



Final Report

gpi real-time Nostro Proof of Concept

Can blockchain pave the way for real-time Nostro reconciliation and liquidity optimisation?

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Can distributed ledger technology (DLT) help financial institutions optimise the real-time liquidity of their Nostro accounts and reduce the significant operational costs associated with reconciliation?

This was the question on the industry's mind when SWIFT – together with 34 leading global transaction banks – kicked off a proof of concept (PoC) to use DLT to provide real-time visibility of Nostro accounts.

Based on the business and technical requirements validated by the participating banks, SWIFT developed a DLT solution whereby the Nostro Account owner and its Servicer share a private confidential ledger recording transactions related to their Nostro account.

The solution leveraged ISO 20022 standards and gpi innovations – including the unique end-to-end transaction reference (UETR) – and integrates the intraday liquidity standards developed in line with the SWIFT intraday liquidity standard rulebook.

Throughout the PoC, the participating banks tested 34 use cases impacting Nostro account balances and went through a liquidity testing phase. Using the developed Nostro application and a supporting back office simulation tool, they collectively assessed whether and how Nostro reconciliation and liquidity optimization could be supported and improved compared to current processes.

The PoC was built within the SWIFT DLT sandbox environment – a use case agnostic DLT platform which enables experimentation and collaboration between SWIFT and its community. The sandbox is a first step towards a SWIFT DLT platform, combining leading distributed ledger technology, Hyperledger Fabric 1.0, with SWIFT assets to deliver a unique offering tailored to the needs of the financial industry. This solution leverages SWIFT's comprehensive governance and identification framework complemented by extensive controls guaranteeing confidentiality and security.

Results

With 34 banks participating in the initiative and 28 banks actively testing using their node deployed in the SWIFT DLT sandbox, the initiative was one of the most extensive blockchain proofs of concept and Hyperledger implementations executed in the industry so far, in terms of participant engagement and of the scale of infrastructure deployed.

Based on extensive testing, the participating banks found that the Nostro DLT application, when combined with the underlying ISO 20022 data model, delivered the business functionalities and data richness required to support automated real-time liquidity monitoring and reconciliation. This was made possible thanks to a systematic real-time confirmation of each account entry and use of the UETR.

The PoC demonstrated the huge progress DLT has made with regards to data confidentiality, governance, security, and the identification framework, evidencing that the emergent technology, combined with SWIFT assets, does now provide the necessary foundation for building financial applications. However, it also showed that further progress is needed on the DLT technology itself before it is ready to support applications in large-scale mission-critical global infrastructures. For example, while 528 channels were required in the PoC to ensure Nostro accounts would only be stored on the nodes of their account servicers and owners, to productise the solution, more than 100,000 channels would need to be defined, covering all existing Nostro relationships, presenting significant operational challenges. It is however clear that it is no longer a question of whether DLT will reach maturity but rather when it will reach maturity.

Key findings

While the results are encouraging, testing also highlighted the need for a set of pre-requisites for such a solution to deliver the expected benefits and be adopted by the industry:

1. There is a need for all Nostro Account Servicers to migrate from batch to real-time liquidity reporting and processing. Today, 44% of cross border payments exchanged over SWIFT generate a real-time confirmation of debit or credit (MT900/910)¹.
2. While the DLT application could provide a platform to share the information, there is significant work and investment required by all banks to upgrade their back office applications to feed the platform with real-time updates. The success of any solution will be dependent upon deep integration with back office systems using APIs. These implementation costs could be significantly lowered should ISO 20022 standards be adopted first for the payments themselves. This would ease integration as a common data model providing the required level of granularity for Nostro.
3. A value proposition for each market segment catering for different levels of sophistication, automation of operations and past investments is key to ensure industry-wide adoption and coexistence, hereby delivering maximum value.

The benefits for the larger clearing banks are less clear since their dependency on external Nostro Servicer providers is reduced overall when compared to mid-tier banks. Larger banks typically manage their key currencies internally and have already invested heavily in highly optimised liquidity and reconciliation tools.

Also, additional intelligence built in to the ledger and deeper integration with existing inter-related processes, such as Nostro liquidity management, reconciliation, exception management or regulatory reporting is needed to fully capture the benefits of a DLT solution.

4. Unique identification of each entry is the cornerstone of any liquidity and reconciliation solution. The re-use of the gpi UETR, leveraging SWIFT's central payments tracker for this purpose is an obvious choice. To cover all Nostro account movements, its usage must be extended to identify key message types such as FX and securities transactions that potentially do not settle through a payment message.

Next steps

While real-time Nostro reconciliation and liquidity remains a strategic priority to reduce operational costs and comply with new regulatory frameworks in some jurisdictions, the PoC revealed that the pre-requisites will have to be met before banks can enjoy the full benefits from switching to a DLT process. Moreover, considering the high impact to banks and payments systems operations, SWIFT, together with the participating banks, concluded that the timing might not be right for a community investment in this area. Current interest rates and other priorities, especially in countries where regulators have not yet published any intraday reporting guidelines, will have an impact on future development.

Therefore, as a next step, SWIFT will continue working together with its community on the following initiatives to address the identified pre-requisites before working on the productisation of the Nostro application itself:

1. SWIFT will continue encouraging its community to migrate towards real-time liquidity reporting and processing, and will be monitoring both progress in that direction, and any regulatory development in this area;

2. SWIFT will start an ISO 20022 consultation with its community to assess a timeline and a migration approach towards ISO 20022 as a means to reduce the community implementation cost; and
3. As part of the gpi roadmap, extension of usage of UETR to other payment types and beyond payments will be considered, in order to provide transaction identification for all nostro movements.

It is a strategic priority for SWIFT to work with new technologies like DLT. SWIFT will be continuing its research and development efforts to ensure that over time, SWIFT members can leverage their existing SWIFT infrastructure and SWIFTNet connectivity to benefit from blockchain services, offered by SWIFT or third parties, on a secure and trusted platform, connected to 11,000 members globally.

In particular, SWIFT's 2018 plans for DLT include:

1. Continue developing DLT usage with its community through other PoCs deployed in the SWIFT DLT sandbox and participating in industry consortia, such as Hyperledger and the CSD working group² to name two;
2. Work towards evolving our platform to complement it with DLT capabilities, developing the value proposition and product offering;
3. Continue reviewing and assessing the evolution of various blockchain technologies in line with financial industry requirements; and
4. Actively promote the re-use of ISO 20022 in a DLT and API context. For example, through the ISO technical committee 307 on blockchain standardisation.

¹ (SWIFTWatch – FIN traffic – 2017)

² <https://www.swift.com/news-events/press-releases/swift-and-csd-community-advance-blockchain-for-post-trade>

Improving operational efficiency and reducing transactional costs for international payments has become one of the key priorities for banks in their response to: increasing customers' expectations and regulatory requirements, whilst maintaining their competitive position.

On average, 34% of the cost of an international payment is related to Nostro trapped liquidity caused by the absence of real-time data to optimise intraday liquidity management. Meanwhile, 9% of the cost is linked to investigations or exceptions mainly driven by a lack of standardisation in the end-to-end payment's process, and by the related Nostro account reconciliation³.

Overfunding of Nostro accounts or alternatively excessive use of credit lines particularly regarding payments settled in a different time zone is mainly driven by the lack of visibility and predictability on intraday in and out flows.

A real-time information mechanism at transactional level would not only reduce costs by enabling liquidity optimisation; it would also enhance banks' ability to provide a better service to their customers by enabling earlier release of payments whilst reducing recalls and liquidity risks.

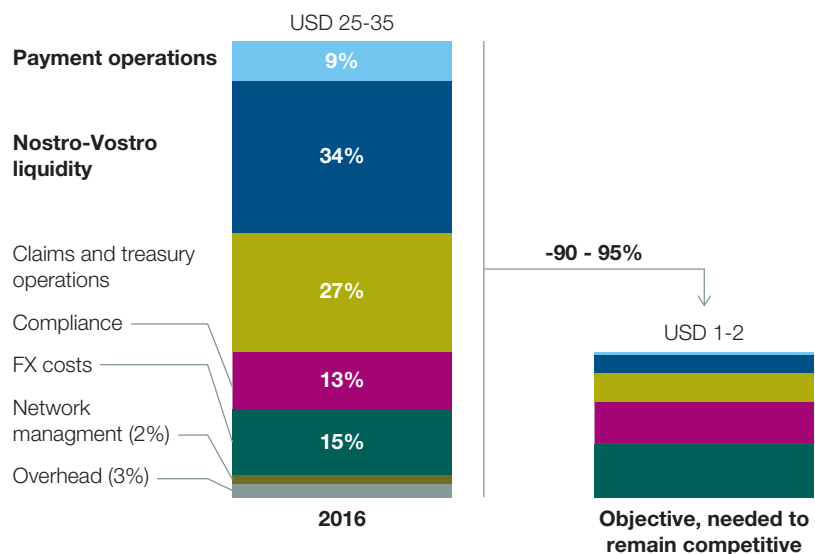
Many banks have initiated projects to implement real-time liquidity management that will deliver substantial financial benefits beyond their compliance with new regulatory requirements. These include financial savings such as lower funding costs and a reduction of related risks, especially during times of higher market volatility.

To achieve this, banks need the ability to monitor their intraday liquidity usage through a real-time confirmation of each entry on their various Nostro accounts, as well as improving their intraday forecasting through systematic early identification of incoming movements.

Real-time Nostro reconciliation is an integral part of this process, which requires timely matching of all movements on the account. It should enable banks to improve operational efficiency leading to a reduction in the cost related to open entries, including an end of day overdrawn balance or potential charges and interests.

To remain competitive, back office cost for international payment should drop by 90 to 95%

Figure 1 - Cost per international payment transaction



Source: McKinsey & Company, Global Payments 2016: Strong Fundamentals Despite Uncertain Times

³ Global Payments Report 2016, McKinsey

What were the main issues we aimed to address?

Data gaps

Real-time Nostro liquidity and reconciliation management require banks to collect transaction-by-transaction debit and credit confirmations in real-time.

Despite the new intraday liquidity rules implemented in some jurisdictions and derived from the recommendations expressed by the Basel Committee on Banking Supervision (BCBS 248) advocating for improvements in intra-day reporting industry practice, there are still important data gaps.

Results of the last market consultation on intraday liquidity carried out at Sibos Geneva in October 2016, reveals that whilst progress has been made, the industry is still facing data challenges:

- Too few transactions reported on a real-time basis (18% of responses).
- Lack of timeliness of the reporting (19% of responses).
- Lack of granularity in the information provided including the required time stamps (21% of responses).
- Limited business practice for the usage of credit notifications in support of intraday liquidity (15% of responses).

Many large account servicers have invested heavily in their real-time reporting capabilities for top currencies. However, the majority is still facing challenges to provide the real-time feeds requested by their customers for some transaction types. Any intraday projection from these account owners will be based on their internal forecasting system and not on the timed confirmations from their account servicers. This will potentially have an impact on their ability to calculate their real-time balance. Transactions leading to such issues will typically include book transfers with no underlying payment instruction, or cash entries related to transactions managed by other business lines such as payments related to corporate actions.

The lack of data centralisation and integration

A number of institutions have not yet centralised the management of their Nostro accounts. Legal entities within the same group may use different payment hubs distributed around the world to send their instructions and receive confirmation messages from both their internal and external clearing service providers.

Treasury and reconciliation systems have, in most cases, not been integrated across regions and currencies. Being able to rely on a single source of aggregated data is a desired objective of larger institutions but there remains a data standardization and distribution challenge in order to build a view of real-time positions both at firm-wide and entity-wide levels for key currencies. The complexity and cost related to such projects represent major obstacles to their implementation.

Exceptions and investigations

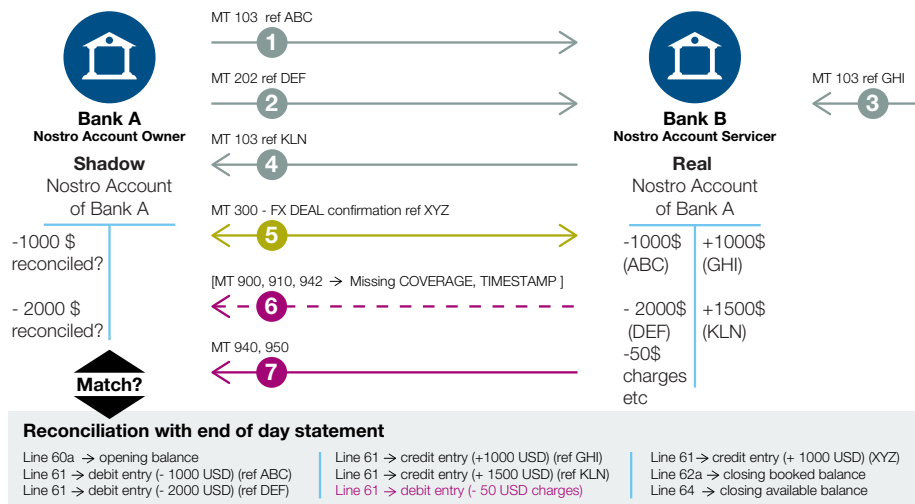
Exceptions and investigations have a multiplier effect on the overall payment cost. Issues related to pending transactions on Nostro accounts (payments and receipts that have not yet settled or cash receipts that have not been pre-advised) which are reported through the end of day statement are only identified towards the end of the day.

From a funding perspective, especially close to the cut-off for a specific currency, it is a key need for banks to identify potential pending transactions or unexpected ones.

Investigations related to post-settlement or to unmatched items (either unreconciled or unconfirmed entries) also result in a highly manual resolution process.

Treasury operations in particular, invoicing of both regular and exceptional payments processing fees based on bilateral price agreement leads to a complex monthly reconciliation process resulting in a number of expensive claims managed manually.

Figure 2 - Simplified current Nostro flows



Basel Committee on Banking Supervision 248 (BCBS 248) – Monitoring tools for intraday liquidity management

How does the PoC fit into the gpi initiative

1. Today

SWIFT gpi brings to banks' corporate customers same day use of funds, transparency, traceability, and unaltered transmission of remittance data for their international payments. The improved visibility of payment status is also expected to reduce the volume of investigations. It already provides the foundational layer thanks to the use by all gpi member banks of a Unique End-to-end Transaction Reference (UETR) to link the real-time status on the payments with the entry status on the related Nostro Account - potentially leading to an impact on the intraday balances.

2. Tomorrow

Building on the successful launch of gpi in early 2017 and the rapid adoption by the community, SWIFT will release three new gpi services towards the latter part of 2018, to be adopted by all gpi banks: the cover service, extended tracking of gpi payments, and the Stop & Recall service; further consolidating gpi as the new normal for correspondent banking.

As from November 2018 gpi will enhance banks liquidity management function through extended tracking of key payment types allowing banks and their customers to identify their incoming payments flows as soon as they have been initiated.

Additionally, as part of the gpi innovation stream, SWIFT conducted its first gpi Industry Challenge in 2017 to encourage FinTech companies to build overlay services leveraging the gpi platform, solving incremental challenges faced by corporate treasurers. During the early part of 2018, the two winning FinTechs will work with SWIFT on a proof of value based on the two winning ideas.

3. Future

This proof of concept is part of the fostering innovation stream of gpi, focussed on the exploration of new technology developments to enhance correspondent banking services and operational processes. Going forward SWIFT will continue to evaluate new technologies through gpi, and that will ultimately benefit the entire community - not just gpi banks.

“We were pleased to participate in this PoC. Once again it confirmed the potential that DLT has for different facets of the international payments process. We look forward to continue working with SWIFT on the GPI and related DLT efforts.”

Julio Faura,
Head of Blockchain, R&D, Santander

Business objectives

The aim of the PoC is to demonstrate whether a real time DLT solution could help resolve the identified issues that include:

- Less than optimal funding positions across Nostro accounts due to lack of real-time visibility of the account's entries, and monitoring of the related intraday expected and available balances;
- Operational savings through increased efficiency of Nostro reconciliation.

End-to-End Nostro account entries workflow (see figure 3)

There is a need to demonstrate that the distributed ledger solution provides real time visibility of relevant information for both the Account Owner and the Account Servicing institutions related to:

- The status of a transaction entry in the Nostro Account as well as of any related account entries (e.g. charges);
- The status of the underlying payment processing that could have an impact on the entry status in the Nostro account (e.g. rejected payments or cancellations) or that could delay the booking process (e.g. payments under investigation or on hold);
- The impact on the related Nostro account intraday balance (expected and/ or available balance).

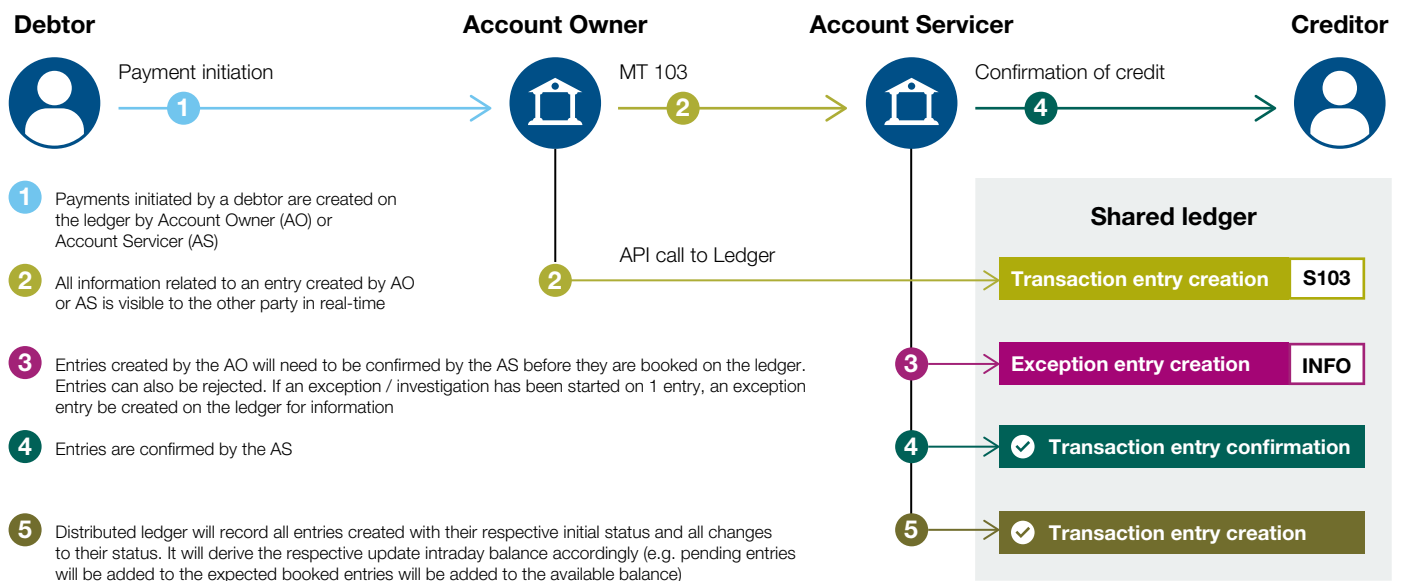
All entries such as charges related to the same transaction (e.g. customer payment) shall be identifiable through the use of a common reference in order to support the reconciliation process.

The life cycle of entries in the DLT Nostro account should be directly synchronized with the payment process because any event in the process could have an impact on the related entry. Therefore, the DLT solution should cater for the creation of exceptions entries to identify in near real-time the underlying reason for pending entries.

It should also enable the account owner to identify whether it could delay the confirmation process and have an impact on the intraday account balance.

The end-to-end account entries workflow concept (see figure 3) was tested during the PoC for a representative number of transaction types and use cases.

Figure 3 - DLT PoC End-to-End entries lifecycle



Audit trail

The distributed ledger needs to provide non-repudiation evidence for each entry on the account. Used in a mutualised way as a trusted data source for liquidity and liquidity risk management, or even for regulatory reporting purposes. A full audit trail being automatically created would provide evidence of the liquidity transfer in case of dispute or provide trusted underlying information in case of a regulatory investigation.

An important condition to support an audit trail of the entry in the ledger is the availability of a unique end-to-end transaction reference (UETR) for each entry in the shared ledger provided by either the Account Owner or the Account Servicer, depending on the use case.

Common standards

A key success factor in an industry solution for real-time Nostro liquidity and reconciliation is the development of common standards created from a set of common business rules and technical specifications.

The data model of the PoC is based on the ISO 20022 standard and is aligned with the existing and newly developed gpi best practices and standards for payments and SWIFT Intraday Liquidity standard for Intraday Nostro reporting⁴.

A standardised input to the shared ledger defined the data set and the format provided to participants to create, confirm or reject an entry. The standard includes a common time stamping model that distinguishes the creation time of an entry from its booking time or its value time.

“ANZ has been encouraged by this initiative, not just in the progress made in extending and testing a DLT solution for Nostro Reconciliation, but also by the scale of the collaboration, which evidences the industry’s desire to go beyond incremental improvements and explore radical changes enabled by new technology. Proofs of concept like these are good examples of how maturing innovations like DLT can, and should, be guided by use cases with clear links to customer and business outcomes. ANZ looks forward to its continuing involvement in furthering causes that benefit the broader community.”

Nigel Dobson,
Banking Services Domain Lead, Digital
Banking, ANZ

⁴ Please refer to <https://www.swift.com/our-solutions/global-financial-messaging/payments-cash-management/intraday-liquidity-reporting>

Business scope

Ten business dimensions (see figure 4) were identified for the development of a DLT based real-time Nostro liquidity and reconciliation concept model. While any production solution would need to address those ten dimensions, the scope of the PoC was limited to the key dimensions required to demonstrate the value of a transaction life cycle whilst ensuring the highest volume coverage.

Thirty-four standard business use cases were specified and developed to cover the selected dimensions and used as the reference for testing by all participants.

A detailed list of objective criteria was agreed in relation to the identified business promises in scope for the PoC (see table 1 in Annex).

Figure 4 - Business dimensions scope

Business dimensions	In scope for the PoC	Not in scope for the PoC
Roles	<ul style="list-style-type: none"> - Account Owner institution - Account Servicing Institution - Shared ledger with smart contract 	<ul style="list-style-type: none"> - Tracker
Transaction entry	<ul style="list-style-type: none"> - Debit entry instructed by AO - Debit - funding other Nostro Account - Credit entry instructed by third party - Debit / credit entry with no payment instruction - Debit entry instructed by AS (pre-agreed) - Debit entry instructed by AO 	<ul style="list-style-type: none"> - Debit entry instructed by third party - Credit entry instructed by third party with COVER - Cheques clearing: single entry settled in bulk - Return / Reversal - Inward / Onward debit - Bulk low value payments - Debit / credit advice
Charge entries	<ul style="list-style-type: none"> - OUR charges - Processing charges (CAT2) - Charges on payments exceptions (e.g. repair) 	<ul style="list-style-type: none"> - Charges billed on other Nostro - Rebate on processing charges
Sub-entries	<ul style="list-style-type: none"> - Exception entry 	<ul style="list-style-type: none"> - Credit interests - Debit interests - Negative credit interests - Account's management
Account entry status	<ul style="list-style-type: none"> - Pending - Booked - Rejected 	
Balanced type	<ul style="list-style-type: none"> - Opening available - Closing available - Interim available - Expected 	<ul style="list-style-type: none"> - Opening booked - Closing booked - Interim booked
FX		<ul style="list-style-type: none"> - FX indication in MT103
Role in payment chain	<ul style="list-style-type: none"> - Book entry - Non-book entry 	
Back / Forward entry	<ul style="list-style-type: none"> - Forward value entry 	<ul style="list-style-type: none"> - Back value entry
Payment status		<ul style="list-style-type: none"> - Pending (ASCP) - Completed (ACSC) - Rejected (RJCT)

Technical objectives

SWIFT have been analysing and testing, for some time now, the potential application of distributed ledger technology in the financial industry. In April 2016, SWIFT conducted an in-depth assessment of DLT that determined the technology was not mature enough to fulfil the requirements of the financial community. While this conclusion still holds true today, SWIFT has seen a number of major advancements in the past year addressing the critical requirements necessary for the technology to achieve industry-wide adoption.

From a technology point of view, the objective of this Proof of Concept was threefold:

1. To assess DLT in a “many-to-many” setting, addressing a real business use case to draw lessons for larger scale implementations of the technology and assess benefits over other architectures.
2. To assess whether these new technology advancements, combined with SWIFT assets, allow the fulfilment of key industry requirements such as governance, security and data privacy.
3. To check the current level of maturity against the requirement for a production grade application, and as a mission critical global infrastructure.

“The PoC provided validation that mid-tier banks will likely see substantial benefits in liquidity management. However, the ability of DLT to reach its maximum, transformative potential for the financial industry is fully dependent upon its capacity for seamless integration and interoperability with existing bank infrastructures.”

Vivek Kohli,

Director, Emerging Payment Technology
Head, BNY Mellon Treasury Services

Using the SWIFT DLT sandbox to meet the PoC technical requirements

The Nostro proof of concept was built within the SWIFT DLT sandbox environment. The sandbox environment is a use case agnostic DLT platform providing the foundations for building proof of concepts and experimenting together, with the SWIFT community. It is a first step towards a potential SWIFT DLT platform, combining leading distributed ledger technology with SWIFT assets to deliver a unique offering tailored to the needs of the financial industry.

Hyperledger Fabric 1.0 was selected as the underlying technology for the SWIFT DLT sandbox for its support of the following features:

- It is a private permissioned ledger solution which is able to strictly control access to the ledger(s).
- It supports selective data distribution, allowing not only secure data access but also physical data storage to relevant nodes only.
- It supports native integration with a certification authority, allowing for all access keys used for parties identification and transaction signing to be certified, providing trust in key authenticity and in the identity of parties.
- It provides a smart contract platform – chaincode in Hyperledger Fabric terminology - that can be leveraged to implement business logic and workflows.

Next to those technical reasons, Hyperledger is an open source initiative driven primarily by the needs of the financial industry. SWIFT, as well as a number of the participants to the proof-of-concept, being Hyperledger members, made the latter a good fit.



The SWIFT DLT sandbox has been built to meet six of the eight industry requirements identified by SWIFT in its [previous paper](#) and illustrated above in figure 5. The below section summarizes for each one of them:

- How this requirement is translated for Nostro reconciliation use case.
- How this requirement is being met in the proof of concept using SWIFT DLT sandbox.

Compliance with regulatory requirements and security are the last two industry requirements which were identified as part of SWIFT's position paper. The Proof of concept does not focus on those two aspects, primarily because we believe that the technology is too new to undergo a security assessment and the regulatory developments remain in their infancy.

Development of the PoC started on Hyperledger Fabric 1.0 alpha. Migration to Hyperledger Fabric 1.0.1 was performed following its availability.

Requirement

Access to the solution must be restricted to the relevant institutions while updates and consultation of a particular account must only be allowed to the actual account owner or servicer. Furthermore, distinction shall be made between the privileges of an Nostro Account Owner and of its Account Servicer. For example, only the Account Servicer must be able to effectively confirm a debit or a credit on the account once it has been successfully processed.

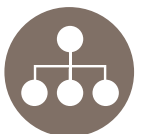
DLT sandbox implementation

Two types of users are defined – SWIFT and participants – with a different set of privileges. SWIFT users are responsible for the administrative and management function (e.g. user management and provisioning, creation of genesis block, smart contract provisioning) while the participants users have access to the actual business functionalities.

Participant membership is managed through a Closed User Group (CUG) while a Role Based Access Control (RBAC) service defines business roles for participants in the CUG.

Two roles have been defined - Account Owner and Servicer – and the combination of the participant identity together with the role assigned determines what actions are allowed. For example, only the Account Servicer may confirm a pending payment to effectively debit or credit the account. Both CUG and RBAC functionalities are implemented through chaincodes on the ledger.

The strict segregation between SWIFT and business participants together with the CUG and RBAC functionalities deliver a comprehensive governance framework where roles and responsibilities are clearly defined and strictly enforced.



Requirement

Access to the data about a particular Nostro/Vostro account must be granted only to the actual Account Owner and Account Servicer. Next to securing access to the data, data must also be physically stored only on the nodes of the relevant parties – the Account Owner and its servicer – rather than disseminated through the entire network. Selective data distribution reduces the risk of malevolent access to the data as even the strongest encryption algorithms may not pass the test of time.

DLT sandbox implementation

To ensure confidentiality of the Nostro accounts, the DLT sandbox relies on the following controls:

1. Access to a particular account is limited to its Owner and to its servicer. The Account Owner and Account Servicer roles define the type of actions that can be performed on the account.
2. Information about a particular Nostro account is only stored (and is only accessible) on the nodes of the Account Owner and of the Account Servicer, and on the ordering service nodes. This is enforced using the “channel” functionality of Hyperledger Fabric 1.0. A channel is being defined for each bilateral business relationship; effectively creating a dedicated ledger storing all information related to the accounts those two institutions hold with each other. This generates a significant number of channels. If there are n participants, the theoretical maximum is $n*(n-1)/2$ channels if all participants have a business relationship with each other.
3. As part of the consensus process, a transaction on the Nostro account is only seen and approved by the Account Owner and of the Account Servicer, and checked by the ordering service operated by SWIFT.

Further to these 3 controls, encryption of the data was not implemented as part of the PoC due to timing constraints, but would be considered for any production implementation.

“Accessing the DLT sandbox environment, we were able to engage with clients to showcase the positive effects on intraday liquidity management.”

Andreas Hauser,
Senior Product Manager for Intraday Liquidity Management, Cash Management, Deutsche Bank



Requirement

Existing MT and ISO 20022 standards providing real-time entry status for Nostro accounts. To foster adoption of any real-time solutions, and minimize its implementation cost, it is a key requirement to leverage newly developed industry practices. To adapt them to a paradigm where information is shared between transaction parties rather than only exchanged through messages.

DLT sandbox implementation

The Nostro reconciliation proof of concept was built leveraging existing newly developed market practices and existing ISO message standards. In particular, the data model used to store all transactions on Nostro accounts is based on the ISO 20022 BankToCustomerStatement (camt.053). ISO 20022 was selected over the MT equivalent (MT950) for its increased richness and granularity. Data quality is an essential requirement to be able to improve transaction reconciliation - one of the key business objectives of the proof of concept.

Next to the data model, the business workflows supporting all 34 use cases covered as part of the proof of concept were implemented using chaincode based on the ISO 20022 standards and in line with the SWIFT intraday liquidity standard rulebook.

Thanks to the data model and the workflow being inspired by ISO 20022, API calls that were created to support the various interactions with the ledger were also defined using ISO 20022 data elements.

Although APIs were developed, they were not exposed to participants for this proof of concept because all interactions were done through a web interface. APIs allow for deep integration with back office applications that are becoming more ISO 20022 compatible.



Requirement

Transactions posted on a Nostro account are very sensitive in nature and it is therefore critical to ensure a strong identity framework where parties are identified through a legal identifier such as the Business Identifier Code (BIC) or the Legal Entity Identifier (LEI). A trusted third party is required to register participants and certify authenticity of security keys. The central registration authority ensures a much stronger identity framework compared to public blockchain models where identities are pseudo-anonymized and keys self-certified.

DLT sandbox implementation

The DLT sandbox relies on a two level participant identification scheme whereby:

- Participants are identified and addressed through a legal identifier. The BIC was used as part of the proof of concept. Membership to the CUG is defined at the participant level.
- Keys used by participants to access/sign transactions are certified by a SWIFT controlled Certification Authority, through the issuance of Certificates. Those keys are tied to the participant through their distinguished name (DN) that contains the business identifier code identifying participant ownership for each of the keys.

Note as part of the PoC, all keys used are stored on disk. For a production implementation, hardware security modules (HSM) that offer suitable protection against key theft would be considered.

“As a global leader in financial innovation, RBC is working collaboratively across industry to explore the use of emerging technologies in a variety of applications. We are excited about the potential of Blockchain technologies. While we are in the early days, this proof of concept has demonstrated how this technology could lead to a number of benefits, such as faster reconciliation, simplified processes and increased security.”

Lisa Lansdowne-Higgins,
VP Business Deposits & Treasury Solutions
RBC Royal Bank



Requirement

With DLT technology rapidly evolving the main objective of the PoC as far as reliability is concerned was to:

1. Assess the maturity and stability of the technology from a reliability point of view; and
2. Understand the impact of running a DLT based solution for a mission critical application such as Nostro reconciliation, taking into account the significant architectural changes inherent with DLT solutions to meet the needs of the financial industry.

DLT sandbox implementation

To cater for the data privacy, strong identification and scalability requirements of the financial industry, the architecture of distributed ledger solutions had to adapt significantly. Emerging technologies are moving from fully distributed architecture to hybrid models whereby some of the components are distributed, others are centralized. Hyperledger Fabric is not different in that regard and was reflected in the DLT sandbox. While the participant nodes storing information on the Nostro accounts are fully distributed, they rely on a number of “central” components operated by SWIFT.

In particular, the following infrastructure is operated by SWIFT:

- A set of nodes in charge of the user and role management. Those nodes have no access to data related to Nostro accounts.
- A central certification authority in charge of issuing certificates and of maintaining a certificate revocation list.
- An ordering service in charge of ordering transactions, within a channel, into blocks.

To ensure a resilient setup, resiliency for the participant nodes as well as for the SWIFT operated components was foreseen. For example, the ordering service was operated as a cluster of 4 nodes.

The resiliency of each participant relies on other nodes from the same participants, on the nodes of its Accounts Servicers/Owners for the accounts it owns/services, or on the ordering service.



Requirement

Scalability needs are very dependent on the use case. For Nostro reconciliation each financial entity would need to have a bi-lateral relationship (channel) with every correspondent they have an account with; and within each relationship there may well be multiple ledgers each representing a single Nostro account.

Secondly, there is a focus on ensuring that DLT can provide real-time visibility on the Nostro accounts and that as such, consensus is achieved within seconds. The latency needs to remain stable as the number of Nostro/ Vostro relationship increases quadratically when the number of correspondents grow.

DLT sandbox implementation

To make sure that consensus is reached within a few seconds for each transaction, irrespective of participant location, the consensus algorithm parameters of the SWIFT DLT sandbox were fine-tuned so that consensus would take place every 2 seconds.

Further to that aspect, the DLT sandbox environment was scaled to support the number of participants (34) and of the related number of channels (528).

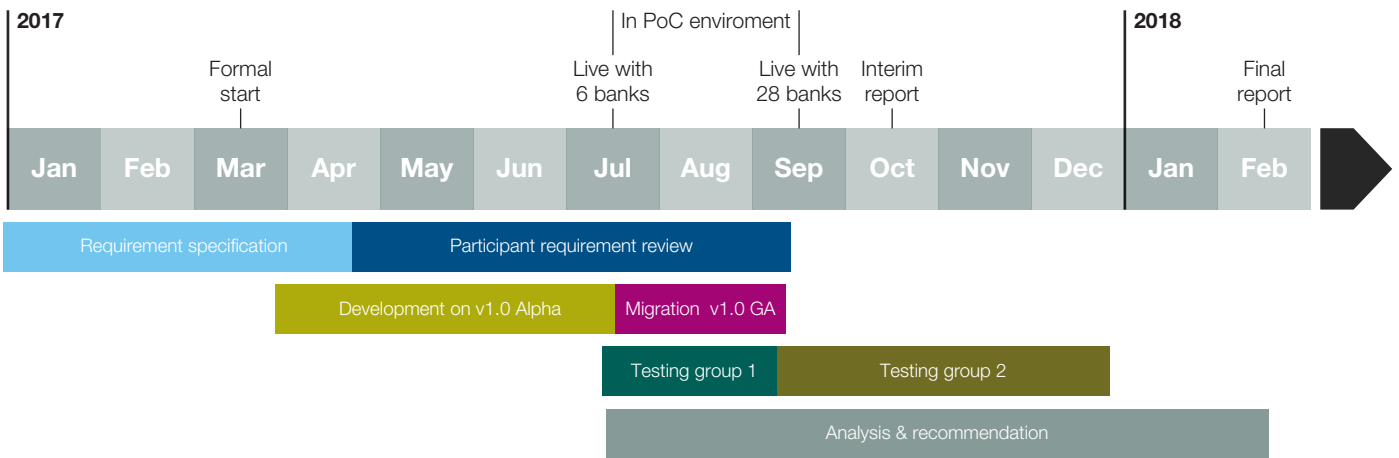
“SWIFT’s gpi Nostro PoC using DLT is focused on driving back office efficiencies. From our perspective, the constraints of such a DLT solution are mostly two-fold: firstly a limited number of counterparties participating in the system could impact the efficiency because banks would be obliged to maintain two different tools to manage two different positions. Secondly, integration of the technology with internal systems, and also from an accounting perspective, is essential to success. A DLT based solution should take integration costs with legacy applications into consideration to avoid any duplication of costs.”

UniCredit Spa



SWIFT engaged with global transaction banks to test the model concept application.

Timeline Summary



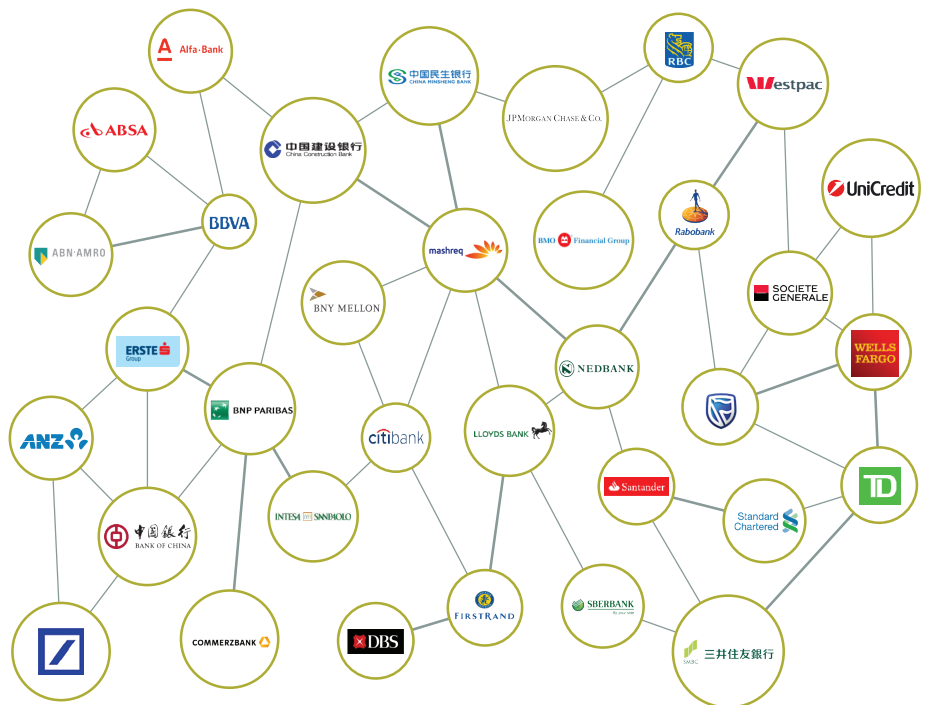
In total, 34 banks contributed to the proof of concept segmented in two groups working independently from each other.

The initial six financial institutions formed the founding group who worked with SWIFT to explore and define the standards, data model, business and functional specifications, that resulted in the creation of the concept model.

The founding group was the first to test the application and to provide feedback. The participating banks also provided a number of change requests to improve the user's experience of the application, of which, a certain number were implemented prior to the start of the final phase of testing with the validation group in September 2017.

The validation group of 28 financial institutions were tasked with executing the same set of tests to provide independent conclusions on the enhanced solution.

The size of the group also provided an opportunity to see how the distributed ledger technology scaled with the increase in the number of Nostro relationships.



Participant validation and testing activities

To validate the proposed concept model, banks participated in the following activities:

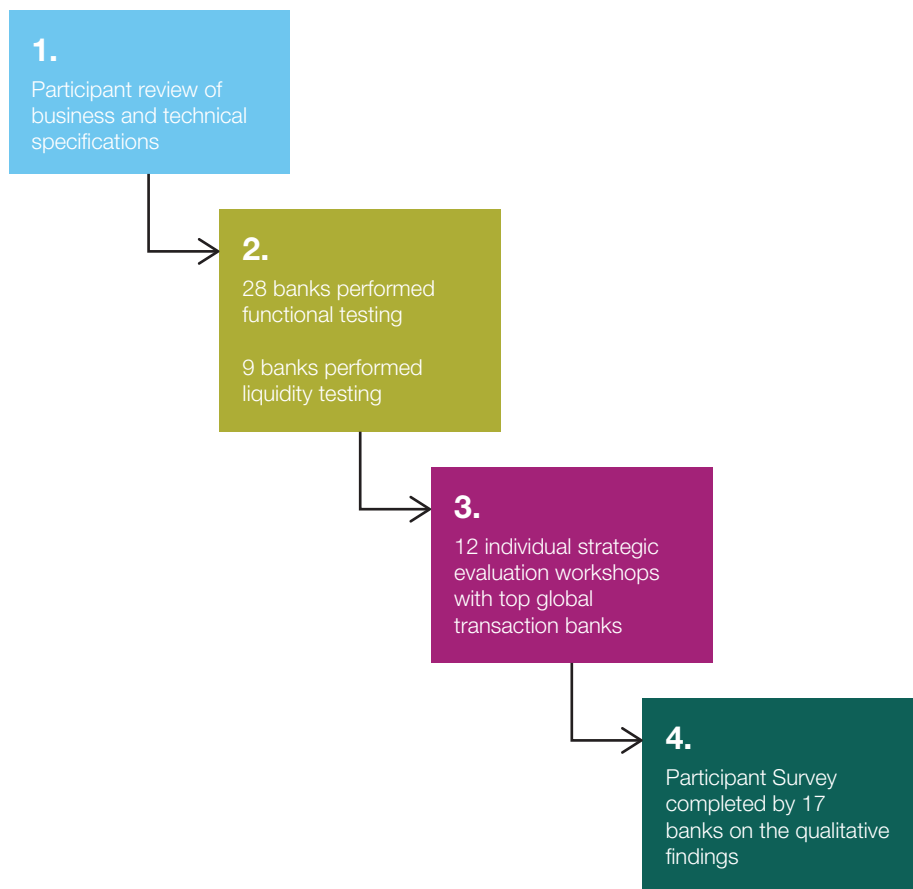
1. Business and technical specifications covering the data model, the functional and technical scope, were reviewed by all participating banks.
2. Testing was executed using the developed proof-of-concept deployed in the SWIFT DLT sandbox. In particular:

Twenty-eight banks performed the functional testing against the 34 use cases aiming at ensuring the PoC met the functional requirement, and to assess the completeness of the ISO 20022 data model.

Nine banks performed the liquidity testing to assess the impact on the visibility of their intraday liquidity positions across accounts, and whether potential savings could be derived from the proposed ledger concept model.
3. Upon completion of the PoC, strategic evaluation workshops were held with 12 participating banks to gather their findings and feedback.
4. Finally, 17 banks replied to the survey to gather qualitative feedback to support the quantitative testing results.

The following section summarises the results and findings of those various activities.

Validation by participants



Functional Testing

The scope of the testing was determined by the business dimensions selected for the PoC, and focussed on the most representative set of industry-wide use cases.

The objective was not only to validate the ISO 20022 data model but also to test extensively the value of the end-to-end workflow for Nostro account's entries with real-time visibility of their status and of the audit trail functionality relying on the re-use of the UETR.

The real-time nature of the solution utilising the UETR also meant that automated reconciliation of payments against the Nostro account entries would result in less enquiries, and consequently to a shorter turn-around time for enquiries.

Results from this extensive testing by the 34 participating banks, confirm that the DLT PoC application relying on a standardised rule book and leveraging the unique end to end transaction reference delivers the expected business functionalities and data richness; required to support business applications and processes in achieving automated real-time liquidity monitoring and reconciliation.

Liquidity Testing

A subset of participants were asked to confirm the impact on the visibility on their intraday liquidity positions across accounts and whether potential savings could be derived from such a shared ledger solution. To that end, participants were asked to upload obfuscated real transaction data to the DLT application covering a period of one to several days. This enabled them to compare the as-is situation based on current reporting updates received from their Account Servicer with a simulation based on the uploaded real-time reporting provided by the concept model application.

As a baseline, the following metrics were used to compare the current liquidity curve based on existing debit and credit entries confirmations by the Account Servicer with the real-time simulated view:

- Impact on intraday balance position at specific time of the day (peak positions).
- Impact on imbalances between credit/debit entries.
- Reduction of difference between expected balance and interim available balance - top peaks in difference and elapsed time.

Results from the participants were representative of the current liquidity curves for the tested Nostro accounts, and simulation of real-time reporting and comparison with as-is situation demonstrated a substantial impact on all these metrics.

Key conclusions from the test are as follows:

- Real-time confirmation for each debit and credit entry could result in visibility of accurate intraday liquidity curves, and an identification of potential imbalances between credit and debit entries.
- The use of systematic real-time confirmations would substantially reduce the gap between the expected and available balance when compared to batch reporting.
- From a time zone perspective, collecting real-time information close to the cut-off would help improve liquidity forecasting, identify potential exceptions and enhance the management of account funding: Participating banks also agreed that potential liquidity savings could be realised by developing or leveraging additional controls, functionalities or business intelligence analytics.

- Liquidity optimisation could be achieved through an automated payment flow control based on the real-time position avoiding extensive use of credit lines, contributing to lower intraday liquidity buffers; and
- Systematic timed data at entry level would support a more accurate regulatory reporting.

However the first pre-requisite in order for the industry to fully grasp liquidity benefits, is for banks to move current liquidity and reconciliation processes to real time. There is also a need to integrate the data from the shared ledger with existing liquidity or treasury applications, and with regulatory reporting modules.

Time zone difference issues can only be solved with an extension of the payments settlement's window and of the bank's operational hours to a full 24 hour period.

Strategic workshops and participant survey results

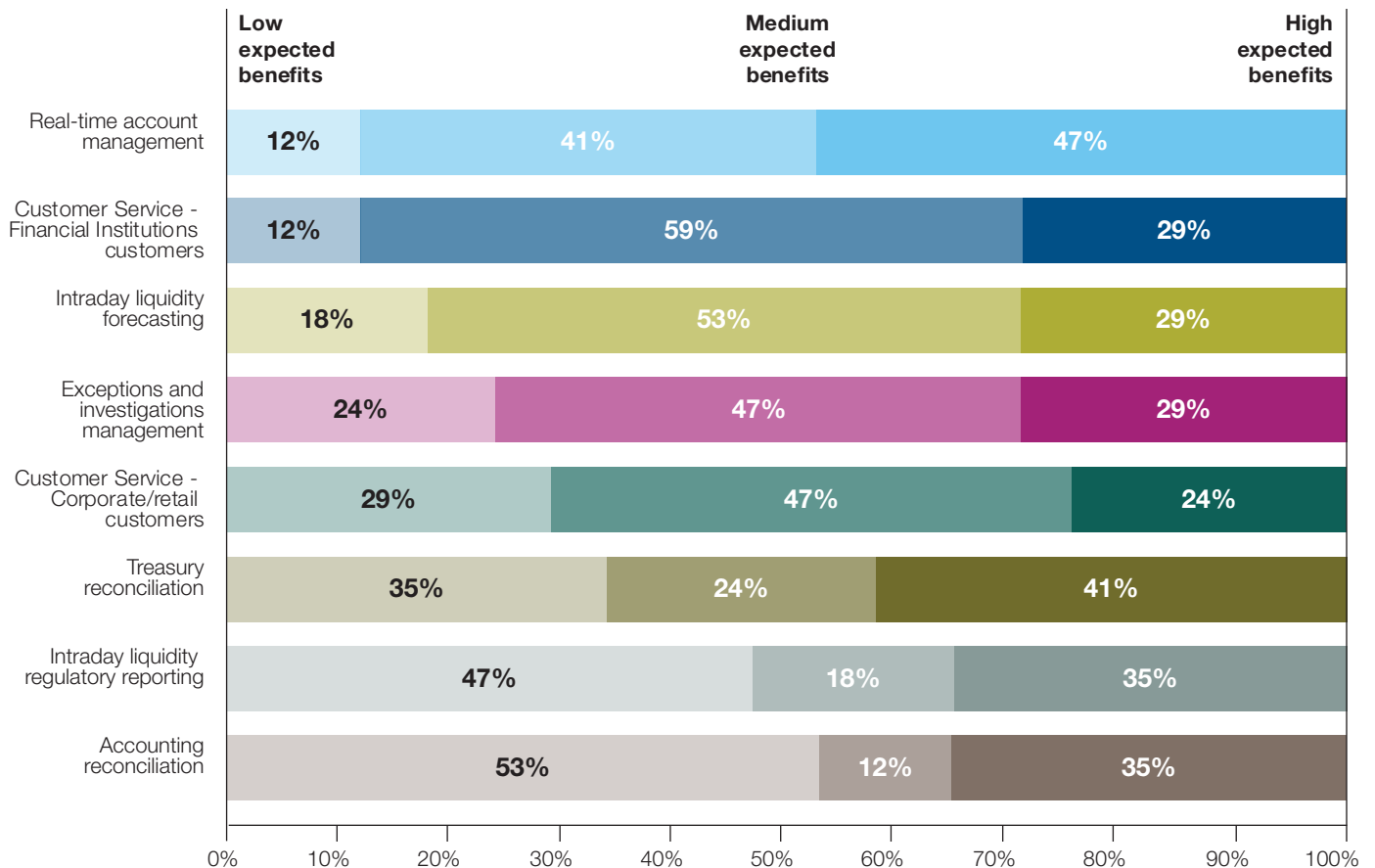
Seventeen banks also provided their input to a questionnaire distributed after the testing. The purpose was to collect structured feedback on PoC and its perceived benefits should such a solution be productised and implemented at the level of the industry.

Respondents were namely asked to indicate the level of importance they associated with the capabilities of a DLT based solution to process liquidity events and reconcile transactions in real time; as applied to eight major back office processes within their respective banks.

The chart on the next page represents a distribution of the level of importance the respondent banks placed on the benefits towards each of those processes moving to a real-time operating model.

From an industry-wide perspective, the majority of respondents agreed on the importance (high or medium rating) of moving to real-time liquidity and reconciliation across the back office to eliminate inefficiencies.

Figure 6 - Level of importance of real-time benefits attributed to liquidity and reconciliation by respondents



Participants feedback on the value of DLT application

Beyond a full alignment with the results already put forward in the liquidity testing section, banks provided some key feedback on benefits and impact.

On the benefits side:

- The size of the institution largely determines the level of importance given to liquidity reporting capabilities offered by a DLT based solution. Mostly determines how respondents see the inherent value of a real-time DLT based Nostro reconciliation service; and

- Whilst respondents see value in improved customer service towards financial institutions, a greater value is placed on improvements to back office processes and efficiency gains.

On the impact side respondents felt that:

- There would be a benefit to explore how smart contract technology could be leveraged in the delivered solution, to lower the cost that would be required from each bank to add some intelligence to the ledger;
- There are significant dependencies outside of the technology to deliver all the promised benefits; and

- Impact on the various back office processes of such a DLT solution would be substantial.

Whilst respondents were positive on many aspects of the technology and related benefits both to the bank and industry, all acknowledged there are unanswered questions and significant challenges to adoption.

It is clear that a value proposition for each market segment catering for different levels of sophistication, automation of operations and past investments is key to ensure industry-wide adoption.

Based on extensive testing, the participating banks found that the Nostro DLT application, when combined with the underlying ISO 20022 data model, delivered the business functionalities and data richness required to support automated real-time liquidity monitoring and reconciliation.

The PoC also demonstrated the significant progress DLT has made with regards to data confidentiality, governance, security, and identification framework, when compared with the results of SWIFT's 2016 assessment of DLT.

However, despite encouraging results, there are still some gaps that need to be addressed, confirming that it is still early days for the latest generation of distributed ledger technology to be considered mature enough as a basis for a global mission critical financial infrastructure.

In short the conclusions can be divided into four main categories:

1. Adequacy of the DLT based Nostro solution as defined by the functional requirements.
2. The value proposition will depend on bank's liquidity management capabilities, level of automation and centralisation.
3. A "one size fits all" DLT solution will not work.
4. New hybrid DLT architectures bring significant progress but it is still early days to consider it as a basis for a global mission critical financial infrastructure.

1. Adequacy of the DLT based Nostro solution as defined by the functional requirements

Testing of the 34 standard use cases by the 34 participating banks and additional liquidity testing with a subset of those banks, demonstrated that the DLT PoC application delivers the expected business functionalities.

Benefits included real-time event handling, transaction status update, a full audit trail and visibility of expected and available balances, and leveraging the SWIFT gpi UETR, which is already being implemented by the SWIFT community for payment transactions tracking.

It also confirmed that the ISO 20022 data model and API's specifically developed for this purpose are pre-requisites to deliver the required structure and data richness to support both real-time liquidity monitoring and reconciliation.

On the reconciliation side, the solution enables for real-time simplified account entries confirmation with an allocation of charge entries to a specific payment, identification of pending entries and of potential related issues.

Extensive testing of the use cases between participants concluded that such a solution could help achieve real-time automated reconciliation, hereby reducing the high costs related to manual enquiries and streamlining their financial institutions customer's experience.

On the liquidity side, the DLT based solution provides real-time visibility across accounts to both the Account Owner and the Account Servicer (account's entries status, of derived expected, and available account balances). It also delivers the timed data required to support regulatory reporting.

Additional liquidity testing confirmed that banks that have not yet achieved such a level of monitoring for their key currencies and could leverage a real-time solution to optimise their intraday liquidity management, enhance their liquidity analytics, and support their regulatory reporting.

Unique identification of each entry is the cornerstone of any liquidity and reconciliation solution. The re-use of the gpi UETR, leveraging SWIFT's central payments tracker for this purpose is an obvious choice. To cover all Nostro account movements, its usage must be extended to identify key message types such as FX and securities transactions that potentially do not settle through a payment message.

"Bringing the providers and clients of correspondent banking Nostro reconciliation together has been the main benefit of this DLT initiative. The potential to improve standardisation as well as speed and transparency has been confirmed. This is also the centrepiece of gpi and could be enhanced even further with the migration to ISO 20022."

Christian Westerhaus,
Global Head of Clearing Products, Cash Management, Deutsche Bank

2. The value of a of DLT solution will depend on bank's liquidity management capabilities, level of automation and centralisation.

The final value proposition will depend on bank's settlement model for their key currencies, their individual existing model to access intraday liquidity data, and their level of internal liquidity monitoring and management process automation.

Global transaction banks usually rely mostly on internal entities for the settlement of their payments in key currencies, representing the largest share of a bank's liquidity at a group level. In most cases these banks have implemented a real-time automated data capture from the different high value payments settlement systems to which they are connected. They have built transactional databases which are not only leveraged to feed in real-time their internal sophisticated liquidity tools, but also to provide services to their different types of customers (both financial institutions and corporates or retail customers).

It is therefore expected that any additional liquidity saving or reduction of the operational costs related to Nostro entries would be rather marginal for these banks. Benefits would mainly be delivered to financial institutions (typically regional players or Investment firms) with a higher dependency on Nostro servicers and not having made such an investment.

However, some key dependencies have been identified to enable banks to grasp the benefits of such a solution:

- a. Additional intelligence and integration with existing related processes such as Nostro liquidity management, reconciliation, exceptions management or regulatory reporting would be required.

Whilst the use of smart contracts for this purpose could be envisaged, it would come at a potentially high cost dependent upon the level of customisation required on the top of the DLT based solution.

In addition, feedback from participating banks indicate that independently from the underlying technology layer, any potential industry solution should leverage existing SWIFT gpi assets and services, such as the central tracker, to limit the banks' required investment.

- b. Many components of today's liquidity management and reconciliation systems are typically based on batch processing, and rely on end-of-day events. Real-time liquidity management is limited by inter-bank and payment systems cut-off times.

To capture the benefits of a real-time solution there is a need for all Nostro Account Servicers to migrate from batch to real-time liquidity reporting and processing. Today, around 44% of cross border payments exchanged in the correspondent banking over the SWIFT network generate a real-time confirmation of debit or credit (Message 900/910). While the DLT application provides a platform to share the information, there is tremendous work and investment required to achieve this consistently across all entry types including those that did not generate any payment instruction (e.g. book transfers).

- c. Independent from the selected technology, the success of any solution targeting a "many-to-many" use case will be dependent upon standard API's or messaging. Implementation costs could be potentially lowered should ISO 20022 standards be adopted.
- d. Unique identification of each entry is the cornerstone of any liquidity and reconciliation solution. The re-use of the SWIFT gpi for this purpose for a correspondent banking DLT application is therefore an obvious choice. To this end its usage must be extended not only to identify any payment type but also other types of entries on the Nostro account such as FX transactions that potentially did not settle through a payment message.

3. A “one size fits all” DLT solution will not work

The integration of DLT technology in the correspondent banking space can only follow an incremental path, avoiding disruption and preventing the need for large players to subsidise a significant part of the industry deployment.

Financial Institutions who have made substantial investments in existing real-time reporting and messaging will indeed be reluctant to duplicate the efforts to integrate data feeds into DLT nodes.

Evidence shows a very large increase in the usage of these message types (Message 900/910) with 130% growth* since 2012 versus 30% growth* in payment messages. (SWIFTwatch - FIN traffic - 2017)

There is a need for a clear segmentation with an implementation model that best integrates with existing operations and leverages current investments such as the gpi central payments tracker to minimize the impact and ensure the value of the DLT based elements. For these banks, extending the central tracking utility to capture these messages (Message 900, Message 910, Message 545, Message 547), and making the data available to the banks that need it would be less impactful than implementing a new vertical solution in addition to their existing messaging capabilities.

Any solution at the level of the industry would have to leverage existing banks' capabilities and allow for an evolution of their internal systems. Additional intelligence would need to be provided to really bring value for other processes such as reconciliation, exceptions management, and regulatory reporting.

4. New hybrid DLT architectures demonstrate significant progress but it is still early days

Leveraging Hyperledger Fabric 1.0, the DLT sandbox clearly demonstrates significant progress of DLT towards maturity, especially with regards to data confidentiality, governance, identification framework and scalability.

The DLT sandbox provides a very strong governance framework where access is controlled and where roles define what actions participants can perform. Selective data distribution ensures that data is stored only on the peers having a stake in the transaction guaranteeing data confidentiality. Participants are identified through their BIC and their PKI keys are certified by SWIFT certification authority ensuring a very strong identity framework. Moreover, the Hyperledger Fabric 1.0 consensus algorithm demonstrated a very low latency and promises to support very high throughput.

One must however realize that it is still early days for this newer generation of blockchain platforms to reach the level of maturity that is required to form the basis of a mission critical financial infrastructure. These new solutions have a very different architecture, moving towards a hybrid model where some components are distributed and where others are centralized and operated by a third party. The architectural design brings significant advantages as they are tailored for the financial industry, and their impact also needs to be carefully assessed.

Via the mechanism of channels, Hyperledger Fabric 1.0 provides a framework that ensures that data is stored only on the peers having a stake in the transaction guaranteeing data confidentiality. However, channels are static in nature and while this mechanism proved to be adequate for this PoC where the account owner and servicer of a Nostro account didn't change, it may be more difficult for use cases

where parties to a transaction evolve over time or where asset ownership changes. Channel configuration and management needs to be assessed and explored further.

The data segregation makes the data resiliency question more complex to answer. Since data is physically segregated to ensure data confidentiality, one node can no longer independently recover from any node. Instead, it will need to rely either on some local resiliency setup within its own institution, on its counterparty's nodes or on a central service.

Another area for investigation is linked to the smart contracts versioning. As smart contracts need to be installed on each peer and instantiated in each and every channel rather than deployed only once, it may bring new operational challenges in case a smart contract update is required to ensure version consistency amongst the peers. Next to the upgrade process for smart contracts, upgrade mechanisms to the underlying data model also needs to be considered. Such migration could be challenging, as the data is stored (chained) forever in the original format, older data models need to be supported forever. SWIFT will be looking at assessing those points in future.

Hyperledger Fabric 1.0 shows to be straightforward to use from a development standpoint. The development tools are stable which is an important factor to guarantee a productive development cycle. Hyperledger Fabric 1.0 fully relies on name-value pairs as the only supported data structure. This is a weak foundation to implement the richness of the ISO 20022 data model.

From an operational standpoint, a number of technical incidents clearly indicate that production readiness is not yet reached, and a number of enhancements in that area are still required. Some elementary tooling is missing to properly manage an application, like adding a node to a channel or tools to prove any non repudiation claim which should be an independent capability of a DLT framework.

Table 1

Requirement	PoC scope
Transparency: increase visibility of a transaction entry status and allow for an early identification of an issue that could have an impact on the account's position	<p>Demonstrate provision of real time transaction entry status by the shared ledger according to the agreed standard based on input/ action by the Account Owner and Servicing Institutions according to the test cases in scope for the PoC.</p> <p>Time stamps are to be provided for each update.</p>
Real-time visibility of account's balances	<p>Demonstrate that intraday and the end of day balances are derived in real-time by the shared ledger and visible to both the Account Owner and Account Servicer based on entry status creation, confirmation or rejection as per the defined use cases.</p>
Reduce the number of manual investigations related to charges	<p>Demonstrate that the PoC provides the foundational layer to decrease the number of investigations related to the charges entries on the Nostro account thanks to its audit trail functionality and identify which would be the required integration or smart contract development required to grasp the full value of this benefit.</p>
Reduce the number of investigations related to being Unable to Apply on the Nostro Account	<p>Demonstrate that entry creation on the shared ledger by the Account Owner simultaneously with the payment instruction prevents the loss of data through data truncation and that the creation or the confirmation of an entry by the Account Servicer based on the UETR will help reduce the number of investigations for the Account Owner related to un-matched entries.</p>
Accuracy of the values and data derived in the shared ledger	<p>Demonstrate transaction entry details and value processed through the distributed ledger is consistent with the data input (e.g. CSV file) from participants. Verification by participants that entries status and related intraday balance are derived correctly according to the defined standard.</p>
Support of life-cycle transaction concept	<p>Demonstrate that the shared ledger provides a full audit trail of entries lifecycle according to the defined standards for each standard use cases.</p>
Intraday liquidity usage curve	<p>DLT Graphical User Interface should update in real-time the intraday liquidity curves respectively for the expected and the available balances based on each status update to an entry on the account with an impact on the balance as per the standard user case.</p>
Support of intraday liquidity forecasting	<p>Establish through the manual testing of the standard use cases the evidence that the solution provides a more accurate real-time liquidity forecasting through a systematic use of expected entries (notifications) by both the Account Owner and Servicer.</p>
Intraday liquidity savings	<p>Provide the evidence on a number of expected liquidity benefits through a real-time monitoring of Nostro Account's entries and balances.</p> <p>A qualitative evaluation of the benefits is done through manual testing of the standard use cases, a quantitative liquidity testing is aimed at evaluating the impact on the visibility of intraday liquidity position/ curve by testing the "AS IS" and the "FUTURE" scenarios:</p> <ul style="list-style-type: none"> - From a time bucket vision to real-time vision: difference in real-time balances & peaks - Identification of imbalances between credit/ debit entries and of opportunities for funding optimisation - Visibility on credit lines usage - Better data for intraday liquidity forecasting.

Thank you to participant banks

SWIFT would like to thank the following financial institutions for their active participation in the Nostro Reconciliation PoC.

Founding Group

ANZ, Bank of New York Mellon, BNP Paribas, DBS, Royal Bank of Canada, Wells Fargo.

Validation Group

ABN AMRO, ABSA, Alfa Bank, Bank of China, Bank of Montreal, BBVA, China Construction Bank, China Minsheng Banking, Citibank, Commerzbank, Deutsche Bank, Erste Group, FirstRand, Intesa SanPaolo, JP Morgan Chase, Lloyds Banking Group, Mashreq, Nedbank, Rabobank, Santander, Sberbank, Standard Chartered Bank, Standard Bank of South Africa, Societe Generale, Sumitomo Mitsui Banking Corporation, Toronto Dominion, UniCredit, WestPac.



About SWIFT

SWIFT is a global member-owned cooperative and the world's leading provider of secure financial messaging services. We provide our community with a platform for messaging and standards for communicating, and we offer products and services to facilitate access and integration, identification, analysis and financial crime compliance.

Our messaging platform, products and services connect more than 11,000 banking and securities organisations, market infrastructures and corporate customers in more than 200 countries and territories, enabling them to communicate securely and exchange standardised financial messages in a reliable way.

As their trusted provider, we facilitate global and local financial flows, support trade and commerce all around the world; we relentlessly pursue operational excellence and continually seek ways to lower costs, reduce risks and eliminate operational inefficiencies.

Headquartered in Belgium, SWIFT's international governance and oversight reinforces the neutral, global character of its cooperative structure. SWIFT's global office network ensures an active presence in all the major financial centres.

To find out more about SWIFT's work on distributed ledger technologies, please contact DLT@swift.com

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About SWIFT gpi

SWIFT gpi has prompted the largest change in cross-border payments over the last 30 years and is the new standard, combining real-time payments tracking with the certainty of same-day settlement. As an initiative, it engages the global banking industry and fintech communities to innovate in the area of cross-border payments while reducing their back-office costs. Since its launch in January 2017, gpi has dramatically improved the cross-border payments experience for corporate treasurers in over 200 country corridors. Key features of the gpi service include enhanced business rules and a secure tracking database in the cloud accessible via APIs, resulting in faster "same day credits" to end beneficiaries, transparency of fees, and end-to-end tracking of payments in real-time.

Disclaimer

This report is the final report. The views expressed in this report are SWIFT's views and interpretation of the results arising out of the PoC and do not necessarily reflect all individual participating bank's views.