystem)

- Eligible Market Participants and companies might participate
- The underlying business transaction (e.g. exchange of securities) takes place in the Eligible Market DLT Platform.
- Eligible Assets will be defined by the Eurosystem

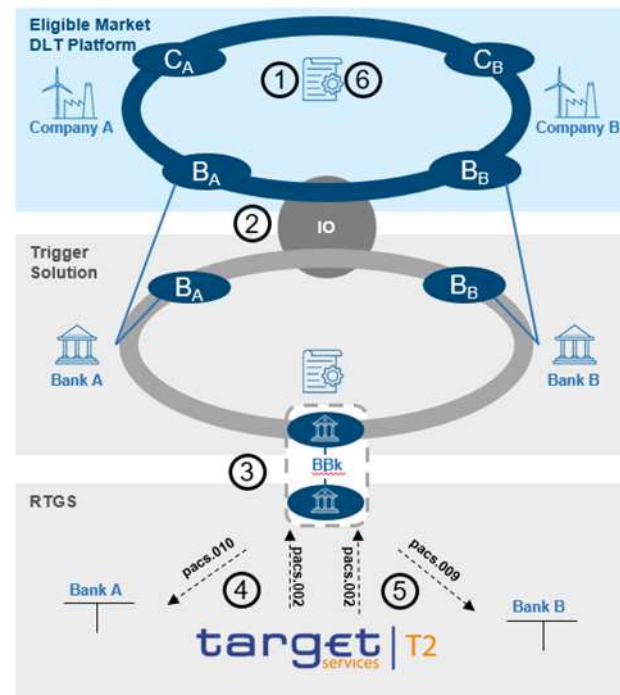
The Trigger Solution is operated by Deutsche Bundesbank

- Only Eligible Market Participants and Eligible Market DLT Operators (as defined by the Eurosystem) participate in the Trigger Solution
- The Trigger Solution is technically agnostic with regard to the business/assets in the Eligible Market DLT Platform.

The settlement of the cash leg takes place in T2/RTGS on the RTGS DCAs of TARGET participants



- ① Buyer and Seller agree on the exchange of Eligible Assets against EUR in an external Eligible Market DLT Platform.
- ② According to the Interoperability Mechanism, a Payment Instruction will be created through a smart contract in the Trigger Solution.
- ③ Deutsche Bundesbank converts the Payment Instruction in the Trigger Solution into ISO20022 messages and submits them via ESMIG to T2/RTGS.
- ④ A direct debit is sent via the Network Service Provider (NSP) to T2 in order to debit the payer bank's RTGS DCA and credit an interim account of Deutsche Bundesbank. Information on the successful or failed settlement will be sent to the Trigger Solution.
- ⑤ A credit transfer is sent via the Network Service Provider to T2 in order to debit the interim account of Deutsche Bundesbank and credit the payee bank's RTGS DCA. Information on the successful or failed settlement will be sent to the Trigger Solution.
- ⑥ The status of the Payment Instruction is transferred to the Eligible Market DLT Platform, where the assets are finally transferred.



Participants:

- The following actors are allowed to participate in the Trigger Solution:
 - Eligible Market Participants according to the Eurosystem definition¹
 - Eligible Market DLT Operators according to the Eurosystem definition²
- In Eligible Market DLT Platforms, Eligible Market Participants as well as companies might – depending on the decision of the Eligible Market DLT Operator – participate.
- In case an actor is active in Eligible Market DLT Platforms and it is not (allowed to be) part of the Trigger Solution, there needs to be a legal agreement between that actor and the respective participant in the Trigger Solution. Bundesbank as Solution Provider for the Trigger Solution is not verifying the existence of such an agreement. This needs to be ensured by the participants in the Trigger Solution and the participants on the respective Eligible Market DLT Platform.

Underlying business transaction:

- The Trigger Solution is agnostic with regard to the assets in the Eligible Market DLT Platforms and does not impose technical requirements on Eligible Market DLT Platforms. However, for the purpose of the Eurosystem exploratory work related to ntw CeBM settlement (new technologies for wholesale Central Bank Money settlement) only Eligible Delivery versus Payment transactions over Eligible Assets³ and Eligible Payments⁴ will be allowed.

Interoperability mechanism:

- The information exchange between an Eligible Market DLT platform and the Trigger Solution is facilitated by an Interoperability Mechanism.
- The Interoperability Mechanism's role is to interact with the Payment Instruction Smart Contract.
- The Interoperability Mechanism is determined by the Eligible Market DLT Operator and can be designed to best fit the underlying business transaction.

¹ Eligible Market Participant means any entity with access to TARGET, within the meaning of Article 4 and Article 7, Annex 1 Part I of the TARGET Guideline

² Eligible Market DLT Operator means (i) CSDs, authorised under the CSDR, operating a Securities Settlement System based on DLT / operating a DLT platform (incl. CSDs subject to a derogation of the contractual and regulatory framework of T2S), (ii) operators of a DLT settlement system or a DLT trading and settlement system as authorised under the DLT Pilot Regime Regulation (Regulation 2022/858), and (iii) 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 and subject to assessment.

³ Eligible Assets means financial instruments, denominated in euro, listed and unlisted alike, within the meaning of Article 4(1), point (15), of the MiFID II, that could be either issued as a native digital assets or as tokenised representation of an existing asset.

⁴ Eligible Payments means Wholesale Payments between euro central bank money and euro or non-euro central bank money or euro or non-euro commercial bank money, including in the form of token

- The Trigger Solution supports different Interoperability Mechanisms implemented by Eligible Market DLT Operators, in particular Hash Time Lock Contract (HTLC).
- Eligible Market DLT Operators can bring their own solution (on-chain and off-chain). In this case the concrete interaction between the Eligible Market DLT platform and the Payment Instruction Smart Contract needs to be discussed by Deutsche Bundesbank and the Eligible Market DLT Operator. To support the implementation of other Interoperability Mechanisms, additional smart contracts can be deployed by the participants to the Trigger Solution.
- For the Trigger Solution two approaches have been implemented:
 - A basic approach for the life timing of payment instructions. All process steps described in the following chapter 3 are part of the basic approach.
 - The “Hash Time Lock” function for the life timing of payment instructions (supporting HTLC-based Interoperability Mechanisms on the Eligible Market DLT Platform). All steps that are only valid when using this “Hash Time Lock” function are introduced by mentioning **HTLC marked in green**.
The described flow is just an example how HTLC could be used. The functionalities can be used by other Interoperability Mechanisms accordingly.

Connection to the Trigger Solution:

- The following options exist to connect to the Trigger Solution:
 - Using an API
 - Participants that do not have an own node can use this API to communicate in U2A mode via a Graphical User Interface provided by Bundesbank.
 - This API can also be used to communicate in A2A mode.
 - Operating an own node and using the own software implementation
- The functionalities in the various process steps as described in chapter 2 can be performed by the participants regardless of the chosen connection to the Trigger Solution.
- To receive updates about the status of the payment instructions, the participants in the Trigger Solution that use the API have to query the current status information. Participants in the Trigger Solution operating an own node can get a notification via an event about the status update of payment instructions.

2 Description of a *Delivery-versus-Payment* process

Step 1: Agreement on the trade in the Eligible Market DLT Platform

- Two actors, e.g. company A and company B (that could also be credit institutions), agree on the trade of assets in the Eligible Market DLT Platform. Both accept the trade of tokenised assets. Company B owns the asset token in the Eligible Market DLT Platform.
- The participants in the Eligible Market DLT Platform can identify the trade by a Correlation ID. The Correlation ID is mandatory for the creation of the payment instruction. The following format restrictions apply for the Correlation ID (to be followed by the participants):
 - `text{4,35}`
`[0-9a-zA-Z/\-?:\(\)\.,'\+]{1,33}[0-9a-zA-Z/\-?:\(\)\.,'\+]`
 - The first three characters identifying the Eligible Market DLT Platform will be provided by the Bundesbank beforehand; the remaining 32 characters are free to use. It is recommended to fill the remaining characters with an existing ID already available on the Market DLT platform (i.e. using an UUID by removing the “-”).

Step 2: Initialisation of the trade in the Eligible Market DLT Platform and blocking of the assets

- Via using a smart contract⁵ in the Eligible Market DLT Platform, the seller blocks the assets.
- When using the **HTLC** on the Eligible Market DLT Platform and the “Hash Time Lock” (HTL) function for the life timing of the payment instruction:
 - The seller transfers the assets in the Interoperability Smart Contract in the Eligible Market DLT Platform.
 - The assets are blocked and assured using a *hash lock*. The hash algorithm used is SHA-256.
 - This hash is generated by the seller based on a pre-image, the so called *secret*.
 - The pre-image to the hash will be revealed by the seller bank to the buyer bank after the respective funds have been blocked (see chapter 2 step 7).
 - Besides that, the hash is combined with a Timeout T_1 , defining the time until which the assets remain blocked awaiting transfer to the buyer.
 - The assets will be transferred with the correct pre-image of the hash but only in case Timeout T_1 has not been reached.

⁵ In general, this smart contract for blocking the assets can be a different one than the Interoperability Smart contract.

- The Trigger Solution does not check the correct blocking of the assets. This lies in the responsibility of company A and B in the Eligible Market DLT Platform.

Step 3: Creation of a payment instruction in the Trigger Solution

- Based on the trade in the Eligible Market DLT Platform, a participant in the Trigger Solution creates a payment instruction in the Trigger Solution.
- The participant in the Trigger Solution, which creates a payment instruction can either be
 - one of the counterparts of the trade, i.e. the payer bank or the receiver bank of the trade or
 - a third party (i.e. another participant in the Trigger Solution).
- All functionalities around the life timing of a payment instruction (starting with the creation) are provided by a Smart Contract in the Trigger Solution.
- The payment instruction contains all necessary information that is needed to create the payment messages for the whole payment process. It also contains the Correlation ID to identify the underlying trade in the Eligible Market DLT Platform. The Correlation ID has to follow the format specified in step 1. The details of the trade itself and the contractual partners are not part of the payment instruction.
- When using HTLC on the Eligible Market DLT Platform and the “Hash Time Lock” function for the life timing of the payment instruction:
 - The payment instruction includes in addition a Timeout T_2 (where T_2 always finishes before a presumed T_1 on the asset side). The whole payment process should be finished successfully before the Timeout T_2 runs up (meaning the amount has been transferred from the RTGS Dedicated Cash Account (DCA) of the payer bank to the RTGS DCA of the receiver bank within that time). T_2 is defined between the two counterparties of the trade in the Eligible Market DLT Platform, it can be a date in the future and the time of T_2 has to end before the close of the trial settlement window.
- The following fields are mandatory and have to be filled with the following format:

Field	Content	Format
<i>Payer bank</i>	BIC of the RTGS DCA to be debited	Swift format: text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}[A-Z0-9]{3,3}

<i>Receiver Bank</i>	BIC of the RTGS DCA to be credited.	Swift format: text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}[A-Z0-9]{3,3}
<i>Amount</i>	Amount to be transferred	Decimal separator as “.”, without thousands separator, max. 16 characters
<i>Currency</i>	Currency of the amount to be transferred	Currency according to the ISO Code: “EUR” to be used
<i>Correlation ID</i>	Via the Correlation ID the underlying trade in the Eligible Market DLT Platform can be identified	Format and restrictions please refer to step 1; the first three characters have to fit to one of the Market DLT platforms.
<i>Creation Date and Time</i>	The date and time when the payment instruction is created	This field is automatically set by the Trigger Solution (reflected <ul style="list-style-type: none"> • in the API U2A in the format YYYY-MM-DD hh:mm:ss; • in API A2A mode or as peer user it is in the format UNIX-epoch
<i>HTLC Hash</i>	When using HTLC : The hash which is used to block the assets in the Eligible Market DLT Platform (SHA-256 hash of the pre-image which is used in the HTLC interoperability mechanism).	[0-9a-f]{64,64}
<i>HTLC Time Out Date and Time</i>	When using HTLC : It reflects the Timeout T2, defining the time until which the liquidity remains blocked on the BBk interim account awaiting transfer to the seller.	Format: <ul style="list-style-type: none"> • in the API (U2A and A2A) the format is YYYY-MM-DD hh:mm:ss; • as peer user it is in the format UNIX-epoch Restrictions for this field: <ul style="list-style-type: none"> • the HTLC Time Out Date has to be a valid business date (see chapter 3)

	<ul style="list-style-type: none"> the HTLC Time Out time has to be at least 15 minutes in the future, 15 minutes after the start of day and before the close of the trial settlement window.
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- The following fields are optional and have to be filled with the following format:

<i>Field</i>	<i>Content</i>	<i>Format</i>
<i>Ordering customer</i>	This represents the customer who is prior to the first agent in the payment chain.	Text, max. 1024 characters
<i>Beneficiary customer</i>	This represents the customer who receives the liquidity at the end of the payment chain.	Text, max. 1024 characters

- For further information regarding the operational day schedule, including until when within the business day a payment instruction can be created for a settlement on the same business day, please refer to chapter 3.
- A modification of the created payment instruction is possible until its approval. In case the 4-eyes mode is used, a modification is possible before the approval by a second user. In case of a modification after the initial approval has been done, the approval process has to start again (i.e. two different users have to approve).
- The creator of a payment instruction, the payer bank or the receiver bank can *modify* an existing payment instruction.
- Only the following data of a payment instruction can be modified:
 - the amount,
 - the currency,
 - the HTLC Hash as well as the HTLC Time Out Date and Time (in case of using **HTLC**).
- In case of mistakes in all other fields, the created payment instruction needs to be *cancelled* and recreated with the correct content.
 - The creator of a payment instruction, the payer bank or the receiver bank can cancel an existing payment instruction. This is only possible until the approval of

the payment instruction. In case the 4-eyes mode is used, a cancellation is possible before the approval by a second user.

- The status of the cancelled payment instruction is “Cancelled”.
- The status of the created (or modified) payment instruction is (stays) “Prepared”.

Step 4: Approval of the payment instruction in the Trigger Solution

- After the creation of the payment instruction it has to be approved. This can be done by the payer bank or by a third party that has been authorised by the payer bank. A third party can only approve a payment instruction that was created by itself.
- During the approval of the payment instruction a signature of the payment instruction is created and added with the certificate⁶ of the approving participant.
- The approval can be done either in 2-eyes or in 4-eyes mode. In case of 4-eyes mode the payment instruction has to be approved by two different users of the payer bank or by two different users of the third party (that is authorised to act for the payer bank).
- In case of 4-eyes mode, the status of the payment instruction changes to “Initially approved” after the approval of the first user. When the second user has approved the payment instruction the status changes to “Approved”.
- After the final approval (in case of 4-eyes mode, after the approval of the second user) it is not possible to modify or cancel the payment instruction anymore and the status of the payment instruction changes to “Approved”.
- Based on the signature of the payment instruction, the Trigger Solution checks whether the payer bank or an authorised third party has approved the payment instruction.
- After the final approval, the creator of a payment instruction, the payer bank or the receiver bank can mark the payment instruction with the status “Submitted” by using the “Submit”-function.

Step 5: BBk-node receives the created and approved payment instruction and validates the payment instruction

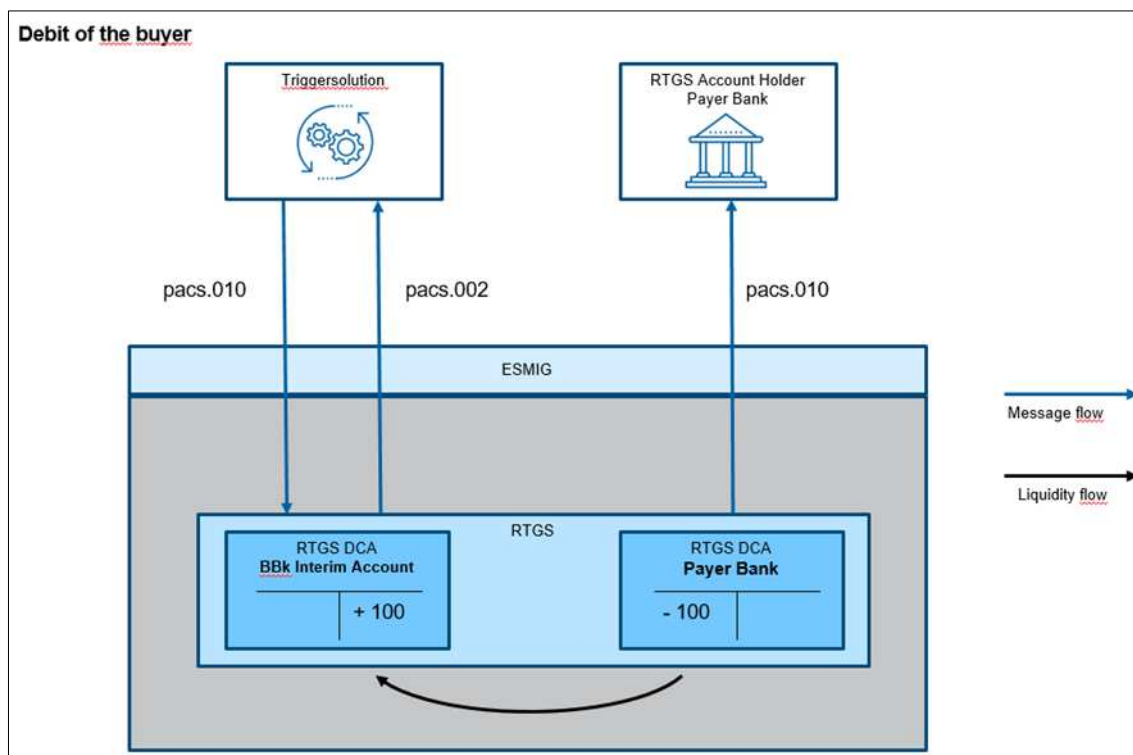
- As soon as the payment instruction is marked as “Submitted”, the Trigger Solution starts processing the payment instruction by providing a value date (date and time). The payment instruction status changes then to “Triggered”.

⁶ The necessary certificates will be provided during the onboarding process.

- The value date of the payment instruction is the date, when the payment should settle (when in a first step the RTGS DCA of the payer bank is debited and in a second step the RTGS DCA of the receiver bank is credited).
- The value date can either be the same day as the creation of the payment instruction or a future date. The buffering of a payment instruction with a future value date is handled by the participant
 - either via submitting the payment instruction at a later point in time
 - or via using the Hash Time Lock functionality and setting the Timeout T_2 with a date in the future (but before the Timeout T_1 runs up).
- In case the payment instruction has been marked as “Submitted” outside of the business hours of the Trigger Solution (see chapter 3), the value date is set to the next business day.
- The Trigger Solution checks whether the payment instruction contains all necessary information that is needed to create the payment messages for the whole payment process. This check encompasses not only the information needed to create a direct debit message (pacs.010 to debit the RTGS DCA of the payer bank) but also covers the information needed for the creation of a credit transfer message (pacs.009 to credit the RTGS DCA of the receiver bank).

Step 6: The Trigger Solution sends the direct debit (pacs.010) to T2

- The Trigger Solution sends the direct debit (pacs.010) via the Eurosystem Single Market Infrastructure Gateway (ESMIG) to T2.
The Trigger Solution always sets the reject time of the direct debit to 5 minutes. At the latest after 5 minutes, the pacs.010 has settled successfully or has been rejected.

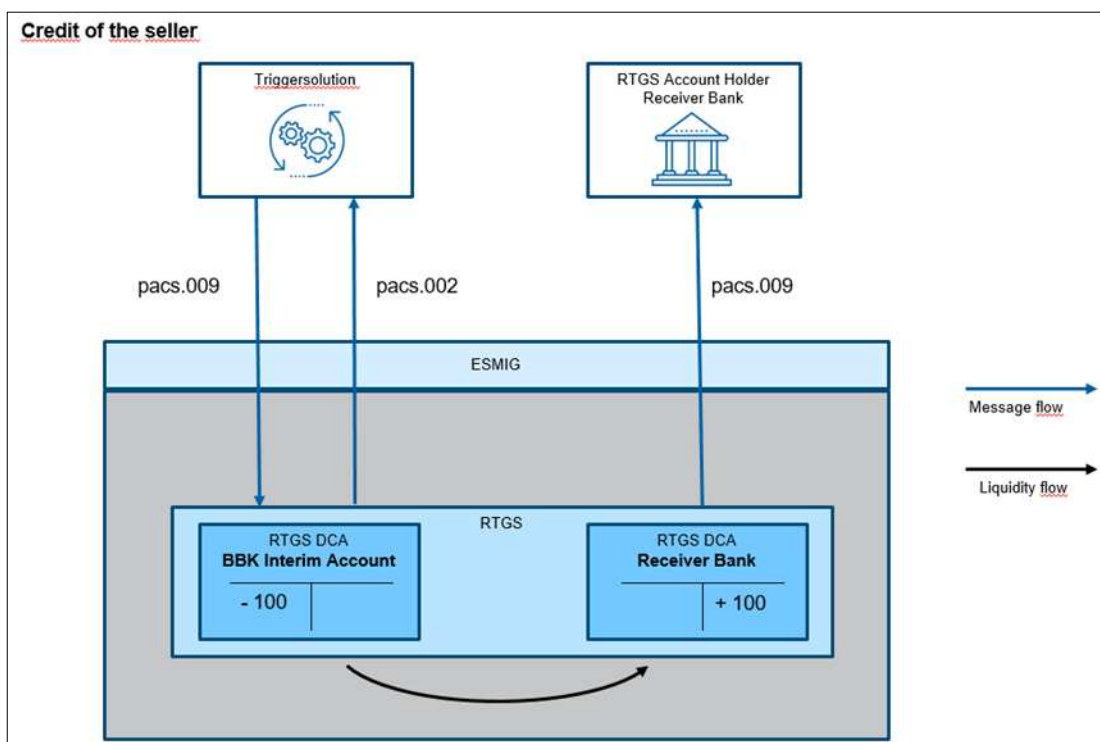


- In case of a successful validation of the pacs.010 in T2, the RTGS Dedicated Cash Account (DCA) of the payer bank is debited and the BBk interim account is credited.
- When using **HTLC**, after receiving the positive payment status report (pacs.002) from T2 the payment instruction status changes to “Payment Locked”.
- In case the pacs.010 could not settle successfully, a negative payment status report (pacs.002) with respective error codes and error descriptions is sent by T2 to the Trigger Solution. The status of the payment instruction changes to “Failed” and the additional information about the error code and error description are included into the payment instruction.
- The creator of a payment instruction, the payer bank or the receiver bank can transfer the information about the (interim) status of the payment instruction to the Eligible Market DLT Platform according to the Interoperability Mechanism used.

Step 7: The Trigger Solution sends the credit transfer (pacs.009) to T2

- When using the basic approach for the life timing of the payment instruction:
 - Directly after receiving the positive payment status report (pacs.002 – meaning the RTGS DCA of the payer bank has been debited successfully) the Trigger Solution creates the respective credit transfer (pacs.009) and sends it via ESMIG to T2.

- When using **HTLC** on the eligible Market DLT Platform and the “Hash Time Lock” function for the life timing of the payment instruction:
 - When the HTLC Transfer-function has been used by the creator of a payment instruction, the payer bank or the receiver bank, the Trigger Solution checks, whether the following conditions are fulfilled:
 - The Timeout T_2 has not yet passed.
 - The correct pre-image to the hash has been provided with the HTLC transfer-function.
 - The pre-image to the hash (as provided in step 3) has to be entered in the format: [0-9a-zA-Z]{1,1024}
 - Only in case the above-mentioned conditions are fulfilled, the Trigger Solution creates the respective pacs.009 and sends it to T2 and the status of the payment instruction changes to “HTLC Ready”.
 - In case the above-mentioned conditions are not fulfilled (e.g. the Timeout T_2 has passed or the provided pre-image is not correct), the Trigger Solution retransfers the cash from the BBk interim account to the RTGS DCA of the payer bank by sending a payment return message (pacs.004) to T2. The status of the payment instruction changes to “Failed”.
- The Trigger Solution always sets the reject time of the credit transfer to 5 minutes. At the latest after 5 minutes, the pacs.009 has settled successfully or has been rejected.



- In case of a successful validation of the pacs.009 in T2, the BBk interim account is debited and the RTGS DCA of the receiver bank is credited.
 - T2 will send as a response a positive payment status report (pacs.002) to the Trigger Solution. The status of the payment instruction changes to “Completed”.

- In case the pacs.009 could not settle successfully, a negative payment status report (pacs.002) with respective error codes and error descriptions is sent by T2 to the Trigger Solution.
 - In case the error code received by T2 is E076 “Reject time reached”, the Trigger Solution will retry to settle the credit transfer (“resend functionality”).
 - Using the basic approach: If the error code does not match E076 or if the second settlement attempt of the pacs.009 also fails, the Trigger Solution retransfers the liquidity from the BBk interim account to the RTGS DCA of the payer bank by sending a payment return (pacs.004). The status of the payment instruction changes to “Failed” and the additional information about the error code and error description are included into the payment instruction. In case the settlement of the pacs.004 fails, further manual steps have to follow by the operator of the Trigger Solution.
 - Using HTLC: If the error code does not match E076 or if the second settlement attempt of the pacs.009 also fails, the Trigger Solution does not send a payment return (pacs.004) to retransfer the liquidity from the Deutsche Bundesbank’s interim account to the RTGS DCA of the payer bank. The status of the payment instruction remains “HTLC Ready”. In this case, Deutsche Bundesbank will contact the receiver bank to enable the completion of the credit transfer.
- In case of remaining liquidity on the Deutsche Bundesbank interim account after the cut-off (i.e. because of a successful direct debit but an outstanding credit transfer due to the fact that the transfer-function has not yet been used and the status of the payment instruction is “Payment Locked”) there will be an automatic sweep function. This means via pacs.004 (payment return) the already settled direct debits will be retransferred to the RTGS DCA(s) of the respective payer bank(s) and the status of the payment instruction changes to “Failed”.
 The only exception to the automatic sweep function is, where the Trigger Solution did not receive a confirmation from T2 for an already sent pacs.009. In that case Deutsche Bundesbank will investigate the root cause and will manually process the necessary next steps.

Step 8: Status change of the payment instruction

- During the various steps the Deutsche Bundesbank node receives the response messages of T2 and updates the status of the payment instruction on the Trigger Solution. Depending on the result of the payment process the status of the payment instruction changes to “Payment Locked”, “Failed”, or “Completed”.
- The participants in the Trigger Solution that use the API can query the result of the updated status information. Participants in the Trigger Solution operating an own node can get a notification about the status update of payment instructions.

Step 9: Transfer the status of the payment instruction to the Eligible Market DLT Platform and transfer of the assets

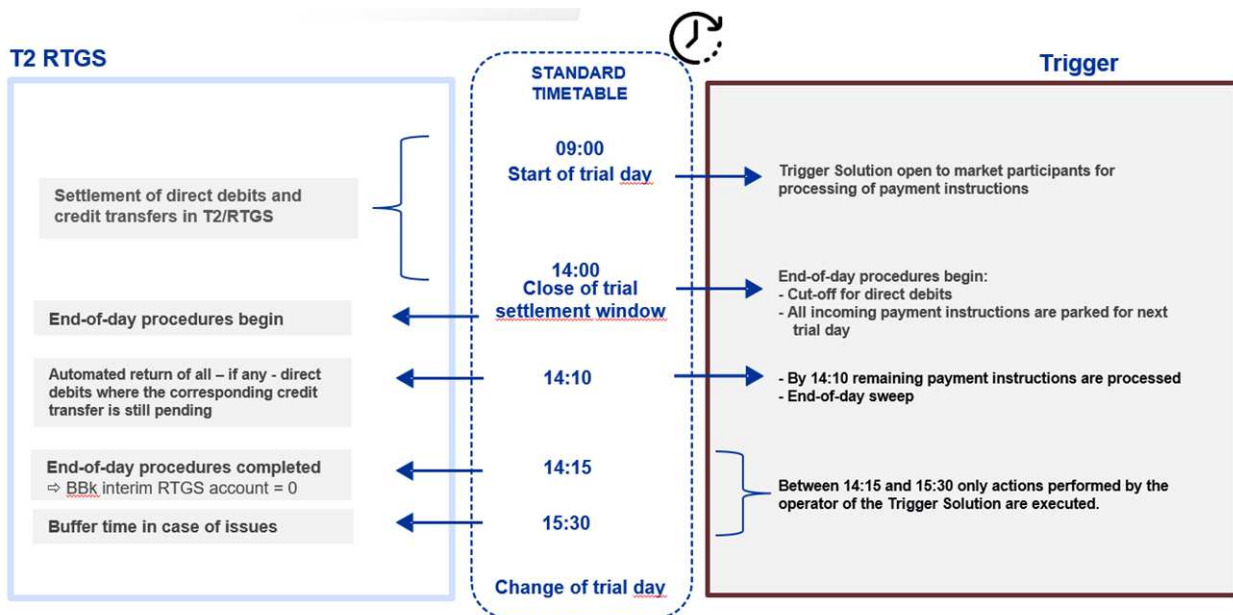
- The creator of a payment instruction, the payer bank or the receiver transfer the status of the payment instruction to the Eligible Market DLT Platform.
- In case of “Payment Locked” payment instructions, the first step of the payment process has been executed successfully. The RTGS DCA of the payer bank has been debited and the Bundesbank interim account has been credited. Step 7 describes the further processing.
- In case of the “Completed” payment the blocked assets in the smart contract will be unblocked and transferred to the buyer.
 - When using **HTLC** on the eligible Market DLT Platform and the “Hash Time Lock” function for the life timing of the payment instruction, the buyer uses the provided pre-image to the hash (see step 7) within the Timeout T_1 to unblock the security and to transfer it from the smart contract to himself.
- In case of the “Failed” payment the blocked assets in the smart contract will be unblocked and retransferred to the seller.

3 Operational day schedule for Trigger Solution

The Trigger Solution operates on the same days as T2. These are all days except for:

- Saturday,
- Sunday,
- New Year's Day,
- Good Friday,
- Easter Monday,
- 1 May,
- Christmas Day and
- 26 December.

During trial days the Trigger Solution operates according to the following schedule as agreed by the Eurosystem to cater for the lightweight nature of the exploratory work:



Settlement with the Trigger Solution will be available from 09:00 until 14:00. During that time, participants' payment instructions can be processed on the Trigger Solution (e.g. as part of DVP initiated on Eligible Market DLT Platforms) and settled in the RTGS component of T2 in a two-step process (direct debit and credit transfer). This also includes those payment instructions foreseen to settle on that day (defined on the HTLC Timeout Date) and those payment instructions that have been created after the cut-off of the previous business day.

From 14:00 until 15:30, the End of Day trial procedures would be conducted: no new transactions in trials from market participants would be settled during this period. The EoD process would involve:

- completing the settlement process for all payment instructions received until 14.00 (cut-off for direct debits),
- queuing all remaining/new payment instructions for processing during the next trial day and,
- in the specific case, where only the first settlement step in T2-RTGS has occurred (direct debit to the Bundesbank interim account), but not the second step (credit transfer from the Bundesbank interim account to the RTGS DCA of the receiver bank), the reverse transactions to refund the payer via the automated sweep function using the pacs.004 (*estimated end: by 14:15*) will be executed.
- Between 14:15 and 15:30 only actions performed by the operator of the Trigger Solution are executed. This time serves as buffer time in case of issues.

Experiments will be conducted during specific windows tailored to the content of the proposed experiments and within the operational schedule of the T2 UTEST environment.

4 Communication and support

When an Eligible Market Participant or Eligible Market DLT Platform Operator encounters any issue while using the Trigger Solution during Trials or Experiments it will contact its local CB⁷ describing the issue.

The local CB will either (i) identify that the issue is not specific to exploratory work and independently affects TARGET Services (e.g. unavailability of RTGS GUI), in which case the regular TARGET procedures shall apply or (ii) identify that the functional or technical issue is specific to the Trigger Solution and notify Deutsche Bundesbank as Solution Provider which shall endeavor to fix it in a timely manner.

⁷ Local CB means the Central Bank (i) where the Eligible Market Participant holds its RTGS DCA or (ii) in the country where the Eligible Market DLT Operator is located.

Annex 1 “Message details for participants”

The following parts of this annex provide message details of those messages that will be sent by T2 to the RTGS DCA account holders.

I pacs.010 – direct debit

Publisher	T2-RTGS (Target Services)
Collection	RTGS_pacs_guidelines
Usage Guideline Name	pacs.010_InterbankDirectDebit_FinancialInstitutionDirectDebit_pacs.010.001.03
Base Message	pacs.010.001.03

Lvl	Name	XML Tag	Mult	Type / Code	Restr	Remarks Bundesbank
0	Financial Institution Direct Debit V03 (pacs.010.001.03)	<FIDrctDbt>				
1	Group Header	<GrpHdr>	[1..1]			
2	Message Identification	<MsgId>	[1..1]	text{1,35}	T/C	NONREF
2	Creation Date Time	<CreDtTm>	[1..1]	dateTime	T/C	2022-11-24T12:31:28.466+00:00
2	Number Of Transactions	<NbOfTxs>	[1..1]	text [0-9]{1,15}	FV	1
1	Credit Instruction	<CdtInstr>	[1..*]		[1..1]	
2	Credit Identification	<CdtId>	[1..1]	text{1,35}	T/C	CorrelationID (ID of the transaction on the asset chain)
2	Instructing Agent	<InstgAgt>	[0..1]		[1..1]	
3	Financial Institution Identification	<FinInstnId>	[1..1]			
4	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}([A-Z0-9]{3,3}){0,1}	[1..1] T/C	MARKDEFFTRI
2	Instructed Agent	<InstdAgt>	[0..1]		[1..1]	
3	Financial Institution Identification	<FinInstnId>	[1..1]			

Lvl	Name	XML Tag	Mult	Type / Code	Restr	Remarks Bundesbank
4	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}([A-Z0-9]{3,3}){0,1}	[1..1] T/C	BANKDEFFXXX
2	Creditor	<Cdtr>	[1..1]			
3	Financial Institution Identification	<FinInstnId>	[1..1]			
4	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}([A-Z0-9]{3,3}){0,1}	T/C	MARKDEFFTRI
2	Direct Debit Transaction Information	<DrctDbtTxInf>	[1..*]		[1..1]	
3	Payment Identification	<PmtId>	[1..1]			
4	Instruction Identification	<InstrId>	[0..1]	text{1,35}	[1..1] T/C	ID-OF-THE-PAYMENT-INSTRUCTION (Unique Identifier of the Payment Instruction in the Triggersolution)
4	End To End Identification	<EndToEndId>	[1..1]	text{1,35}	T/C	ID of the transaction on the asset chain, i.e. CorrelationID
4	UETR	<UETR>	[0..1]	text [a-f0-9]{8}-[a-f0-9]{4}-4[a-f0-9]{3}-[89ab][a-f0-9]{3}-[a-f0-9]{12}	[1..1]	UETR of the payment sent by the Triggersolution
4	Clearing System Reference	<ClrSysRef>	[0..1]	text{1,35}	T/C	RTGS booking reference
3	Interbank Settlement Amount	<IntrBkSttlmAmt>	[1..1]	0 <= decimal td = 18 fd = 5	T/C	100.00

Lvl	Name	XML Tag	Mult	Type / Code	Restr	Remarks Bundesbank
4	Property Ccy			text [A-Z]{3,3}		EUR
3	Interbank Settlement Date	<IntrBkSttlmDt>	[0..1]	date	[1..1]	2022-11-24
3	Settlement Priority	<SttlmPrty>	[0..1]	text		HIGH
3	Settlement Time Indication	<SttlmTmIndctn>	[0..1]			
4	Debit Date Time	<DbtDtTm>	[0..1]	dateTime	T/C	2022-11-24T12:31:28.466+00:00
3	Settlement Time Request	<SttlmTmReq>	[0..1]			
4	Reject Time	<RjctTm>	[0..1]	time	T/C	14:35:00+01:00 (winter time) 14:35:00+02:00 (summer time)
3	Debtor	<Dbtr>	[1..1]			
4	Financial Institution Identification	<FinInstnId>	[1..1]			
5	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}([A-Z0-9]{3,3}){0,1}	T/C	BANKDEFFXX

II pacs.009 – credit transfer

Publisher T2-RTGS (Target Services)
Collection RTGS_pacs_guidelines
Usage Guideline Name pacs.009_FIToFIFinancialInstitutionCreditTransfer_pacs.009.001.08
Base Message pacs.009.001.08

Lvl	Name	XML Tag	Mult	Type / Code	Restr	Remarks Bundesbank
0	Financial Institution Credit Transfer V08 (pacs.009.001.08)	<FICdtTrf>				
1	Group Header	<GrpHdr>	[1..1]			
2	Message Identification	<MsgId>	[1..1]	text{1,35}	T/C	NONREF
2	Creation Date Time	<CreDtTm>	[1..1]	dateTime	T/C	2022-11-24T12:31:28.466+00:00
2	Number Of Transactions	<NbOfTxs>	[1..1]	text [0-9]{1,15}	FV	1
2	Settlement Information	<SttlmInf>	[1..1]			
3	Settlement Method	<SttlmMtd>	[1..1]	text		CLRG
3	Clearing System	<ClrSys>	[0..1]	Choice	[1..1]	
4	Code	<Cd>	[1..1]	text{1,3}	FV	TGT
1	Credit Transfer Transaction Information	<CdtTrfTxInf>	[1..*]		[1..1]	
2	Payment Identification	<PmtId>	[1..1]			
3	Instruction Identification	<InstrId>	[0..1]	text{1,35}	[1..1] T/C	ID-OF-THE-PAYMENT-INSTRUCTION (Unique Identifier of Payment Instruction in Triggerchain)
3	End To End Identification	<EndToEndId>	[1..1]	text{1,35}	T/C	CorrelationID (ID to identify the underlying business on the Asset Chain)
3	UETR	<UETR>	[0..1]	text [a-f0-9]{8}-[a-f0-9]{4}-4[a-f0-9]{3}-[89ab][a-f0-9]{3}-[a-f0-9]{12}	[1..1]	UETR assigned for the payment sent by Triggersolution
3	Clearing System Reference	<ClrSysRef>	[0..1]	text{1,35}	T/C	RTGS booking reference provided by RTGS
2	Interbank Settlement Amount	<IntrBkSttlmAmt>	[1..1]	0 <= decimal td = 18 fd = 5	T/C	100.00

Lvl	Name	XML Tag	Mult	Type / Code	Restr	Remarks Bundesbank
3	Property Ccy			text [A-Z]{3,3}		EUR
2	Interbank Settlement Date	<IntrBkSttlmDt>	[0..1]	date	[1..1]	2022-11-24
2	Settlement Time Indication	<SttlmTmIndctn>	[0..1]			
3	Credit Date Time	<CdtDtTm>	[0..1]	dateTime	[1..1] T/C	2022-11-24T12:32:03.500+00:00
2	Settlement Time Request	<SttlmTmReq>	[0..1]			
3	Reject Time	<RjctTm>	[0..1]	time	T/C	14:45:00+01:00 (winter time) 14:45:00+02:00 (summer time)
2	Instructing Agent	<InstgAgt>	[1..1]		[1..1]	
3	Financial Institution Identification	<FinInstnld>	[1..1]			
4	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}[A-Z0-9]{3,3}{0,1}	[1..1] T/C	MARKDEFFTRI
2	Instructed Agent	<InstdAgt>	[1..1]		[1..1]	
3	Financial Institution Identification	<FinInstnld>	[1..1]			
4	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}[A-Z0-9]{3,3}{0,1}	[1..1] T/C	BANKDEFFXXX
2	Debtor	<Dbtr>	[1..1]			
3	Financial Institution Identification	<FinInstnld>	[1..1]			

Lvl	Name	XML Tag	Mult	Type / Code	Restr	Remarks Bundesbank
4	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}[A-Z0-9]{3,3}{0,1}	T/C	MARKDEFFTRI
2	Creditor	<Cdtr>	[1..1]			
3	Financial Institution Identification	<FinInstnld>	[1..1]			
4	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}[A-Z0-9]{3,3}{0,1}	T/C	BANKDEFFXXX

Note: this reflects the payload of the credit transfer message. In the header (head.001) of the pacs.009 the message definition ID will be: <MsgDefldr>pacs.009.001.08**CORE**</MsgDefldr>.

III pacs.004 – payment return

Publisher T2-RTGS (Target Services)
 Collection RTGS_pacs_guidelines
 Usage Guideline Name pacs.004_PaymentReturn_pacs.004.001.09
 Base Message pacs.004.001.09

Lvl	Name	XML Tag	Mult	Type / Code	Restr	BBk-internal remarks
0	Payment Return V09 (pacs.004.001.09)	<PmtRtr>				
1	Group Header	<GrpHdr>	[1..1]			
2	Message Identification	<MsgId>	[1..1]	text{1,35}	T/C	NONREF
2	Creation Date Time	<CreDtTm>	[1..1]	dateTime	T/C	2022-11-24T12:31:28.466+00:00
2	Number Of Transactions	<NbOfTxs>	[1..1]	text [0-9]{1,15}	FV	1
2	Settlement Information	<SttlmInf>	[1..1]			
3	Settlement Method	<SttlmMtd>	[1..1]	text		CLRG
3	Clearing System	<ClrSys>	[0..1]	Choice	[1..1]	
4	Code	<Cd>	[1..1]	text{1,3}	FV	TGT
1	Transaction Information	<TxInf>	[0..*]		[1..1]	
2	Original Group Information	<OrgnlGrpInf>	[0..1]			
3	Original Message Identification	<OrgnlMsgId>	[1..1]	text{1,35}	T/C	Original Message ID of the pacs.010 originally sent to debit the buyer. Example: TRI2023-05-02T09:22:00
3	Original Message Name Identification	<OrgnlMsgNmId>	[1..1]	text{1,35}	T/C	Example: pacs.010.001.03

3	Original Creation Date Time	<OrgnlCreDtTm>	[0..1]	dateTime	T/C	Creation Date Time from the original pacs.010 payment. Example 2023-05-02T09:22:00
2	Original Instruction Identification	<OrgnlInstrId>	[0..1]	text{1,35}	T/C	InstructionId from the original pacs.010 payment. Example: ID-OF-THE-PAYMENT-INSTRUCTION
2	Original End To End Identification	<OrgnlEndToEndId>	[0..1]	text{1,35}	[1..1] T/C	EndToEndId from the original pacs.010 payment. Example: Correlation ID
2	Original UETR	<OrgnlUETR>	[0..1]	text [a-f0-9]{8}-[a-f0-9]{4}-4[a-f0-9]{3}-[89ab][a-f0-9]{3}-[a-f0-9]{12}	[1..1]	To be filled with UETR from the original pacs.010 payment. Example: e010b031-59c5-41e9-be4c-d45102fc201e
2	Original Interbank Settlement Amount	<OrgnlIntrBkSttlmAmt>	[0..1]	0 <= decimal td = 18 fd = 5		Amount of the pacs.010 Example: 100.00
3	Xml Attribute Currency	<Ccy>		text [A-Z]{3,3}		EUR
2	Original Interbank Settlement Date	<OrgnlIntrBkSttlmDt>	[0..1]	date		Example: 2023-05-02
2	Returned Interbank Settlement Amount	<RtrIntrBkSttlmAmt>	[1..1]	0 <= decimal td = 18 fd = 5	T/C	Amount of the pacs.010 Example: 100.00
3	Property Ccy			text [A-Z]{3,3}		EUR

2	Interbank Settlement Date	<IntrBkSttlmDt>	[0..1]	date	[1..1]	Example: 2023-05-02
2	Settlement Time Indication	<SttlmTmIndctn>	[0..1]			
3	Credit Date Time	<CdtDtTm>	[0..1]	dateTime	[1..1] T/C	2022-11-24T12:32:03.500+00:00
2	Clearing System Reference	<ClrSysRef>	[0..1]	text{1,35}	T/C	RTGS booking reference provided by RTGS
2	Instructing Agent	<InstgAgt>	[0..1]		[1..1]	
3	Financial Institution Identification	<FinInstnId>	[1..1]			
4	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}([A-Z0-9]{3,3}){0,1}	[1..1] T/C	MARKDEFFTRI
2	Instructed Agent	<InstdAgt>	[0..1]		[1..1]	
3	Financial Institution Identification	<FinInstnId>	[1..1]			
4	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}([A-Z0-9]{3,3}){0,1}	[1..1] T/C	BANKDEFFXXX
2	Return Chain	<RtrChain>	[0..1]		[1..1]	
3	Debtor	<Dbtr>	[1..1]	Choice		
4	Agent	<Agt>	[1..1]			
5	Financial Institution Identification	<FinInstnId>	[1..1]			

6	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}([A-Z0-9]{3,3}){0,1}	T/C	MARKDEFFTRI
3	Creditor	<Cdtr>	[1..1]	Choice		
4	Agent	<Agt>	[1..1]			
5	Financial Institution Identification	<FinInstnId>	[1..1]			
6	BICFI	<BICFI>	[0..1]	text [A-Z0-9]{4,4}[A-Z]{2,2}[A-Z0-9]{2,2}([A-Z0-9]{3,3}){0,1}	T/C	BANKDEFFXXX
2	Return Reason Information	<RtrRsnInf>	[0..*]		[1..1]	
3	Reason	<Rsn>	[0..1]	Choice	[1..1]	
4	Code	<Cd>	[1..1]	text{1,4}		Example: ED05 means: Settlement failed

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Trigger Solution

User Requirements Document

Last updated: 13 December 2023

Versions

Version	Chapter	Change information	Date	Name and departmental ID number
1.0	All	Created	10/11/23	Deutsche Bundesbank
1.1	All	Publication	13/12/23	Deutsche Bundesbank

Table of contents

	Seite
Versions	2
Table of contents	3
1 Overview	4
1.1 Business Process	4
1.2 Participants and Business Case	4
2 Functional Requirements	6
2.1 Connectivity	6
2.2 Access Rights Management (incl. 4-eyes principle).....	7
2.3 Dashboard (Content, Sorting Order)	8
2.4 Audit log	9
2.5 Create Payment Instruction	9
2.6 Modify Payment Instruction.....	11
2.7 Cancel Payment Instruction	12
2.8 Approve Payment Instruction (incl. approval by Third Party).....	13
2.9 Submit Payment Instruction	14
2.10 Check Signature	15
2.11 Send pacs.010 to T2.....	16
2.12 Send pacs.009 to T2.....	17
2.13 Send Pacs.004 to T2	19
2.14 Receiving an admi.007	20
2.15 Status Payment Instruction	20

1 Overview

1.1 Business Process

The business process consist of the following steps:

- Step 1: Agreement on the trade in the Eligible Market DLT Platform
- Step 2: Initialisation of the trade in the Eligible Market DLT Platform and blocking of the assets
- Step 3: Creation of a payment instruction in the Trigger Solution
- Step 4: Approval of the payment instruction in the Trigger Solution
- Step 5: BBk-node receives the created and approved payment instruction and validates the payment instruction
- Step 6: The Trigger Solution sends the direct debit (pacs.010) to T2
- Step 7: The Trigger Solution sends the credit transfer (pacs.009) to T2
- Step 8: Status change of the payment instruction
- Step 9: Transfer the status of the payment instruction to the Eligible Market DLT Platform and transfer of the assets

For further details, please refer to the “Trigger Solution – Process Description Document”.

1.2 Participants and Business Case

- As described in the Trigger Solution Process Description Document, the following actors are allowed to participate in the Trigger Solution:
 - Eligible Market Participants according to the Eurosystem definition¹.
 - Eligible Market DLT Operators according to the Eurosystem definition.²
- In Eligible Market DLT Platforms, Eligible Market Participants as well as companies might – depending on the decision of the Eligible Market DLT Operator – participate.

¹ Eligible Market Participant means any entity with access to TARGET, within the meaning of Article 4 and Article 7, Annex 1 Part I of the TARGET Guideline

² Eligible Market DLT Operator means (i) CSDs , authorised under the CSDR, operating a Securities Settlement System based on DLT, DLT / operating a DLT platform (incl. CSDs subject to a derogation of the contractual and regulatory framework of T2S) (ii) operators of a DLT settlement system or a DLT trading and settlement system as authorised under the DLT Pilot Regime Regulation, (Regulation 2022/858) and (iii) 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 and subject to assessment.

- In case an actor is active in the Eligible Market DLT Platform and it is not (allowed to be) part of the Trigger Solution, there needs to be a legal agreement between that actor and the respective Participant in the Trigger Solution. Bundesbank as Solution Provider for the Trigger Solution is not verifying the existence of such an agreement. This needs to be ensured by the participants in the Trigger Solution and the participants on the Eligible Market DLT Platform.

As described in the Trigger Solution Process Description Document the following underlying business transactions are possible within the Trigger Solution:

- The Trigger Solution is agnostic with regard to the assets in the Eligible Market DLT Platform and does not impose technical requirements on Eligible Market DLT Platforms. However, for the purpose of the Eurosystem exploratory work related to ntw CeBM settlement (new technologies for wholesale Central Bank Money settlement) only Eligible Delivery versus Payment transactions over Eligible Assets³ and Eligible Payments⁴ will be allowed.

³ Eligible Assets means financial instruments, denominated in euro, listed and unlisted alike, within the meaning of Article 4(1), point (15), of the MiFID II, that could be either issued as a native digital assets or as tokenised representation of an existing asset.

⁴ Eligible Payments means Wholesale Payments between euro central bank money and euro or non-euro central bank money or euro or non-euro commercial bank money, including in the form of token

2 Functional Requirements

2.1 Connectivity

Id	TRI.UR.CON.001
Name	Connectivity via peer
Description	It shall be possible for all participants to connect via their own node to the Trigger Solution.

Id	TRI.UR.CON.002
Name	Connectivity via non-peer A2A
Description	It shall be possible for all participants to connect via API (without its own node) to the Trigger Solution using an A2A communication.

Id	TRI.UR.CON.003
Name	Connectivity via non-peer U2A
Description	It shall be possible for all participants to connect via API (without its own node) to the Trigger Solution using an U2A communication. For this kind of connectivity there shall be a graphical user interface provided by the Trigger Solution.

Id	TRI.UR.CON.004
Name	Full scope of functionality independent from chosen connectivity
Description	Independent from the chosen connectivity (peer, non-peer A2A, non-peer U2A) the full scope of functionality shall be available.

Id	TRI.UR.CON.005
Name	Connectivity via multiple modes possible
Description	It shall be possible for all participants to connect with more than one connectivity mode to the Trigger Solution (peer, non-peer A2A, non-peer U2A). That means, that e.g. one participant can create a payment instruction via non-peer A2A and as a next step, the same payment instruction is approved (by the same participant) via non-peer U2A.

2.2 Access Rights Management (incl. 4-eyes principle)

Id	TRI.UR.ARM.001
Name	Only registered participants gain access
Description	Only participants that have provided a valid registration form and whose data are captured in the course of the onboarding process for the Trigger Solution will gain access.

Id	TRI.UR.ARM.002
Name	Data scope - participants
Description	The participants shall only see its own payment instructions, that means <ul style="list-style-type: none"> • payment instructions that they have captured by themselves • payment instructions where they are involved in. • payment instructions where they have a mandate to see them (as third party). The third party shall only see the own created payment instructions.

Id	TRI.UR.ARM.003
Name	Data scope – central banks
Description	Central banks in its monitoring role shall see all data where participants are involved which belong to their TARGET component.

Id	TRI.UR.ARM.004
Name	Data scope – solution provider
Description	The Trigger Solution provider shall see all data in the Trigger Solution.

Id	TRI.UR.ARM.005
Name	Privileges
Description	A registered and authorised user has the full scope of functionality available. A distinction to restrict the scope is not required.

Id	TRI.UR.ARM.006
Name	User is linked to a participant
Description	There is a 1:1 link between a user and a participant. One user belongs always to only one participant.

Id	TRI.UR.ARM.007
Name	2-eyes or 4-eyes principle for the approval of a payment instruction

Description	<p>A payment instruction shall be approved in 2-eyes or 4-eyes mode.</p> <p>In case of 4-eyes mode the approval shall be done by two different users of the payer bank or by two different users of the third party (that is authorised to act for the payer bank).</p> <p>In case of a modification after the initial approval, the approval process shall start again (i.e. two different users shall approve).</p>
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2.3 Dashboard (Content, Sorting Order)

Id	TRI.UR.DSB.001
Name	Transaction overview provided as Dashboard
Description	<p>In the Graphical User Interface (GUI) of the Trigger Solution there shall be a dashboard providing an overview of all payment instructions.</p> <p>The data scope is defined under TRI.UR.ARM.002, TRI.UR.ARM.003, TRI.UR.ARM.004</p>

Id	TRI.UR.DSB.002
Name	Content of the Dashboard
Description	<p>The Dashboard shall include the following columns in the following order:</p> <ul style="list-style-type: none"> – Correlation ID – Creation Date – Payer Bank – Receiver Bank – Amount – Status

Id	TRI.UR.DSB.003
Name	Default Sorting
Description	<p>The content of the Dashboard shall by default be sorted by “Creation Date”.</p> <p>The newest payment instruction shall be listed on top.</p>

Id	TRI.UR.DSB.004
Name	Navigation to the Details
Description	<p>It shall be possible to navigate to the details of a selected payment instruction by clicking</p> <ul style="list-style-type: none"> – either on the button at the end of the row – or on the row itself.

2.4 Audit log

Id	TRI.UR.AUL.001
Name	Audit log
Description	It shall be possible to identify who did what when with the payment instruction. That means which user created, modified, approved, submitted, transferred (in case of HTLC) or cancelled a payment instruction and when.

2.5 Create Payment Instruction

Id	TRI.UR.CRP.001
Name	Create a payment instruction function
Description	It shall be possible to create a payment instruction in the Trigger Solution via peer, non-peer U2A and non-peer A2A.

Id	TRI.UR.CRP.002
Name	Creation of a payment instruction by participants
Description	All participants in the Trigger Solution shall be able to create a payment instruction.

Id	TRI.UR.CRP.003
Name	Participants allowed to create a payment instruction
Description	The participant allowed to create a payment instruction shall be <ul style="list-style-type: none">– either one of the counterparts of the trade, i.e. the payer bank or the receiver bank of the trade or– a third party (i.e. another participant in the Trigger Solution).

Id	TRI.UR.CRP.004
Name	Error message with error description
Description	In case an error occurs while creating a payment instruction, the Trigger Solution shall provide a meaningful error message with an understandable error description.

Id	TRI.UR.CRP.005.01
Name	Content of a payment instruction – without using HTLC
Description	During the creation of a payment instruction the following information shall be provided: Mandatory data: <ul style="list-style-type: none">– Payer bank– Receiver bank

	<ul style="list-style-type: none"> – Amount – Currency – Correlation ID – Creation date and time <p>Optional data:</p> <ul style="list-style-type: none"> – Ordering customer – Beneficiary customer
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Id	TRI.UR.CRP.005.02
Name	Content of a payment instruction – with using HTLC
Description	<p>During the creation of a payment instruction the following information shall be provided:</p> <p>Mandatory data:</p> <ul style="list-style-type: none"> – Payer bank – Receiver bank – Amount – Currency – Correlation ID – Creation date and time – HTLC Hash – HTLC Time Out Date and Time <p>Optional data:</p> <ul style="list-style-type: none"> – Ordering customer – Beneficiary customer

Id	TRI.UR.CRP.005.03
Name	Requirements regarding the HTLC Time Out
Description	<ul style="list-style-type: none"> – The HTLC Time Out time has to be at least 15 minutes in the future, 15 minutes after the start of day (SoD: 9:00) and before the close of the trial settlement window (EoD: 14:00).

Id	TRI.UR.CRP.006
Name	Automatic generation of information by the Trigger Solution
Description	<p>When the create function is started, the Trigger Solution adds automatically the following data to the payment instruction:</p> <ul style="list-style-type: none"> – ID to uniquely identify a payment instruction in the Trigger Solution, which shall be randomly generated. – Status – Creator – Signature

Id	TRI.UR.CRP.007
Name	Status of created payment instructions
Description	The status of the created payment instruction is "Prepared".

2.6 Modify Payment Instruction

Id	TRI.UR.MOP.001
Name	Modify a payment instruction function
Description	It shall be possible to modify a payment instruction in the Trigger Solution via peer, non-peer U2A and non-peer A2A.

Id	TRI.UR.MOP.002
Name	Modification of a payment instruction by participants
Description	All participants in the Trigger Solution shall be able to modify a payment instruction.

Id	TRI.UR.MOP.003
Name	Participants allowed to modify a payment instruction
Description	The participant allowed to modify a payment instruction shall be <ul style="list-style-type: none"> – the creator of a payment instruction, – the payer bank or – the receiver bank.

Id	TRI.UR.MOP.004
Name	Latest modification
Description	An update of the already created payment instruction is possible until its approval. In case the 4-eyes mode is used, a modification is possible before the approval by a second user.

Id	TRI.UR.MOP.005
Name	Possible modifications of a payment instruction
Description	The following information shall be modifiable (independent of using HTLC or not): <ul style="list-style-type: none"> – Amount – Currency. <p>In case of using HTLC it shall also be possible to modify</p>

	<ul style="list-style-type: none"> – HTLC Hash – HTLC Timeout. <p>The Payment Instruction has to have either both attributes, HTLC Hash and HTLC Timeout, or none.</p> <p>It is not possible to modify all other information of a payment instruction. In case of a mistake here the cancellation and new creation is necessary.</p>
--	--

Id	TRI.UR.MOP.006
Name	Error message with error description
Description	In case an error occurs while modifying a payment instruction, the Trigger Solution shall provide a meaningful error message with an understandable error description.

Id	TRI.UR.MOP.007
Name	Status of modified payment instructions
Description	The status of the modified payment instruction does not change and remains as “Prepared”.

2.7 Cancel Payment Instruction

Id	TRI.UR.CAP.001
Name	Cancel a payment instruction function
Description	It shall be possible to cancel a payment instruction in the Trigger Solution via peer, non-peer U2A and non-peer A2A.

Id	TRI.UR.CAP.002
Name	Cancellation of a payment instruction by participants
Description	All participants in the Trigger Solution shall be able to cancel a payment instruction.

Id	TRI.UR.CAP.003
Name	Participants allowed to cancel a payment instruction
Description	<p>The participant allowed to cancel a payment instruction shall be</p> <ul style="list-style-type: none"> – the creator of the payment instruction, – the payer bank or – the receiver bank.

Id	TRI.UR.CAP.004
Name	Latest cancellation
Description	A cancellation of the already created payment instruction is possible until its approval. In case the 4-eyes mode is used, a cancellation is possible before the approval by a second user.

Id	TRI.UR.CAP.005
Name	Error message with error description
Description	In case an error occurs while cancelling a payment instruction, the Trigger Solution shall provide a meaningful error message with an understandable error description.

Id	TRI.UR.CAP.006
Name	Status of a cancelled payment instructions
Description	The status of the cancelled payment instruction is "Cancelled".

2.8 Approve Payment Instruction (incl. approval by Third Party)

Id	TRI.UR.APP.001
Name	Approve a payment instruction function
Description	It shall be possible to approve a payment instruction in the Trigger Solution via peer, non-peer U2A and non-peer A2A.

Id	TRI.UR.APP.002
Name	Approval of a payment instruction by participants
Description	All participants in the Trigger Solution shall be able to approve a payment instruction.

Id	TRI.UR.APP.003
Name	Participants allowed to approve a payment instruction
Description	The participant allowed to approve a payment instruction shall be <ul style="list-style-type: none"> – either the payer bank of the trade or – a third party (that is authorised to act for the payer bank). A third party can only approve a payment instruction created by itself.

Id	TRI.UR.APP.004
Name	Error message with error description

Description	In case an error occurs while approving a payment instruction, the Trigger Solution shall provide a meaningful error message with an understandable error description.
--------------------	--

Id	TRI.UR.APP.005
Name	Status of approved payment instructions
Description	In case of 4-eyes mode (please refer to TRI.UR.ARM.007), the status of the payment instruction changes to “Initially approved” after the approval of the first user. When the second user has approved the payment instruction the status changes to “Approved”.

2.9 Submit Payment Instruction

Id	TRI.UR.SUP.001
Name	Submit a payment instruction function
Description	It shall be possible to submit a payment instruction in the Trigger Solution via peer, non-peer U2A and non-peer A2A.

Id	TRI.UR.SUP.002
Name	Submission of a payment instruction by participants
Description	All participants in the Trigger Solution shall be able to submit a payment instruction.

Id	TRI.UR.SUP.003
Name	Participants allowed to submit a payment instruction
Description	The participant allowed to submit a payment instruction shall be <ul style="list-style-type: none"> – The creator of a payment instruction, – the payer bank or – the receiver bank.

Id	TRI.UR.SUP.004
Name	Error message with error description
Description	In case an error occurs while submitting a payment instruction, the Trigger Solution shall provide a meaningful error message with an understandable error description.

Id	TRI.UR.SUP.005
Name	Status of submitted payment instructions

Description	The status of the submitted payment instruction is “Submitted”.
--------------------	---

Id	TRI.UR.SUP.006
Name	Provision of a value date by the Trigger Solution
Description	As soon as the status changes to “Submitted” the Trigger Solution shall start processing the payment instruction. This includes the provision of a value date. During the business hours of the Trigger Solution this date shall equal the same business day. Outside of the business hours of the Trigger Solution the value date shall be the next business day.

Id	TRI.UR.SUP.007
Name	Status of the payment instruction after the provision of a value date
Description	The status of the payment instruction shall change to “Triggered” as soon as the value date is provided.

2.10 Check Signature

Id	TRI.UR.CSI.001
Name	The signature is created during the approval process
Description	During the approval of the payment instruction a signature of the payment instruction is created and added with the certificate ⁵ of the approving participant.

Id	TRI.UR.CSI.002
Name	The signature covers the whole content of the payment instruction
Description	The signature is the signed Hash of the following fields of the payment instruction: <ul style="list-style-type: none"> • ID, • Payer Bank, • Receiver Bank, • Amount, • HTLC Hash, • HTLC Timeout.

Id	TRI.UR.CSI.003
Name	Signature check while processing the payment instruction

⁵ The necessary certificates will be provided during the onboarding process.

Description	The Trigger Solution shall check the signature while processing the payment instruction. This also includes the check, if the participant is allowed to approve the payment instruction.
--------------------	--

2.11 Send pacs.010 to T2

Id	TRI.UR.SDD.001
Name	Send a direct debit to T2 (RTGS)
Description	<p>The Trigger Solution shall be able to send a direct debit (pacs.010) to T2 (RTGS) in A2A-mode to transfer liquidity from the RTGS DCA of the payer bank to the Deutsche Bundesbank's interim account.</p> <p>If the settlement in T2 has not taken place within a predefined period of time, the direct debit shall be rejected by T2. The definition of the period shall be done in the Trigger Solution operator.</p>

Id	TRI.UR.SDD.002
Name	Store and process positive answer from T2 (RTGS)
Description	The Trigger Solution shall be able to store and process the positive answer from T2 (pacs.002) and trigger the next process step.

Id	TRI.UR.SDD.003
Name	Store and process negative answer from T2 (RTGS)
Description	The Trigger Solution shall be able to store and process negative answers from T2 (pacs.002 or admi.007) and trigger the next process step depending on the error description and error code provided by T2.

Id	TRI.UR.SDD.004
Name	Status of payment instructions after positive answer from T2
Description	<p>After receiving a positive response (positive pacs.002) from T2, the status of the payment instruction changes to "Payment Locked" when using HTLC.</p> <p>In case HTLC is not used, the status of the payment instruction remains "Triggered".</p>

Id	TRI.UR.SDD.005
Name	Status of payment instructions after negative answer from T2
Description	After receiving a negative response (negative pacs.002) from T2, the status of the payment instruction changes to "Failed".

2.12 Send pacs.009 to T2

Id	TRI.UR.SCT.001
Name	Send a credit transfer to T2 (RTGS)
Description	<p>The Trigger Solution shall be able to send a credit transfer (pacs.009) to T2 (RTGS) in A2A-mode to transfer liquidity from the Deutsche Bundesbank's interim account to the RTGS DCA of the receiver bank.</p> <p>If the settlement in T2 has not taken place within a predefined period of time, the credit transfer shall be rejected by T2. The definition of the period shall be done in the Trigger Solution operator.</p> <p>As soon as the pacs.009 has been sent, the payment instruction is flagged. This flag has the purpose to ensure that the automatic sweep at the end of the day does not return payments automatically that have not been confirmed (positively or negatively). Deutsche Bundesbank will check the reason for the open response and will manually process the remaining steps.</p>

Id	TRI.UR.SCT.002
Name	Timing of sending the credit transfer to T2 without using HTLC
Description	Directly after receiving the positive pacs.002 of the direct debit the Trigger Solution creates the respective pacs.009 and sends it to T2.

Id	TRI.UR.SCT.003
Name	Timing of sending the credit transfer to T2 with using HTLC
Description	<p>Only in case the following conditions are fulfilled, the Trigger Solution shall send the pacs.009 to T2:</p> <ul style="list-style-type: none">• The Timeout T_2 has not yet passed.• The correct pre-image to the hash has been provided with the HTLC transfer-function. <p>The status of the payment instruction changes to "HTLC Ready".</p>

Id	TRI.UR.SCT.004
Name	Conditions for sending the credit transfer to T2 with using HTLC not fulfilled
Description	<p>In case the conditions in TRI.UR.SCT.003 are not fulfilled, the Trigger Solution shall retransfer the liquidity from the interim account to the RTGS DCA of the payer bank by sending a pacs.004 (payment return).</p> <p>The status of the payment instruction changes to "Failed".</p>

Id	TRI.UR.SCT.005
Name	Store and process positive answer from T2 (RTGS)

Description	The Trigger Solution shall be able to store and process the positive answer (pacs.002).
--------------------	---

Id	TRI.UR.SCT.006
Name	Store and process negative answer from T2 (RTGS)
Description	The Trigger Solution shall be able to store and process negative answers (pacs.002 or admi.007) and trigger the next process step depending on the error description and error code provided by T2.

Id	TRI.UR.SCT.007
Name	Status of payment instructions after positive answer from T2
Description	After receiving a positive response (positive pacs.002) from T2, the status of the payment instruction changes to "Completed"

Id	TRI.UR.SCT.008
Name	Without HTLC: Sending of payment return and status of payment instructions after negative answer from T2
Description	<p>After receiving a negative response from T2 (negative pacs.002 or admi.007) it is checked whether the error code is "E076" (Reject time reached).</p> <ul style="list-style-type: none"> • If yes, a resend of the pacs.009 is triggered. • If no or the resend is also not successful, the Trigger Solution shall send a pacs.004 (payment return) to retransfer the liquidity from the Deutsche Bundesbank's interim account to the RTGS DCA of the payer bank and the status of the payment instruction changes to "Failed" and the additional information about the error code and error description are included into the payment instruction.

Id	TRI.UR.SCT.009
Name	With HTLC: No sending of payment return and status of payment instructions after negative answer from T2
Description	<p>After receiving a negative response from T2 (negative pacs.002 or admi.007) it is checked whether the error code is "E076" (Reject time reached).</p> <ul style="list-style-type: none"> • If yes, a resend of the pacs.009 is triggered. • If no or the resend is also not successful, the Trigger Solution shall <u>not</u> send a pacs.004 (payment return) to retransfer the liquidity from the Deutsche Bundesbank's interim account to the RTGS DCA of the payer bank. In this case, Deutsche Bundesbank will contact the receiver bank in order to be able to complete the credit transfer. <p>The status of the payment instruction remains "HTLC Ready".</p>

2.13 Send Pacs.004 to T2

Id	TRI.UR.SPR.001
Name	Send a payment return to T2 (RTGS)
Description	The Trigger Solution shall be able to send a payment return (pacs.004) to T2 (RTGS) in A2A-mode to retransfer liquidity from the Deutsche Bundesbank's interim account to the RTGS DCA of the payer bank.

Id	TRI.UR.SPR.002
Name	Reasons for sending a payment return to T2 (RTGS)
Description	In the following cases a payment return shall be sent by the Trigger Solution to T2: <ul style="list-style-type: none">- TRI.UR.SCT.004 (Conditions for sending the credit transfer to T2 with using HTLC not fulfilled)- TRI.UR.SCT.008 (Without HTLC: Sending of payment return and status of payment instructions after negative answer from T2) and- TRI.UR.SPR.006 (Automatic payment return in case of liquidity on the Deutsche Bundesbank's interim account at the end of day).

Id	TRI.UR.SPR.003
Name	Store and process positive answer from T2 (RTGS)
Description	The Trigger Solution shall be able to store and process the positive answer (pacs.002).

Id	TRI.UR.SPR.004
Name	Store and process negative answer from T2 (RTGS)
Description	The Trigger Solution shall be able to store and process negative answers (pacs.002 or admi.007) and inform the Operator of the failed retransfer. The Operator shall - depending on the error code and the error description provided by T2 - manually retransfer the liquidity from the Deutsche Bundesbank's interim account to the payer bank.

Id	TRI.UR.SPR.005
Name	Status of payment instructions when sending a pacs.004
Description	As soon as the pacs.004 is sent following a negative pacs.002 the status of the payment instruction shall change to "Failed".

Id	TRI.UR.SPR.006
Name	Automatic payment return in case of liquidity on the Deutsche Bundesbank's interim account at the end of day

Description	At the end of the business day the Trigger Solution shall check for payment instructions with the status "Payment Locked". It shall then initiate the payment return in order to transfer the liquidity from the Deutsche Bundesbank's interim account to the RTGS DCA of the payer bank. As soon as the payment return was successfully booked (positive pacs.002), the status of the payment instruction changes to "Failed".
--------------------	---

2.14 Receiving an admi.007

Id	TRI.UR.RAD.001
Name	Store and process admi.007 from T2 (RTGS)
Description	The Trigger Solution shall be able to store and process an admi.007 and inform the Operator. The Operator shall check the reason for this error message and manually correct and initiate the original process again.

2.15 Status Payment Instruction

Id	TRI.UR.SPI.001
Name	Status of the payment instruction
Description	Every payment instruction shall have one of the following status: <ul style="list-style-type: none"> - Prepared - Cancelled - Initially approved - Approved - Submitted - Triggered - Payment Locked [only in case of using HTLC] - HTLC Ready [only in case of using HTLC] - Completed - Failed.

Id	TRI.UR.SPI.002
Name	Notifications on status updates of the payment instruction
Description	Participants in the Trigger Solution operating an own node shall receive a notification about the status update of payment instructions.

Id	TRI.UR.SPI.003
Name	Queries on the status of the payment instruction
Description	The participants in the Trigger Solution that use the API shall be able to query status information of the payment instruction.

Id	TRI.UR.SPI.004
Name	No forwarding of status information to the Eligible Market DLT Platform
Description	No direct connection to the Eligible Market DLT Platform shall be established. The Trigger Solution shall not sent any status information to the Eligible Market DLT Platform. The participants in the Trigger Solution (i.e. the creator of a payment instruction, the payer bank or the receiver bank) shall transfer the status of the payment instruction to the Eligible Market DLT Platform.

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Trigger Solution

Onboarding Guide

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Versions

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1.0	All	Created	10/11/23	Deutsche Bundesbank
1.1	All	Publication	13/12/23	Deutsche Bundesbank

Table of contents

	Page
Versions	2
Table of contents	3
Abbreviations	4
How to read this document	5
1 General information	6
1.1 What is the Trigger Solution?.....	6
1.2 Who are the participants?	7
1.3 How to identify Eligible Market DLT Operators in the Trigger Solution?	8
2 Onboarding	9
2.1 Process	9
2.2 Registration for the Trigger Solution	10
2.3 Registration for Bundesbank ExtraNet for API users.....	10
2.4 Prerequisites in TARGET	13
3 Prerequisites for the start of Experiments and Trials	15
3.1 Mandatory test cases and testing conditions for the testing phases	16
3.1.1 Testing phase 1B (Tests with Eligible Market DLT Operators and Eligible Market Participants without interaction with T2)	16
3.1.2 Testing phase 2A (Rehearsal testing interaction with T2)	18
3.1.3 Migration phase 2B	19

Abbreviations

Abbreviation	Long form
A2A	Application to Application
API	Application Programming Interface
CeBM	Central Bank Money
DLT	Distributed Ledger Technology
PROD	Production environment of T2
RTGS	Real-time gross settlement component of T2 for the settlement of individual payments and ancillary system transactions.
RTGS DCA	Dedicated Cash Account in the RTGS component of T2
T2	TARGET Service for the settlement of wholesale payments (RTGS component) and the liquidity management (CLM component).
TARGET	T rans-European A utomated R eal-time G ross E xpress T ransfer System
U2A	User to Application
UTEST	User testing environment of T2

How to read this document

This document is relevant for all parties that are interested in technically connecting to the Trigger Solution.

Chapter 1 gives a brief overview on the Trigger Solution. Additionally, it explains who is allowed to connect to the Trigger Solution.

Chapter 2 explains in detail the steps that have to be done to start working with the Trigger Solution. It clarifies the onboarding process as a whole, which documents are needed and where they have to be sent to (chapter 2.1). In addition, it provides information about the registration for the Trigger Solution, e.g. where to submit the registration form (chapter 2.2). For those, who are not participating in the Trigger Solution with their own node, but who would like to use the connection via API, chapter 2.3 provides details about the registration in the Bundesbank Extra-Net. Chapter 2.4 clarifies the prerequisites in TARGET that are necessary for a successful end-to-end settlement of a payment processed via the Trigger Solution.

Chapter 3 provides information on what needs to be done in terms of testing after the registration but before the start of the Experiments and Trials.

1 General information

1.1 What is the Trigger Solution?

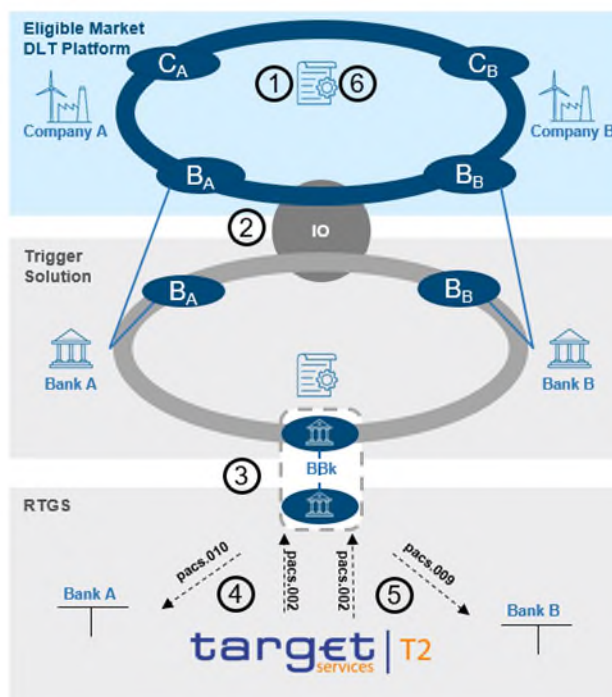
In April 2023 the Eurosystem published its plans to look into how wholesale financial transactions recorded on DLT platforms could be settled in central bank money. The purpose of this initiative is to (i) consolidate and further develop the ongoing work of Eurosystem central banks in this area, and (ii) gain insight into how different solutions could facilitate interaction between TARGET services and DLT platforms.

The Trigger Solution provided by Deutsche Bundesbank (Solution Provider) is one of the technical solutions for the purpose of conducting Experiments and Trials¹ with Eligible Market Participants and Eligible Market DLT Operators during the Eurosystem exploratory work for ntw CeBM settlement (new technologies for wholesale Central Bank money settlement). It allows the settlement of DLT-based wholesale financial transactions in CeBM using the existing TARGET service T2.

The Trigger Solution consists of a DLT infrastructure developed and operated by Deutsche Bundesbank which acts as technical bridge between the RTGS component of T2 and Eligible Market DLT Platforms.

The below picture gives an overview of the interactions between the Trigger Solution and the Eligible Market DLT Platforms as well as the interaction between the Trigger Solution and TARGET.

- ① Buyer and Seller agree on the exchange of Eligible Assets against EUR in an external Eligible Market DLT Platform.
- ② According to the Interoperability Mechanism, a Payment Instruction will be created through a smart contract in the Trigger Solution.
- ③ Deutsche Bundesbank converts the Payment Instruction in the Trigger Solution into ISO20022 messages and submits them via ESMIG to T2/RTGS.
- ④ A direct debit is sent via the Network Service Provider (NSP) to T2 in order to debit the payer bank's RTGS DCA and credit an interim account of Deutsche Bundesbank. Information on the successful or failed settlement will be sent to the Trigger Solution.
- ⑤ A credit transfer is sent via the Network Service Provider to T2 in order to debit the interim account of Deutsche Bundesbank and credit the payee bank's RTGS DCA. Information on the successful or failed settlement will be sent to the Trigger Solution.
- ⑥ The status of the Payment Instruction is transferred to the Eligible Market DLT Platform, where the assets are finally transferred.



¹ The Experiments will be conducted in the user testing environment of T2 (UTEST). The Trials will be conducted in the T2 production environment.

Further details regarding the process can be found in the “Process Description Document”.

1.2 Who are the participants?

The following actors are allowed to participate in the Trigger Solution:

- Eligible Market Participants according to the Eurosystem definition².
- Eligible Market DLT Operators according to the Eurosystem definition³

In general, there is no technical connection between the Eligible Market DLT Platform and the Trigger Solution: It is the Eligible Market Participant that creates the payment instruction in the Trigger Solution (see step 2 in part 1.1). Thus, it is only the Eligible Market Participant that has a technical connection to the Trigger Solution.

However, it is also possible that the payment instruction (see step 2 in part 1.1) is created by a third party. This third party can be any other actor that is allowed to participate in the Trigger Solution, i.e. another Eligible Market Participant or an Eligible Market DLT Operator. If an Eligible Market DLT Operator acts as third party for a participant in the Trigger Solution, this Eligible Market DLT Operator needs to be technically connected to the Trigger Solution.

Thus, to sum up, an Eligible Market DLT Operator can interact either passively with the Trigger Solution without any technical connection to the Trigger Solution or in an active role as third party which requires a technical connection to the Trigger Solution. Eligible Market DLT Operators without any technical connection to the Trigger Solution do not have to run through the technical onboarding process. However, each Eligible Market DLT Operator is provided by Deutsche Bundesbank with a code. This allows to clearly identify from which Eligible DLT Market Platform the business transaction to be processed via the Trigger Solution stems from (see chapter 1.3).

In Eligible Market DLT Platforms, Eligible Market Participants as well as companies might – depending on the decision of the Eligible Market DLT Operator – participate.

In case an actor is active in Eligible Market DLT Platforms and it is not (allowed to be) part of the Trigger Solution, there needs to be a legal agreement between that actor and the respective participant in the Trigger Solution. Bundesbank as Solution Provider for the Trigger Solution is not verifying the existence of such an agreement. This needs to be ensured by the participants in the Trigger Solution and the participants on the respective Eligible Market DLT Platform.

² Eligible Market Participant means any entity with access to TARGET, within the meaning of Article 4 and Article 7, Annex 1 Part I of the TARGET Guideline

³ Eligible Market DLT Operator means (i) CSDs, authorised under the CSDR, operating a Securities Settlement System based on DLT / operating a DLT platform (including CSDs subject to a derogation of the contractual and regulatory framework of T2S), (ii) operators of a DLT settlement system or a DLT trading and settlement system as authorised under the DLT Pilot Regime Regulation (Regulation 2022/858), and (iii) 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 assessment.

1.3 How to identify Eligible Market DLT Operators in the Trigger Solution?

Each Eligible Market DLT Operator is provided by Deutsche Bundesbank with a code. This code allows to clearly identify from which Eligible DLT Market Platform the business transaction to be processed via the Trigger Solution stems from. It will be part of the Correlation ID, which is a mandatory attribute of the payment instruction; concretely the first three characters (for further details on the Correlation ID see Trigger Solution Process Description chapter 2 step1).

After a Market DLT Operator has been considered (preliminarily) eligible by the Eurosystem and this information is formally forwarded to Deutsche Bundesbank as Solution Provider, the Deutsche Bundesbank will provided the respective code to the Eligible Market DLT Operator.

2 Onboarding

2.1 Process

In general the onboarding process includes the following steps:

1. The registration for the Trigger Solution,
2. (if relevant) The registration for Bundesbank ExtraNet, and
3. Provision of necessary information to the responsible Central Bank regarding the static data in TARGET.

The registration for the Trigger Solution will be done via the local Central Bank where (i) the Eligible Market Participant holds its RTGS DCA with or (ii) in the country where the Eligible Market DLT Operator (if participating in the Trigger Solution in an active role as third party) is located, by submitting the respective registration form for the Trigger Solution. The local Central Bank will forward the necessary registration form to the Bundesbank as Solution Provider for further processing.

[Please note that an Eligible Market DLT Operator only has to submit a registration form if participating in the Trigger Solution in an active role as third party and thus with a technical connection to the Trigger Solution. An Eligible Market DLT Operator that does not act as third party in the Trigger Solution consequently does not have a technical connection to the Trigger Solution, and does not need to submit a registration form.]

The onboarding process depends on the way, the participants will connect to the Trigger Solution. In general, the following options exist:

- Connection via the API as non-peer user. Participants communicate
 - either in U2A mode via a Graphical User Interface provided by Deutsche Bundesbank or
 - in A2A mode.
- Connection as peer user operating an own Hyperledger Fabric node and using the own software implementation.

Technical details for the connection with the Trigger Solution via API or via an own node are described in the document Trigger Solution Onboarding Guide – Technical Annex.

Those actors participating via the API have to connect and communicate via Bundesbank ExtraNet. Further information regarding the Bundesbank ExtraNet is provided in chapter 2.3.

All technical documentation that is necessary in order to connect to and interact with the Trigger Solution (e.g. API file, chaincode) will be provided in the restricted service area “Trigger Solution” on Deutsche Bundesbank’s [website](#). Access to this restricted service area will be granted after having formally expressed interest in the context of the Call for Interest.

The necessary information regarding the static data in TARGET (in particular the direct debit mandate) need to be provided to the Central Bank the RTGS DCA to be used is held with. Further information can be found in chapter 2.4.

2.2 Registration for the Trigger Solution

The Trigger Solution Registration Form is part of the documentation package published in the context of the Call for Interest.

The interested participant will submit the completed Registration Form to the local CB where (i) the Eligible Market Participant holds its RTGS DCA with or (ii) in the country where the Eligible Market DLT Operator (if participating in the Trigger Solution in an active role as third party) is located.

Those interested participants, that do not use their own RTGS DCA (i.e. Eligible Market Participants when acting as third party) or do not have an own RTGS DCA (i.e. Eligible Market DLT Operators in an active role as third party) have to contact the Deutsche Bundesbank as Solution Provider (triggersolution@bundesbank.de) before the submission of the registration form to enquire an ID for identifying the registering third party in the Trigger Solution. This ID is needed to be able to complete the registration form.

The form has to be submitted regardless of the way the participant wants to connect to the Trigger Solution (via an own node or the API).

The completed form is to be duly signed by the participant and sent to their responsible local Central Bank who performs the necessary checks (i.e. eligibility and signature check). Before submitting the duly signed (paper-based) version of the registration form to the local Central Bank the interested participants have the opportunity to send the pre-filled registration form for consistency checks to triggersolution@bundesbank.de .

If the Eligible Market Participant holds its RTGS DCA with Deutsche Bundesbank, the form needs to be signed by persons that are allowed to sign for the RTGS DCA. If the Eligible Market DLT Operator is located in Germany, the form needs to be signed by persons authorised according to the commercial register (Handelsregister). The procedural aspects how the verification will be conducted will be shared in the context of the onboarding process. If the RTGS DCA is held with another local Central Bank and the Eligible Market DLT Operator is not located in Germany, the respective rules of the local Central Bank apply. The Central Bank that received the form from the participant will forward it to the Deutsche Bundesbank as Solution Provider for further processing.

2.3 Registration for Bundesbank ExtraNet for API users

The ExtraNet is the Bundesbank's e-business platform. All participants that are connecting to the Trigger Solution via API (A2A und U2A) need to register for the ExtraNet to ensure a secure communication.

A registration for Bundesbank ExtraNet is necessary for the Experiments and Trials.

For testing (in advance of Experiments and Trials) as well as for Experiments the ExtraNet test environment will be used, while Trials will be conducted via the ExtraNet production environment.

For **testing** (in advance of Experiments and Trials) and if you participate in the **Experiments** please use the following link for the initial registration / first registration in the ExtraNet test environment: <https://extranet-t.bundesbank.de/bsvpub/register1.do?fv=TRIGGER>

If you participate in the **Trials** please use the following link for the initial registration / new registration in the ExtraNet production environment: <https://extranet.bundesbank.de/bsvpub/register1.do?fv=TRIGGER>⁴.

In case you want to participate in both, Experiments and Trials, you need to use both links and register twice.

The following description and screenshots are valid for both registrations (Experiments and Trials).

When you enter the above mentioned links please first copy the link, change the language to English (in the upper right corner of the screen) and enter the link again in your browser. Then you will reach the following English website⁵:

The screenshot shows the 'User and master data management' interface for 'Trigger solution'. The page title is 'User registration Trigger solution'. It includes a navigation menu on the left with options: 'Home', 'Register user', 'Change user', and 'Delete user'. The main content area contains the following text and form fields:

Registration to Trigger solution
The fields marked with * are mandatory.

Note: If you are already registered for another specialised procedure, you can register for an additional procedure with your user ID and password via the [secondary registration](#) procedure.

Institution data and list of the specialised procedure functions

BIC of the RTGS DCA for use in Trigger * [input field]

Name of the institution/respondent * [input field]

Street * [input field]

Postcode * [input field]

Place * [input field]

Possible functions *

- Access to Trigger solution in four-eyes mode
- Access to Trigger solution in two-eyes mode
- User Manager TRIGGER

<<Back [Continue]

Deutsche Bundesbank
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D-60006 Frankfurt am Main

⁴ In order to manage your profile data or define a new password, please use <https://extranet-t.bundesbank.de/bsvpriv/> (Tests and Experiments) and <https://extranet.bundesbank.de/bsvpriv/> (Trials). You can login with your already existing User-ID and password.

⁵ This screenshot contains the relevant roles for the Eligible Market Participants and the Eligible Market DLT Operators. There will be a separate monitoring role for Central Banks only.

Please enter all the mandatory data (marked with a *) of your institution (as specified in the Trigger Solution registration form – see chapter 2.2). Bundesbank offers either the access to the Trigger Solution in two-eyes or four-eyes mode⁶. In case you want to register an application (A2A) please choose “Access to Trigger Solution in two-eyes mode”. Please choose the relevant mode also if registering a person (U2A). Then press “Continue”. The last option “User Manager TRIGGER” is not necessarily relevant for the registration of participants. It can be used to gain an overview which users of a institution have already registered within the ExtraNet for the Trigger Solution.

DEUTSCHE BUNDESBANK EUROSISTEM

ExtraNet User and master data management

Home

Register user

Change user

Delete user

User registration
Trigger solution

Please enter your personal data in the fields provided.
The fields marked with * are mandatory for the registration procedure and therefore must be filled in.

Please enter the address of your institution/enterprise in the address fields. Please remember that the following details refer to your place of work. This can differ from the head office of your institution/enterprise. In order to be able to send your password, we require the address and, as an option, the department. If you have opted to take part in the simplified password resetting procedure, you can ask for your password to be reset by contacting the ExtraNet Call Centre directly. To do this, once you have logged in successfully, you only need to enter your chosen question and the corresponding answer.

Entry of personal data

First name *

Surname *

Street and house number *

Postcode / Place *

Department

Telephone *

Fax

E-mail address *

Participation in the simplified password resetting procedure * Yes No

Register user Abort registration

<<Back

Deutsche Bundesbank
Postfach 10 06 02
D-60006 Frankfurt am Main

Please enter your personal information (mandatory fields are marked with a *). Please use for the address (street, house number etc.) the details of your institution related to your place of work. In case of connecting in A2A mode, please enter the details of the responsible contact person. Please mark the field “Participation in the simplified password resetting procedure” with “Yes” and click “Register user”. On the next page the entered data need to be confirmed and the registration needs to be completed by clicking “Complete registration”. Within this step it is also possible to enter the data of another user for the same institute.

After confirmation of the data and completing the registration the following screen is shown:

⁶ The two-eyes and four-eyes mode is relevant for the authorisation of a payment instruction. If you choose two-eyes mode one user is sufficient to authorise the payment instruction. In case of four-eyes mode two different users of the same participant need to authorise the payment instruction.

Please download and save the provided PDF form containing the User-ID, print it, sign it by duly authorised persons and send the form via mail order to Deutsche Bundesbank, Trigger Solution (Z 14), Postfach 10 06 02, 60006 Frankfurt am Main and via e-mail to triggersolution@bundesbank.de. Deutsche Bundesbank will then check your registration and will provide the password to the registered e-mail address (the sender of this e-mail is extranet@bundesbank.de).

Even if you already use ExtraNet communication with Bundesbank for other purposes, you need a new initial registration for Trigger Solution as described above.

2.4 Prerequisites in TARGET

In general no new RTGS DCA needs to be opened. The already existing account can be used for the settlement of transactions processed via the Trigger Solution. If the participant wishes to separate the liquidity to be used for the Experiments and Trials a new RTGS DCA can be opened with the local Central Bank. The already existing procedures for the opening of a new account in TARGET apply.²

In order to allow Deutsche Bundesbank as the Solution Provider for the Trigger Solution to debit the RTGS DCA of the payer bank, a direct debit mandate in favour of MARKDEFFTRI needs to be captured in the CRDM component of TARGET (Common Reference Data Management). This is to be requested by the interested participant via the TARGET registration form provided to the Central Bank the RTGS DCA is held with.

The following information needs to be provided for the Experiments (in T2 UTEST) as well as for the Trials (in T2 PROD):

Field in the TARGET registration form	Content
Payee Parent BIC	MARKDEFFXXX
Payee Party BIC	MARKDEFFTRI

² For further details please refer to [TARGET SERVICES REGISTRATION AND ONBOARDING GUIDE \(europa.eu\)](https://www.europa.eu/target-services-registration-and-onboarding-guide)

From Cash Account Number	The account number of the RTGS DCA to be debited
Payee Reference	Trigger Solution
Maximum amount per counterparty	to be defined by the Account Holder to be debited
Maximum amount per payment	to be defined by the Account Holder to be debited

The completed form needs to be sent to the Central Bank the RTGS DCA is held with. This Central Bank will inform the Deutsche Bundesbank of the captured Direct Debit Mandate.

3 Prerequisites for the start of Experiments and Trials

Before the participants can start with any Experiments or Trials the following two steps have to be successfully passed:

1) Successful onboarding process, which includes:

- the successful registration for the Trigger Solution,
- optionally the registration for the ExtraNet of Deutsche Bundesbank and
- the set-up of all necessary static data updates in TARGET (at least the direct debit mandate is mandatory)

2) Successfully passing the mandatory test cases according to the testing phases foreseen by the Eurosystem

- Test cases have to be performed in the test environment of the Trigger Solution that – depending on the testing phase – could lead to settlement on the RTGS DCAs held in the T2 UTEST environment.
- With the successful execution of the test cases it shall be ensured that the connection to the Trigger Solution is properly established and that an end-to-end transaction can be conducted.

The mandatory test cases are the minimum set of test cases to be performed by all participants. Additional tests depending on business cases and type of participation in exploratory phase (Experiments and Trials) are optional.

3.1 Mandatory test cases and testing conditions for the testing phases

Trials and Experiments are preceded by a mandatory testing phase. The dates mentioned in this chapter reflect the current status and might be subject to further review. The test cases described in this chapter shall be performed by the participants. Testing phase 1A includes Eurosystem-internal tests that are not part of this document. As of testing phase 1B the Eligible Market Participants and Eligible Market DLT Operators are involved.

3.1.1 Testing phase 1B (Tests with Eligible Market DLT Operators and Eligible Market Participants without interaction with T2)

Aim of this testing phase:

- Ensure that the necessary connections can be established between Eligible Market DLTs Platforms and corresponding market participants and Trigger Solution to conduct trials or experiments.
- This phase includes Eligible Market DLT platforms and their market participants as well as Deutsche Bundesbank implementing all required steps to use the interoperability mechanisms proposed, and Eligible Market Participants being onboarded on the Trigger Solution.
- The necessary configurations (e.g. participants accessing the Trigger Solution through nodes or API and ensuring the necessary static data setup in T2) 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 Trigger Solution when the cut-off would be reached at 14:00: Deutsche Bundesbank would test their manual/automatic process to stop handling new requests and providing meaningful responses to the participants trying to interact with the platforms outside of the trial settlement window.
- Finally, the tests could cover specific functionalities and processes that participants to trials and experiments would use during the execution phase depending on the respective business case.

Timeline of this testing phase:

- This testing phase is scheduled currently from December 2023 until January 2024. Further details regarding the timing will be agreed with Deutsche Bundesbank as Solution Provider in the course of the onboarding process.
- Onboarding and testing takes place after the preliminary assessment of the eligibility of the participant.

Mandatory test cases during this testing phase:

Precondition:

- Successful connection to the Trigger Solution (API or node)

Test data that could be used:

- As payer bank, use your own Account BIC of the RTGS DCA used in the UTEST (in order to ensure that the approval step can be executed)
- As receiver bank, one of the following mock-BICs of Deutsche Bundesbank for testing the Trigger Solution could be used: ZYRPDEFFXXX, ZYRODEFFXXX or ZYBODEFFXXX
- Further details, how the payment instruction should be filled, can be found in the “Process Description Document”

Test cases (considering the interoperability mechanism used):

Test case	Expected result (to be proved via screenshot)
Create a payment instruction	Payment Instruction has the status “Prepared”
Approve a payment instruction (where applicable in 4-eyes mode)	Payment Instruction has the status “Approved” In case of 4-eyes mode: The screenshot should also include the status “Initially approved”
Submit a payment instruction	Payment Instruction has the status “Triggered”
In case of using HTLC: Use the Transfer function	Payment Instruction has the status “HTLC ready”
Receive a status change (if connected via node)	When connecting via node, status changes of the payment instruction will be sent in push mode to the participant
Query a status change (if connected via API)	When connecting via API, the participant has to pull the status changes via executing a query.
Create, approve and submit a payment instruction outside of the opening hours of Trigger Solution	The submitted payment instruction will be parked by the Trigger Solution and executed in the course of the start of day processes on the next business day
In case of HTLC: create, approve and submit a payment instruction without executing the “transfer function” in order to force the automated sweep function at the end of the day.	For those payment instructions, where the status is not “Completed” until the end of day, the status changes to “Failed”

Out of scope:

- Bookings on RTGS DCAs in UTEST and
- The messages sent by T2 to the RTGS Account Holder (pacs.010, pacs.009, pacs.004) are not part of this testing phase.

Provide evidence about the successful execution of the test cases:

- Testing results need to be provided to triggersolution@bundesbank.de (Screenshots)

3.1.2 Testing phase 2A (Rehearsal testing interaction with T2)

Aim of this testing phase:

- Rehearsing a full daily end-to-end process (from 09:00 to 15:30 depending on the UTEST availability) settling multiple DvPs
- The content may depend on the respective business cases

Timeline of this testing phase:

- This testing phase is currently scheduled to start in February 2024.
- It will be conducted on dedicated days to be further defined and that will be communicated in advance.

Mandatory test cases during this testing phase:

Precondition:

- Successful completion of testing phase 1B
- Successful static data setup in T2-UTEST, e.g. direct debit mandate

Test data that could be used:

- As payer bank, use your own Account BIC of the RTGS DCA used in the UTEST (in order to ensure that the approval step can be executed)
- As receiver bank, one of the following mock-BICs of Deutsche Bundesbank for testing the Trigger Solution could be used: ZYRPDEFFXXX, ZYRODEFFXXX or ZYBODEFFXXX
- Further details, how the payment instruction should be filled, can be found in the "Trigger Solution Process Description Document"

Test cases (considering the interoperability mechanism used):

Test case	Expected result (to be proved via screenshot)
Check bookings on RTGS DCAs in UTEST resulting from the execution of a payment instruction in the Trigger Solution.	The account owner of the RTGS DCA debited via the direct debit, should either query the cash postings in U2A or A2A mode
Check the received messages sent by T2 (e.g. as payer bank pacs.010) resulting from the execution of a payment instruction in the Trigger Solution.	As soon as the direct debit (pacs.010) settles, a pacs.010 is sent by T2 to the RTGS Account Holder. The payer bank should check the receipt of this message and whether it can be executed in the own systems.

Provide evidence about the successful execution of the test cases:

- Testing results need to be provided to triggersolution@bundesbank.de (Screenshots)

3.1.3 Migration phase 2B

This phase is only relevant for participants that want to conduct trials.

Aim of this phase:

- Set-up of necessary connectivity and static data prior to trials in the production environment of Trigger Solution and T2

Timeline of this testing phase:

- This phase is currently scheduled to start in April 2024.

Precondition for entering this phase:

- Successful completion of testing phases 1B and 2A
- Successful static data setup in T2-PROD, e.g. direct debit mandate.

Provide evidence about the successful connectivity to the Trigger Solution Production environment.

- Evidence needs to be provided to triggersolution@bundesbank.de (Screenshots)
 - API U2A: Screenshot of the Dashboard screen
 - API A2A: Screenshot of a successful API request to the “Welcome” API endpoint. The API request can be performed using tools such as Postman or terminal with curl command line. The following API response should be part of the screenshot: “Welcome to Trigger Solution External APIs”

- Node: Participants can run the peer command "peer channel list" to check if their peer node has successfully joined the channel. Please send to us a screenshot

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Deutschland



Trigger Solution

Onboarding Guide - Technical Annex

Last updated: 13 December 2023

Versions

Version	Chapter	Change information	Date	Name and departmental ID number
1.0	All	Created	10/11/23	Deutsche Bundesbank
1.1	All	Publication	13/12/23	Deutsche Bundesbank

Table of contents

	Seite
VERSIONS	2
TABLE OF CONTENTS	3
1 OVERVIEW	4
1.1 HYPERLEDGER FABRIC	4
2 ARCHITECTURE	5
2.1 ARCHITECTURE DIAGRAM	5
2.2 COMPONENTS	5
3 INTEGRATION	7
4 API USER	8
4.1 TECHNICAL REQUIREMENTS	8
4.2 ONBOARDING STEPS	9
4.2.1 <i>Step 1: API Documentation Review</i>	9
4.2.2 <i>Step 2: Firewall Setup / Opening</i>	9
4.2.3 <i>Step 3: Application Development (only relevant if an A2A-connection shall be established)</i> ..	9
4.2.4 <i>Step 4: API Integration (only relevant if an A2A-connection shall be established)</i>	10
4.2.5 <i>Step 5: Digital signature process</i>	10
5 PEER NODE	11
5.1 TECHNICAL REQUIREMENTS	11
5.2 ONBOARDING STEPS	11
5.2.1 <i>Step 1: System preparation</i>	11
5.2.2 <i>Step 2: Node Deployment and Configuration</i>	12
5.2.3 <i>Step 3: Connectivity Establishment</i>	12
5.2.4 <i>Step 3: Setup a Sub CA</i>	13
5.2.5 <i>Step 4: MSP Definition in Channel Configuration</i>	13
5.2.6 <i>Step 5: Network Interaction</i>	14
5.2.7 <i>Step 6: Chaincode provision</i>	14
5.2.8 <i>Step 7: Security and Endorsement Policies</i>	14
5.2.9 <i>Step 8: Digital signature process</i>	15
6 DIGITAL SIGNATURE PROCESS	16
6.1 OVERVIEW	16
6.2 FOUR-EYES PRINCIPLE	16
6.3 ISSUANCE	16
6.4 SIGNING	17
6.5 VERIFICATION	19

1 Overview

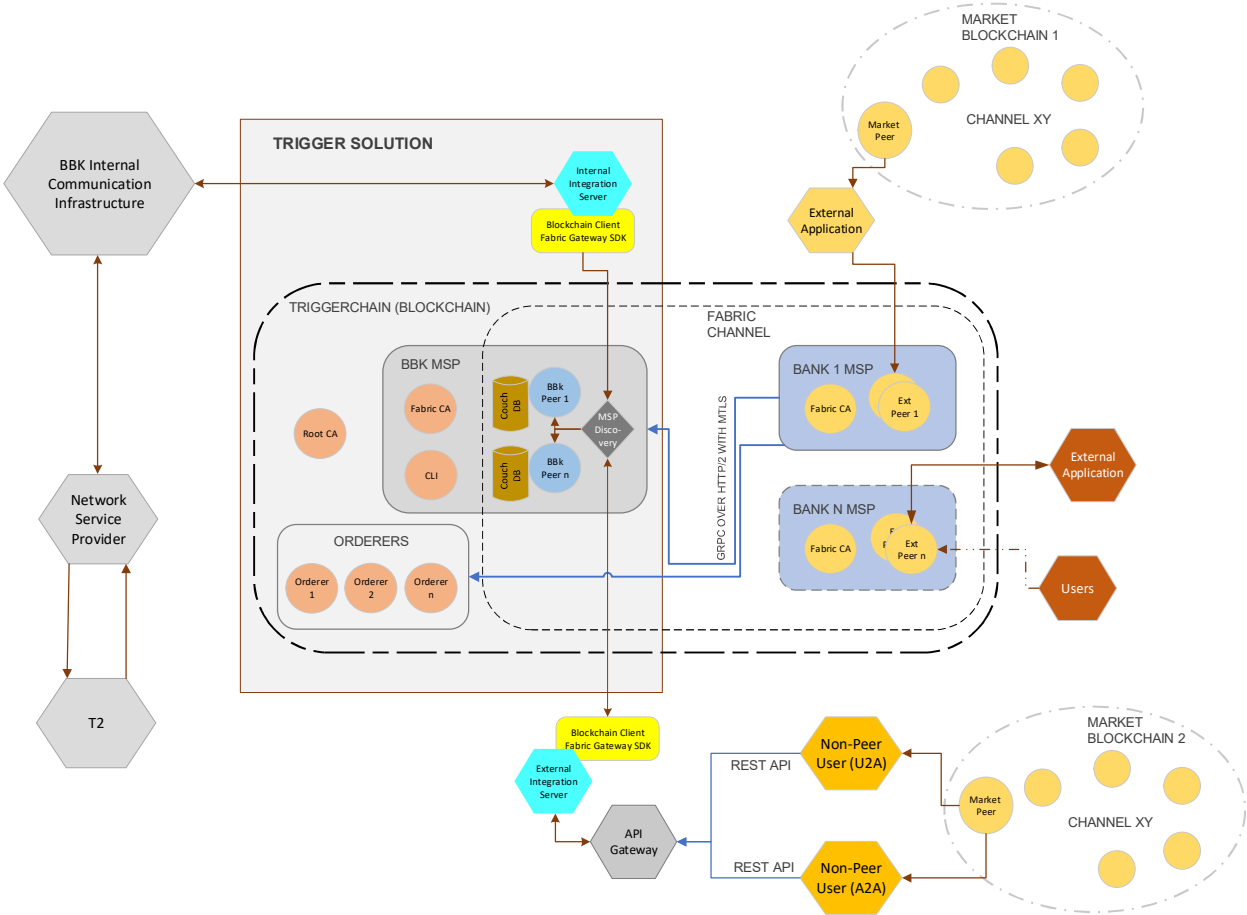
The Trigger Solution is a blockchain-based solution that allows participants to settle Eligible DVP transactions and Eligible Payments in central bank money. The system is based on Hyperledger Fabric 2.5 and is able to take input from numerous Eligible Market DLT Platforms. When an Eligible DVP transaction or an Eligible Payment is confirmed on an Eligible Market DLT Platform, the participant in the Trigger Solution initiates a payment instruction which leads to a payment in the RTGS component of T2.

1.1 Hyperledger Fabric

Hyperledger Fabric 2.5 is being used in the Trigger Solution due to its advanced features that align with the requirement of keeping payment instructions private between the concerned parties. The utilization of **Hyperledger Fabric's private data collection** capabilities offers a robust framework for achieving this privacy while maintaining the benefits of a distributed ledger system.

2 Architecture

2.1 Architecture Diagram



2.2 Components

- Hyperledger Fabric Orderers:** The Hyperledger Fabric orderers are responsible for ordering transactions on the Trigger Solution blockchain network. They ensure that transactions are processed in a secure and deterministic manner.
- Hyperledger Fabric Peers:** The Hyperledger Fabric peers are responsible for maintaining the Trigger Solution blockchain ledger and processing transactions. They also store the cryptographic keys that are used to sign transactions.
- Root Certificate Authority (CA):** The Root CA is hosted by Bundesbank and is responsible for issuing certificates to the Sub CA of participants of the Trigger Solution.
- Sub Certificate Authority (Sub CA):** This Sub CA will be used to issue certificates for its own peers to authenticate the nodes on the network and to encrypt communications between the nodes (i.e. TLS communication certificates). It will also be used to issue

certificates to its users (i.e. authorisation certificates). These certificates are used to authorize them to perform certain actions on the network. This Sub CA must be owned and hosted by every peer participant in the network.

In case of API users, the Deutsche Bundesbank owned Sub CA will be used to issue users certificates.

- **Trigger Solution Server behind API Gateway:** The Trigger Solution Server is responsible for managing the Trigger Solution network. It handles requests from users and applications, and it coordinates the activities of the other components of the network.
- **Eligible Market DLT Platforms:** The Eligible Market DLT Platforms are the blockchains that are used to track the ownership of assets. They are interacting with the Trigger Solution network via the Interoperability Mechanism to allow for the seamless settlement Eligible DVP transactions and Eligible Payments.
- **External Applications:** External applications can interact with the Trigger Solution network through the API Gateway. This allows external applications to submit requests to the Trigger Solution Server and to receive notifications about events that occur on the network.

3 Integration

There are two primary options available to banks:

API USER

The API approach allows for connection to the Trigger Solution using exposed REST APIs offered by Bundesbank. Through these APIs, participants can build and configure their applications to communicate with the Trigger Solution. This approach offers a simplified integration process, making it accessible for institutions with less blockchain experience.

PEER NODE

The peer node approach involves hosting own Hyperledger Fabric nodes. This entails setting up and configuring dedicated nodes within the Trigger Solution network. Participants gain full control over their nodes, enabling direct interaction with the underlying blockchain network. While this approach demands a certain level of blockchain expertise, it offers the advantages of customization and enhanced security. In addition, the deployment of own smart contracts in the Trigger Solution operated by Deutsche Bundesbank is possible to cater for complex transactions requiring for example the coordination of input from several Eligible Market DLT platforms. However, the Deutsche Bundesbank node will not execute these smart contracts.

Both approaches cater to diverse technical capacities, offering flexibility to choose the option that best aligns with a participant's resources and requirements.

4 API USER

4.1 Technical Requirements

In order to use the API the registration for Bundesbank ExtraNet for receiving the necessary authentication information (User ID and password) is necessary (please see Trigger Solution Onboarding Guide chapter 2.3). Via API an A2A- and/or U2A-Access to the Trigger Solution is offered.

Proper security measures should be implemented to ensure the confidentiality and integrity of data exchanged with the APIs.

For testing (in advance of Experiments and Trials) as well as for Experiments the Trigger Solution test environment will be used, while Trials will be conducted in the Trigger Solution Production environment.

The URLs for U2A access are as follows:

Environment	URL
Tests (for Experiments and Trials)	https://experiment-triggersolution.bundesbank.de
Experiments	https://experiment-triggersolution.bundesbank.de
Trials	https://triggersolution.bundesbank.de

The API endpoints for A2A access are as follows:

Environment	URL
Tests (for Experiments and Trials)	https://api-a.bundesbank.de/experiment
Experiments	https://api-a.bundesbank.de/experiment
Trials	https://api.bundesbank.de/triggersolution

The API endpoints are strictly https, hence it can only be reached on port 443.

Component	Minimum System Requirements
Application Server	CPU: Dual-core or higher
	RAM: 4GB or more
	Storage: 20GB or more (SSD recommended)
Programming	Programming language runtime environment (e.g., Python, Java, Node.js)
	API client libraries or frameworks
Network	Stable internet connection with low latency (100 Mbps or higher recommended)

Security Measures	Secure coding practices
	Encryption mechanisms (HTTPS, data encryption)
	Monitoring and logging tools for application performance and troubleshooting
API Specifications	Understanding of OpenAPI 3.0 as a consumer

4.2 Onboarding Steps

4.2.1 Step 1: API Documentation Review

Begin by thoroughly reviewing the API documentation provided by Deutsche Bundesbank as Solution Provider in the restricted service area “Trigger Solution” on the Deutsche Bundesbank website (see chapter 2.1 Trigger Solution Onboarding Guide) . This is a JSON file and is written as per OpenAPI 3.0 specifications, hence it can be imported easily to any REST API tools like Postman etc.

Understand the available endpoints, request and response formats, authentication mechanisms (API keys, Basic Auth, etc.), rate limits, and any specific guidelines for API usage. This step is crucial for gaining a comprehensive understanding of how to interact with the Trigger Solution through the exposed APIs.

4.2.2 Step 2: Firewall Setup / Opening

The API gateway of Deutsche Bundesbank is restricted to allowed users only. Hence it is required to get in touch with Deutsche Bundesbank onboarding team and supply them with your IP or IP range which must be whitelisted before you can start using the endpoints. Please send the details to triggersolution@bundesbank.de after having submitted the initial Trigger Solution Registration Form.

4.2.3 Step 3: Application Development (only relevant if an A2A-connection shall be established)

Develop the application that will interact with the exposed APIs. Choose a suitable programming language (Python, Java, Node.js, etc.) based on your team's expertise and application requirements. Utilize programming frameworks and libraries to simplify API integration and streamline the development process. Set up the necessary environment variables, configuration files and follow other best practices for application development.

4.2.4 Step 4: API Integration (only relevant if an A2A-connection shall be established)

Integrate the API endpoints into your application's codebase. Implement functions or methods to send HTTP requests (GET, POST, PUT, DELETE) to the Deutsche Bundesbank APIs, passing the required parameters and headers as specified in the documentation. Utilize API client libraries or packages to handle authentication, and error handling. Ensure that the application can successfully communicate with the APIs and retrieve the expected responses.

4.2.5 Step 5: Digital signature process

After the previous steps have been completed, the participants need to get a digital certificate (authorisation certificate) from the Sub CA of Deutsche Bundesbank in order to be able to approve payment instructions. This will be a public/private keypair, which can be generated as per steps in chapter 6.

5 PEER NODE

5.1 Technical Requirements

The peer node approach involves hosting own Hyperledger Fabric nodes. This entails setting up and configuring dedicated nodes within the Trigger Solution network. Participants gain full control over their nodes, enabling direct interaction with the underlying blockchain network.

Deploy a minimum of three servers (physical or virtual) for a basic setup: one for the endorsing peer, one for couchdb and the last one for the Hyperledger Fabric (or any other) CA (Certificate Authority).

Component	Minimum System Requirements
Peer	CPU: Dual-core or higher
	RAM: 2GB or more
	Storage: 50GB or more (SSD recommended)
CouchDB	CPU: Dual-core or higher
	RAM: 4GB or more
	Storage: 20GB or more (SSD recommended)
Fabric CA	CPU: Single-core or higher
	RAM: 1GB or more
	Storage: 5GB or more (SSD recommended)
Network	Stable internet connection with low latency (100 Mbps or higher recommended)
	Network security configurations (firewalls, security groups)
Docker	Docker Engine installed
	Docker Compose for orchestration if no K8S (optional)
	Kubernetes for scalability (optional & recommended)

5.2 Onboarding Steps

This section is an overview of steps to be performed for the onboarding of a participant to the network.

5.2.1 Step 1: System preparation

This step involves setting up the necessary infrastructure to host Hyperledger Fabric nodes.

- Selection of suitable hardware, such as servers or cloud instances, with adequate computational power, memory, and storage.
- Install the required operating system (e.g., Ubuntu, CentOS) and Docker to create containers for deploying nodes.
- Configure network settings, including static IP addresses and domain names, to ensure reliable communication within the network.

5.2.2 Step 2: Node Deployment and Configuration

- Deploy and configure the Hyperledger Fabric nodes according to your network's specifications.
- Utilize tools like Docker Compose / Kubernetes to define and manage the containers that make up the network.
- Set up the committing peer node, a Hyperledger Fabric CA node. A CLI can also be setup optionally to interact with peer node.
- Configure the cryptographic materials, including TLS certificates and cryptographic keys, to ensure secure communication between nodes. Refer Step 4 below.
- Establish connections between nodes to create a functional Hyperledger Fabric network. Verify that the nodes are up and running, and that they can communicate effectively within the network.

5.2.3 Step 3: Connectivity Establishment

Participants must also ensure to open the connectivity and share their intended IP address(es) and PORT(s) so that it is reachable by other peers on the network. This is crucial for private data dissipation through gossip protocol. Please send the details to triggersolution@bundesbank.de after having submitted the initial Trigger Solution Registration Form.

All peer participants must establish the connectivity to the following after they provided IP address(es) and PORT(s) are unlocked in the firewall by Deutsche Bundesbank:

For testing (in advance of Experiments and Trials) as well as for Experiments the Trigger Solution test environment will be used, while Trials will be conducted in the Trigger Solution Production environment.

TEST ENV:

peer1.experiment.triggersolution.bundesbank.de on port 443
peer2.experiment.triggersolution.bundesbank.de on port 443
orderer1.experiment.triggersolution.bundesbank.de on port 443
orderer2.experiment.triggersolution.bundesbank.de on port 443
orderer3.experiment.triggersolution.bundesbank.de on port 443

PROD ENV:

peer1.triggersolution.bundesbank.de on port 443
peer1.triggersolution.bundesbank.de on port 443
orderer1.triggersolution.bundesbank.de on port 443

orderer2.triggersolution.bundesbank.de on port 443

orderer3.triggersolution.bundesbank.de on port 443

5.2.4 Step 3: Setup a Sub CA

Participants need to start with first deploying a Sub Certificate Authority. This Sub CA will be used to issue certificates for its own peers (i.e. TLS communication certificates) and users (i.e. authorisation certificates). This Sub CA must be signed by the Root CA of Bundesbank Trigger Solution. The following steps are needed to achieve this:

- Start by creating a private key and CSR (certificate signing request) for the sub CA. Read the official documentation for more information and commands: https://hyperledger-fabric.readthedocs.io/en/release-2.5/deployment_guide_overview.html#step-three-set-up-your-cas
- Share the CSR with Deutsche Bundesbank Administrators via mail to triggersolution@bundesbank.de and get the signed certificate (public key) as a response.
- Start the CA node with the public and private keypairs you have from above step. More info here: <https://hyperledger-fabric-ca.readthedocs.io/en/latest/deployguide/cadeploy.html#optional-deploy-an-intermediate-ca>
- Next, MSP certificate and identities need to be created. More info here: https://hyperledger-fabric.readthedocs.io/en/release-2.5/deployment_guide_overview.html#step-four-use-the-ca-to-create-identities-and-msps

5.2.5 Step 4: MSP Definition in Channel Configuration

Once you have gathered all the certificates and MSPs you need, you're almost ready to create a node. Before any node can be deployed, its configuration file must be customized. For the peer, this file is called core.yaml. You have three main options for tuning your configuration.

- Edit the YAML file bundled with the binaries.
- Use environment variable overrides when deploying. (recommended)
- Specify flags on CLI commands.

More details on above process can be found here in the official documentation: https://hyperledger-fabric.readthedocs.io/en/release-2.5/deployment_guide_overview.html#creating-a-peer

Once the peer is started, we need to generate MSP definition JSON or YAML file which would contain all the public information about the peer, such as public keys, MSPID's and endpoints etc. To generate this file, refer to: https://hyperledger-fabric.readthedocs.io/en/release-2.5/channel_update_tutorial.html#generate-the-org3-crypto-material

This MSP definition file must be shared with the Deutsche Bundesbank administrators (trigger-solution@bundesbank.de), who will then take over the subsequent step. The Deutsche Bundesbank administrators will incorporate the provided cryptographic materials and certificates into the channel configuration using the configxlator tool from the Hyperledger Fabric suite. This inclusion ensures that each node's identity and access privileges are accurately defined within the channel, thus enhancing the overall security and integrity of the network. Hence, while participants initiate the cryptographic setup, it is the Deutsche Bundesbank administrators who seamlessly integrate these materials into the channel configuration.

This step requires coordination between the node administrator of the participants and the Trigger Solution team of Deutsche Bundesbank.

5.2.6 Step 5: Network Interaction

After Deutsche Bundesbank's administrators confirm the channel update was successful, and the participant's MSPID was added to the channel, participants need to interact with the Trigger Solution network, for which you can proceed to try joining the "triggersolution" channel. Refer to: https://hyperledger-fabric.readthedocs.io/en/release-2.5/channel_update_tutorial.html#generate-the-org3-crypto-material

5.2.7 Step 6: Chaincode provision

The chaincode package will be provided by Bundesbank Trigger Solution team via a restricted service area on the Deutsche Bundesbank website (see Trigger Solution Onboarding Guide chapter 2.1). It can be enhanced by the participant to the extent that it does not change the read-write sets of any function. Test the chaincode logic by invoking transactions and checking the endorsement results. This stage requires careful coding, validation, and thorough testing to ensure the chaincode function as intended.

For chaincode installation, refer to: https://hyperledger-fabric.readthedocs.io/en/release-2.5/cc_service.html#running-chaincode-as-an-external-service

5.2.8 Step 7: Security and Endorsement Policies

Security is paramount in blockchain networks. Configure the security settings for nodes by enabling mutual Transport Layer Security (mTLS) encryption. Ensure that only authorized entities can access and communicate with the nodes. Define endorsement policies that specify the minimum number of nodes required to approve a transaction. This adds an additional layer of security and prevents fraudulent or unauthorized transactions. Continuously monitor and update security settings to address potential vulnerabilities and maintain a secure network environment.

5.2.9 Step 8: Digital signature process

After the previous steps have been completed, the participants need to get a digital certificate (authorisation certificate) from the Sub CA in order to be able to approve payment instructions. This will be a public/private keypair, which can be generated as per steps in chapter 6.

6 Digital Signature Process

6.1 Overview

Out of various functions which the Trigger Solution has, there is an Approve function which basically translates to its literal meaning, the approval of the payment transaction.

This is a formal go-ahead by the payer bank and must be supplied with a valid digital signature regardless of the chosen connectivity option of the participant.

6.2 Four-eyes principle

The Trigger Solution has implemented a functionality to approve (i.e. digitally sign) payment instructions in four-eyes mode. Each user's certificate must contain information about the privilege level of that user to sign the payment instructions (either two-eyes or four-eyes mode).

During the signing process, the chaincode will check the privilege of a user via a specific attribute in the certificate OID (Object Identifier) 2.5.4.45.

- If the value of OID 2.5.4.45 for that user is set to 4E (being the approval in 4-eyes mode), the signature will be recorded and the payment instruction will now need to be signed by another user to confirm the approval.
- If the value of OID 2.5.4.45 for that user is set to 2E (being the approval in 2-eyes mode), the signature will be recorded and the payment instruction will be approved, without requiring further approvals.

In case of API users, the value of this OID will be set automatically by Trigger Solution backend based on the ExtraNet registration (see Trigger Solution Onboarding Guide, chapter 2.3). More details can be found below in the Issuance section.

While PEER users need to ensure the values for these OID are set when they issue user certificates from their own Sub CA.

6.3 Issuance

As a part of onboarding, the users will create a CSR (certificate signing request) with their real name or identity in CN of the certificate. The private key must be strictly kept secured and it shall remain with only them. This must be done by each user individually.

The CSR should be strictly of type ECDSA with elliptical curve as prime256v1 (also known as P-256)

The API USERS can then call the certificate signature API and get their CSR signed by the Deutsche Bundesbank Certificate authority.

All users will be required to supply the signature string and their public key in PEM format in the payload of the API call for approval.

The PEER USERS can get their CSR signed by the Sub CA which they have hosted as a part of node installation.

Illustration of a certificate creation process:

Step 1: Create a CSR using a certificate management tool (e.g. openssl) with at least the following mandatory fields: CN, O, OU, OID 2.5.4.41, OID 2.5.4.45, C, ST & L

The two custom OIDs must include:

- 2.5.4.41: value set to MSPID/BIC code.
- 2.5.4.45: value set to 4E for users using the four-eyes mode, OR value set to 2E for users using the two-eyes mode.

Note: If OID option is not suitable to set the four-eye principle value and MSPID/BIC in the certificate, this information can be set alternatively via “attrs” tag. This might be helpful in case fabric ca is used to issue certificates. For more information on how to do this, read: [Attribute-Based-Access-Control](#). Example below:

```
--id.attrs 'privilege=4E,MSPID=TESTMSPID123'
```

Step 2: For API USERS: Call the signCSR API endpoint with the CSR file as payload. More details on the API usage can be found in the API documentation (json file) provided in the restricted area “Trigger Solution” on the Deutsche Bundesbank website (see Trigger Solution Onboarding Guide chapter 2.1)

For PEER USERS: Use your own Sub CA to get your CSR signed.

6.4 Signing

Users sign a SHA256 sum of a JSON string of ID + AMOUNT + PAYERBANK + RECEIVERBANK + HTLCHASH + HTLCTIMEOUT, generating a unique transaction signature.

Note: The HTLC Hash and HTLC Timeout would remain blank if the payment instruction is non-JTLC.

Signature and public key are included in the payload for operations like payment instruction approval.

Illustration of a signing process:

Step 1: Suppose the payment instructions JSON is:

```
{
  "pdc": "pdcname1",
  "payload": {
    "data": {
      "id": "6daf1139-35a1-4360-bbf7-32aadaef2c92",
      "amount": "500",
      "currency": "EUR",
      "payerBank": "ZBANKMSP1",
      "receiverBank": "ZBANKMSP2",
```

```

    "orderingCustomer": "ZBANKMSP3",
    "beneficiaryCustomer": "",
    "correlationId": "AC9I-23hjm23k3pn4b94or3s",
    "htlcHash": "810ff2fb242a5dee4220f2cb0e6a519891fb67f2f828a6cab4ef8894633b1f50",
    "htlcTimeout": "1699443184234",
    "approvalTimeOut": "1800"
  },
  "sign": {
    "signature": "",
    "signerPEM": ""
  },
  "error": {
    "code": "",
    "description": ""
  }
}
}
}

```

Step 2: Calculate the string to sign. It will be ID + AMOUNT + PAYERBANK + RECEIVERBANK + HTLCHASH + HTLCTIMEOUT. That becomes as follows in this case:

```

6daf1139-35a1-4360-bbf7-32aadaef2c92500ZBANKMSP1ZBANK-
MSP2810ff2fb242a5dee4220f2cb0e6a519891fb67f2f828a6cab4ef8894633b1f501699443184234

```

Note: In case of non-HTLC payment this would look like: 6daf1139-35a1-4360-bbf7-32aadaef2c92500ZBANK-MSP1ZBANKMSP

Step 3: Calculate sha256sum of above string.

```

7c4792beb90db71a7842c19b666f77204e16914f74fad18ca041877ecf22138b

```

Step 4: Sign the above string using private key.

The output of signing is what we will refer to as “signature string”.

Few signature generation examples from code:

- Using OpenSSL

Where privkey.pem is user’s private key and signature string is stored in a file called signature.bin

```

openssl dgst -sha256 -binary << "7c4792beb90db71a7842c19b666f77204e16914f74fad18ca041877ecf22138b" > hash.bin
openssl ecDSA -in privkey.pem -sign hash.bin -out signature.bin

```

- Using NODEJS:

```

//sign
const sign = crypto.createSign('SHA256');
sign.update(payloadSHA256);
sign.end();
const signature = sign.sign(privatekey , 'base64');

```


Step 5: Call the approve API with post request and pass the signature string and public key (user certificate public PEM) in the payload under “sign” section. More details can be found in the shared in the API documentation (json file).

6.5 Verification

Signature verification occurs at the Trigger Solution level.

Custom OID, Issuer, and signature string undergo validation.

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