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CROSS-BORDER INTERBANK PAYMENTS AND SETTLEMENTS

Emerging opportunities for digital transformation

November 2018

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CONTENTS

1.0 EXECUTIVE SUMMARY

1.0 Executive Summary

The report “Cross-Border Interbank Payments and Settlements” is a cross-jurisdictional industry collaboration between Canada, Singapore and the United Kingdom to examine the existing challenges and frictions that arise when undertaking cross-border payments. This report explores proposals for new and more efficient models for processing cross-border transactions.

The project was initiated by the Bank of Canada (BOC), the Bank of England (BOE) and the Monetary Authority of Singapore (MAS) in consultation for domain knowledge with subject matter experts from a group of commercial banks led by HSBC. Other commercial banks in the group include Oversea-Chinese Banking Corporation (OCBC Bank), Toronto-Dominion Bank (TD Bank) and United Overseas Bank (UOB). KPMG Services Pte. Ltd (KPMG) helped facilitate a workshop between these participants to discuss views on this topic, and compiled views from them to assist in the development of this report.

This report is aimed at developing further insights into the challenges and root causes of issues associated with cross-border interbank payments and settlements. These insights are used to derive desired outcomes, which we refer to as “future-state capabilities.” A persistent challenge in addressing issues in cross-border payments relates to coordination and perspective. By bringing together several banks from different countries and three central banks, this report provides insight into the root causes in challenges relating to cross-border payments, while being agnostic of the context, and undertakes an appraisal of the limits of technological innovation.

The report notes the current initiatives under way in the industry that go some way to address the challenges identified. Nevertheless, our conclusion is that these are incremental changes, and in the longer term there may need to be a more fundamental paradigm shift to address these challenges in a more holistic way, enabled by new technology platforms.

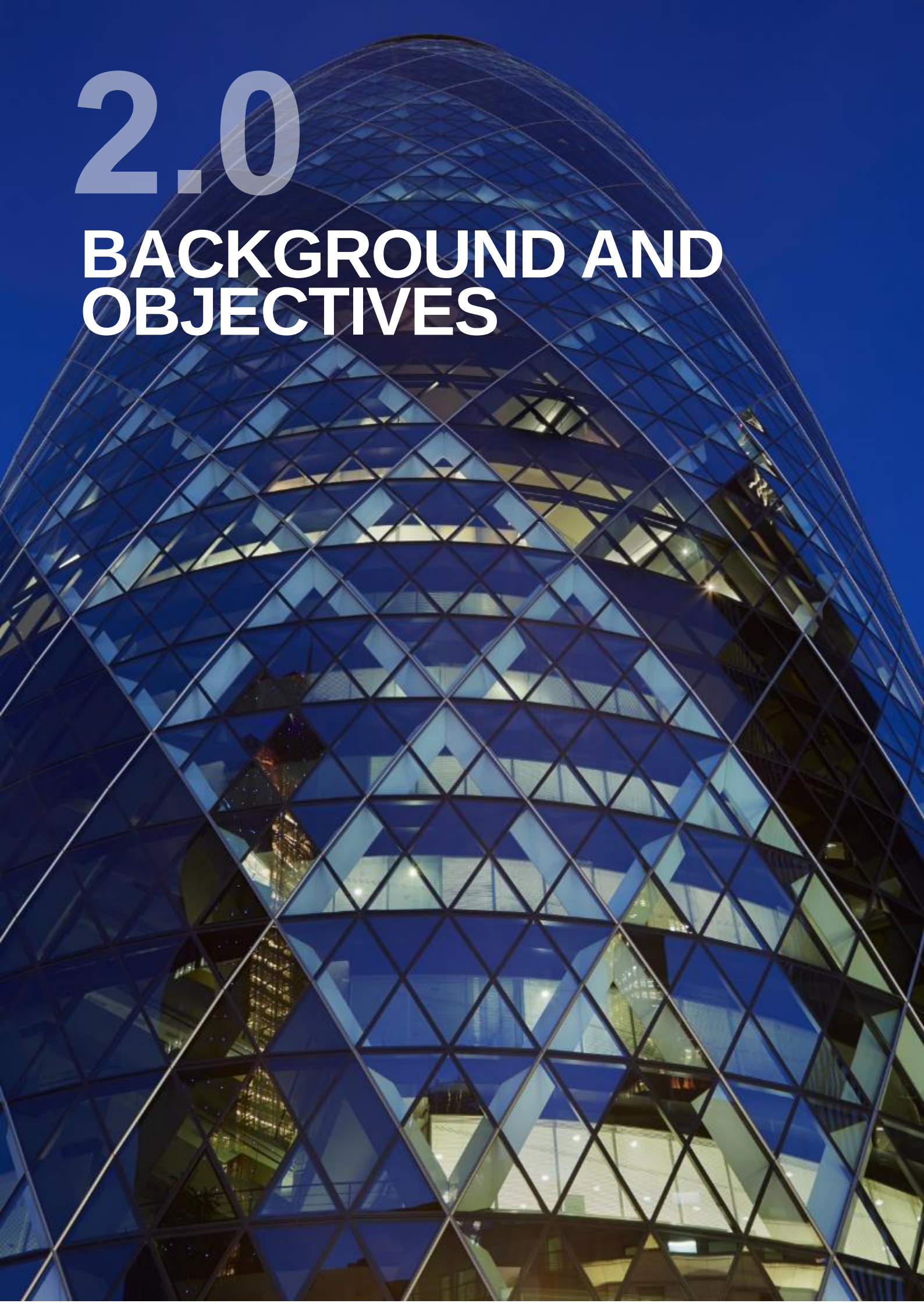
The report discusses three possible models that could potentially address the issues identified to achieve the future-state capabilities. These models are not intended to be exhaustive, and they are purely hypothetical proposals that enable an analysis of the relative merits and challenges. The first two models are based on enhancing existing domestic interbank payment systems with current or traditional technology. Without changing the underlying correspondent banking model, these two models could meet some, but not all, of the future-state capabilities.

Given the experience from BOC and MAS research projects (Jasper and Ubin, respectively) in exploring tokenized forms of central bank liabilities for domestic use cases, the third model considers three variations based on issuing a wholesale central bank digital currency (W-CBDC).

This report is a starting point that enables the global financial community to conduct exploratory projects to deepen the collective understanding of how these models can be operationalized—from both non-technical and technical perspectives. The report does not provide specific recommendations for a future-state model for cross-border payments and settlements. Instead, it provides the overall framework in which specific aspects of cross-border payments and settlements can be explored in more depth by interested parties. The contents of this report do not inform the policy positions on access of the contributing central banks, nor do they represent the supervisory view of any firms which fall within the supervisory remit of the central banks. The intention of the report is not to pick a model for the future, but to explore hypothetical future states.

2.0

BACKGROUND AND OBJECTIVES



2.1 Background

The overall value of cross-border payments is expected to rise by 5.5 per cent per year from US$22 trillion in 2016 to US$30 trillion in 2022 across both retail and corporate payments.[1] New business models and service providers are starting to emerge offering cross-border payments to retail market segments. At the same time, the number of active correspondent banks globally is in decline. In the period 2011 to mid-2017 there was an 8 per cent decline in active correspondent banks globally.[2] These contrasting forces, which affect money transfers across markets globally ensure that cross-border payments are a priority for businesses, commercial banks and regulators alike.

Today, cross-border payments are expensive (compared with domestic payments), can take multiple days and lack transparency, regarding both costs and delivery times.[3] This is primarily due to the complexity of the cross-border payment and settlement process, which includes the involvement of multiple entities in the execution of a cross-border transaction, the degree of regulation—for example, anti-money laundering (AML), counter terrorist financing (CTF) and know-your-customer (KYC) requirements, as well as capital requirements - differences in technical and operational standards across jurisdictions, and the prevalence of legacy systems and infrastructure. The difficulties of developing a safe, efficient and inclusive international system are compounded by divergence in the regulatory approaches of different jurisdictions.

The ability to automatically process a payment is crucial to ensuring that the cost is reduced. This is harder to do if the transaction must go through multiple entities in multiple locations. If the sender's service provider has no presence in the beneficiary's location, and thus cannot receive the funds there, it will need to rely on another financial institution(s) to complete the transaction on its behalf.[4]

This is known as the "correspondent banking" model, which has been the foundation of cross-border payments and settlements for centuries.[5] Currently, correspondent banking remains the only ubiquitous cross-border payment solution. It can reach any country or currency and can be used by anyone with a bank account. However, the number of firms offering correspondent banking services is in decline.

The growing demand for cross-border payments warrants a review of current payment and settlement processes. By considering the differing lenses of end-users (the senders and beneficiaries of payments), commercial banks and central banks, this report analyses the different challenges faced by stakeholders to identify the underlying root causes of these challenges.

Global cross-border trade volumes are expected to witness steady growth over the coming years. Cross-border payments will need to evolve to be able to support these increased volumes and at the same time resolve the complexity associated with the cross-border payments and settlement process today

2.2 Objectives and approach

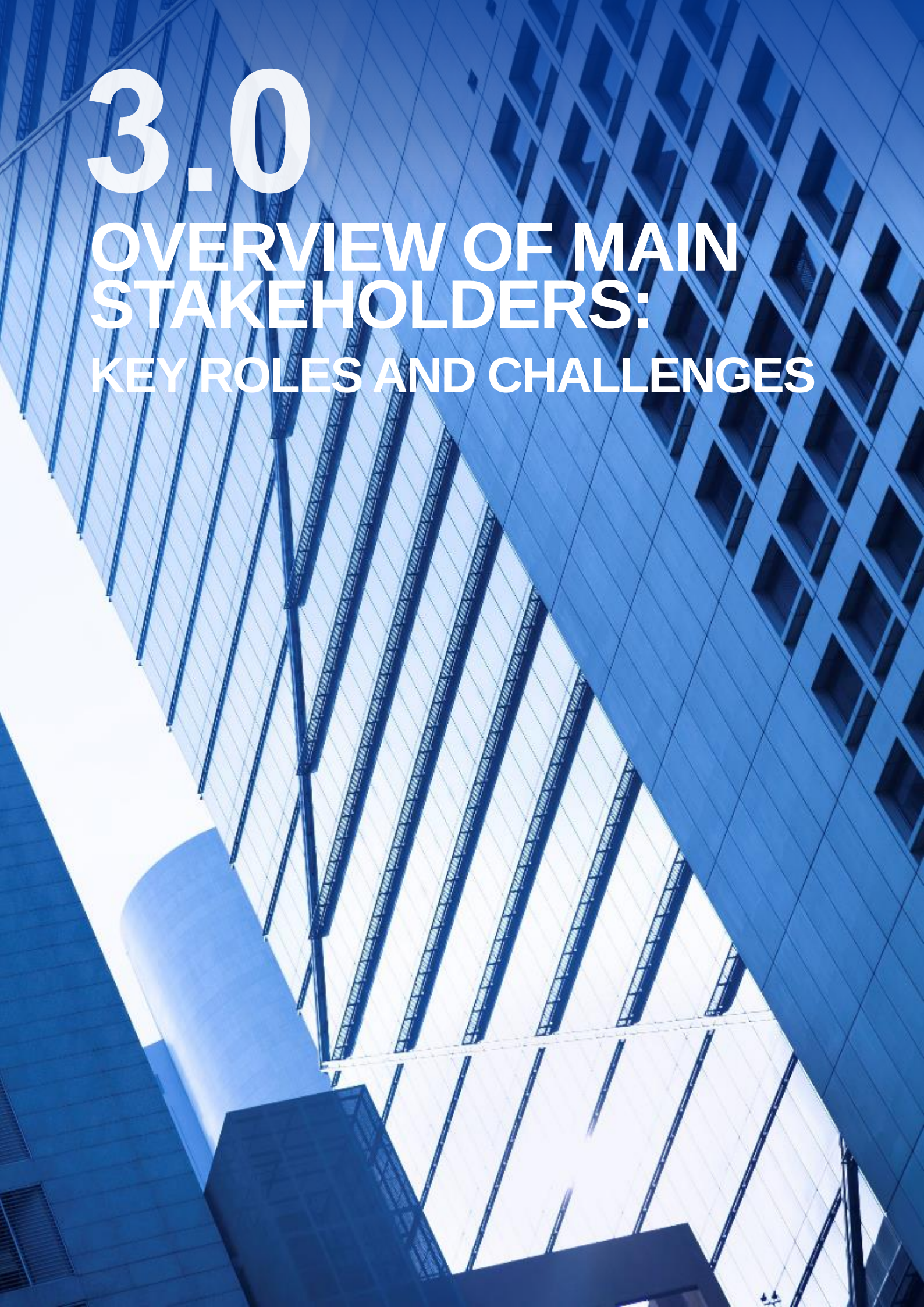
This report looks at how high-value corporate payments are processed. While some of the challenges faced in executing low-value payments (such as person-to-person migrant remittances) may be comparable, low-value payments are outside the scope of this report.

This project started with a series of focused discussions with Report Contributor groups within participating commercial banks involved in cross-border payments.[6] As the lead commercial bank, HSBC provided an in-depth review coordinating multiple stakeholder contributions, while the other participating commercial banks sponsored key representatives who are subject matter experts (SMEs) in different banking areas to provide holistic views of cross-border challenges.

The discussions covered three key areas: current-state pain points, potential future state enablers (future-state capabilities), and industry use cases for cross-border payments and settlements. The findings from this process were then discussed among the core working group (made up of central banks and commercial banks) at a three-day workshop held in the United Kingdom at U-Collaborate™ facilities.[7]

This report builds on the current literature available, summarising the key challenges faced by the main stakeholders in the cross-border payments process as well as the key findings from the workshop deliberations and discussions on the proposed models. Section 3 explores the different participant groups in greater detail, including their perspectives on the main challenges associated with cross-border payments. Section 4 examines root causes of these challenges and assesses current initiatives that seek to address key pain points. Section 5 introduces potential future-state capabilities, detailing how these proposals mitigate challenges identified by respective stakeholders. Section 6 outlines the future-state models we have illustrated for consideration and compares the relative benefits across the models. The discussion of the future-state models does not represent a policy position of the contributing central banks and/or commercial banks, but is rather an exploration of hypothetical future states. The report concludes in Section 7, which sets out possible next steps for both technical and policy work seeking to address these pain points.

This report is developed based on existing literature on cross-border payments and is the outcome of a collaborative effort between central banks and commercial banks across different jurisdictions



3.0 OVERVIEW OF MAIN STAKEHOLDERS: KEY ROLES AND CHALLENGES

3.1 Overview of main stakeholders

The process for enacting a cross-border payment involves several parties, each facing its own challenges.

End-users are the businesses and individuals who need to send money to or receive money from a foreign country. To do this, they will use banking services obtained from a commercial bank. The sender will provide the bank with the details of the beneficiary of the payment.

If the commercial bank has a presence in the jurisdiction of the beneficiary (i.e., it holds a settlement account with the relevant central bank), this may be a relatively straightforward transaction where money is transferred across its own books and then sent to the beneficiary's bank via the high-value payment system operated in that country. The beneficiary's bank can then credit the funds to its customer, and the payment is complete.

In many cases, however, the payment must travel via a chain of other commercial banks that create a network between domestic payment systems, i.e., correspondent banking. This happens when the beneficiary bank does not hold a settlement account with the relevant central bank. Via this chain, a payment might travel across multiple jurisdictions before arriving at its destination. Each time the payment passes between institutions, it may or may not be settled via high-value payment infrastructure operated by a central bank.

The analysis below therefore focuses on the challenges faced by these three key stakeholders: central banks, commercial banks and end-users.

3.2 Challenges for central banks

Central banks have several key roles that are pertinent to cross-border payments. They are at the centre of the system, often operating the real-time gross settlement (RTGS) infrastructure and high-value payment schemes within which interbank obligations must eventually settle. They may regulate all or some of the payment schemes that banks use to offer cross-border services, operate or oversee domestic RTGS systems and ensure that they are compliant with the Principles for Financial Market Infrastructures (PFMI), have mandates for financial and monetary stability, or take on roles as overseers of economic well-being or facilitators of payments sector competition and innovation within their jurisdictions.

RTGS and high-value payment systems

There are two crucial, risk-reducing features to central bank-operated RTGS high-value payment systems, that places them at the heart of the global payments system. The first is that settlement takes place at a central bank, in "central bank money." Given that central banks have the lowest risk of default of any agent in the economy, this reduces the risk of settlement agent failure to close to zero.

The second feature is the move to RTGS systems themselves, as opposed to systems where settlement occurs on a deferred net basis. Under a real-time system, obligations are extinguished as soon as they arise, meaning that participants are not building up credit risk between them while awaiting settlement. Central banks generally adopted this model over the 1980s and 1990s as the technology developed to support real-time settlement. The move to RTGS systems effectively eliminates settlement risk from high-value payment systems.

Several central banks are now facing challenges related to operating legacy infrastructure. This has driven the recent decisions of a number of central banks to renew their RTGS systems. One example of a legacy infrastructure challenge is the need for some systems to have periods of downtime for end-of-day or end-of-period batch processing, thereby restricting the possibility of having operations available 24 hours a day, seven days a week. This can lead to risks building up via overnight exposures between banks awaiting settlement, or to a restriction in services offered to end-users by commercial banks. The restricted operating hours of RTGS systems means there are only very small windows of time when the systems across different countries are open at the same time. As a result, cross-border payments can get trapped in a country, waiting for the relevant RTGS system to open, and therefore drive the time lag in cross-border payments reaching their final destination.

Payment infrastructures across the world were often developed to run on proprietary communications, security and data standards and protocols. As a result, there is a lack of interoperability across platforms and systems, and data standards differ

across payment networks, which adversely affects cross-border payment processing for banks. For example, 52 per cent of the volume and 25 per cent of the value of high-value payments are formatted to be ISO 20022 compliant, US-dollar high-value systems use a proprietary standard; and the SWIFT cross-border network uses the MT messaging format.[8]

Operational resilience is a key feature of RTGS systems. In contrast, strategic resilience (the ability for RTGS to adapt and facilitate innovation or change in payments markets) is not always inherent. To offer settlement services to new market infrastructures leveraging new technology platforms, RTGS systems must be able interoperate with them. This may not always be possible with some legacy infrastructure. For example, RTGS infrastructure may not be able to incorporate the necessary processes or proofs required to interoperate with systems based on distributed ledger technology (DLT). This could prevent innovative new platforms for conducting payments from accessing central bank settlement, without which they might not reach scale; that is, the crucial settlement risk-reducing capacity of RTGS is out of their reach.

Access to settlement accounts

To access RTGS systems, institutions must be able to hold settlement accounts in these systems.[9] The range of eligible institutions varies across jurisdictions, but eligibility is generally limited, and the bar to access can be high. In offering accounts, operators of RTGS systems need to manage several operational risks. To manage these risks, they may place certain requirements on their account holders, such as having the requisite processes and controls in place to operate their accounts. These requirements can be seen by some smaller players as barriers to entry. Additionally, the increasing threat of cyber-attacks requires sophisticated defences at the participant level and may further raise the costs of access.

These high technical barriers to entry have often prevented smaller payment service providers from seeking settlement accounts and participating in high-value payment schemes. This can stifle innovation, restrict consumer choices and increase risk. The resulting highly tiered networks contain direct participants, servicing other banks, that may represent single points of systemic importance. However, compared with networks with large numbers of direct participants, such tiered networks can drive system-wide liquidity-savings benefits.

There is an explicit policy choice for central banks regarding the regulatory categories of firms they allow to have access to settlement accounts. Broadly, this is bounded by risk mitigation, regulation and an unwillingness to disintermediate the financial system. This policy choice also extends to emerging-market infrastructures of the type described above.

Differing technical requirements combined with varying regulatory standards across jurisdictions present a barrier to an institution that wants to have access to settlement accounts in different countries simultaneously; it adds cost and complexity to these operations. Consequently, few banks have the scale required to maintain a global network of settlement accounts in multiple jurisdictions. This can impose fragilities on the international financial system due to the concentration of risks in a small number of firms offering correspondent banking services.

Payment networks and systems in most jurisdictions are based on proprietary standards and protocols, built on legacy infrastructure. This results in a lack of interoperability across networks and systems and a diminished ability of in-country networks to adapt and facilitate innovation

3.3 Challenges for commercial banks

The correspondent banking model has provided a ubiquitous mechanism to enable and support cross-border payments. However, there are high costs for banks providing this service and growing pressure from end-users to transform the user experience; at the same time, banks must also satisfy more stringent regulation and sanction regimes imposed by domestic and international authorities. This puts pressure on the commercial viability of the correspondent banking model. Hence, to respond to these growing pressures and mitigate accompanying risks, banks have started reviewing their cost drivers and legacy systems.

Profitability and complexity of correspondent banking

A 2016 McKinsey report estimated that the average cost for a US bank to execute a cross-border payment via the correspondent banking network is in the range of US$25 to US$35, more than 10 times the cost of an average domestic payment.[10] The cost of trapped liquidity in correspondent bank accounts was estimated at 34 per cent of this overall cost, treasury operations (invoicing, claims handling, dispute management) at 27 per cent, foreign exchange (FX) costs at a further 15 per cent, compliance costs at 13 per cent, payment operations (reconciliation, investigation, repair) at 9 per cent and network management at 2 per cent.[11]

Balance sheet costs, in the form of trapped liquidity, are being accentuated by the post-financial crisis context of low interest rates and excess liquidity.[12] However, they are also linked to the environment set by RTGS operators. As discussed above, operating hours can be limited and thus can require respondent banks to place large sums of liquidity in prefunded accounts as collateral. Restrictive access policies and requirements enhance the need for such correspondent banking relationships. Finally, by not being open to or interoperable with new and emerging platforms for settlement, RTGS operators may restrict innovation that could change liquidity costs for correspondent banks.

Costs arising from treasury operations, compliance and payment operations can be grouped broadly under operational costs. As explained below, a significant portion of the operational costs arises from legacy infrastructure in commercial banks, which in turn inherit challenges from the RTGS infrastructures they interface with. Banks are increasingly finding themselves under pressure from new entrants who are not burdened with these legacy infrastructure issues. Nevertheless, certain cost drivers are inherent in cross-border payments, namely, those from FX and from higher compliance requirements. Focusing on the implications of compliance requirements can provide an insight into the challenges facing cross-border payment service providers.

An international regulatory framework exists alongside domestic regulation to combat the financing of terrorism and other cross-jurisdictional economic crimes (e.g., money laundering). Many jurisdictions have additional domestic regulatory requirements, which add more complexity. Banks across the payment value chain must comply with multiple regulatory requirements, (e.g., AML measures and sanctions screening) and assessments of collateral requirements. They must also comply with different payment message formats and requirements on message content (including around using the right clearing codes, purpose of payment codes, etc.). To give an indication of the scale of global regulatory change, a recent report[13] by Thomson Reuters' regulatory intelligence services notes that their service captures an alert issued by a regulatory body once every seven minutes. Although not all alerts will correspond to

> Correspondent banking remains the most ubiquitous model for interbank payment and settlement globally. The complexity of this model accompanied by the divergence in regulatory standards across jurisdictions adds to the overall costs – explicit and implicit – associated with cross-border payments

a business impact or additional requirement for payment services, firms operating globally will face costs in tracking or responding to relevant alerts. It is estimated that financial institutions incur an additional cost amounting to about 5 per cent to 10 per cent of their annual turnover as a result of regulatory divergence across jurisdictions.[14] Costs arising from regulations and international sanctions regimes, and the risk associated with non-compliance, have made the provision of correspondent banking services a less financially attractive business proposition.

Smaller financial institutions are more likely to view regulatory divergence costs as material to their overall performance.[15] This can affect the provision of correspondent banking services. Many banks have terminated or limited their correspondent banking services to certain regions, jurisdictions or categories of clients in order to mitigate some of their costs and their exposure to potential reputational or financial risks (also known as de-risking).[16] According to data published by the Financial Stability Board, during the period 2011 to mid-2017, the number of active correspondents declined by 8 per cent across all currencies.[17] This may in part be a result of increasing compliance costs for banks to maintain correspondent banking relationships.[18]

Legacy infrastructure constraints

Commercial banks face challenges in interacting with legacy infrastructure run by central banks, as described above. Most notably, the fragmentation of data standards can result in banks having to manually collect and repair payment data to process transactions. In any instance where two different data formats meet, the data must be translated, which introduces cost and complexity to systems, with ensuing operational and compliance risks. Manual intervention also means a longer processing time and additional costs. Although the proportion of payments requiring manual intervention is low, their cost of repair is an order of magnitude higher than the repair cost for transactions satisfying straight-through processing requirements. It can be the case that payments requiring manual intervention are concentrated in some channels and certain destinations.

One consequence of the reduction in correspondent banking services is that it can increase the length of a payment chain - i.e., the transaction is handled by more banks before it reaches the beneficiary. As shown above, this can also be linked to policies and requirements around access. Processes around AML/CTF are replicated in each jurisdiction by each bank that the payment flows through, which can result in a lengthy time for a payment transfer to complete.[19] Furthermore, it increases the chance that there will be an error in the automatic processing of a payment.

Any payment messages that require manual intervention by bank employees to be processed incur costs that are a significant magnitude higher than the conventional, automated straight-through processing. As each bank involved in a cross-border payment has their own internal guidelines around processing payment transactions, the likelihood of a payment requiring manual processing is a factor of the number of banks in the payment chain and the payment's ultimate destination.[20] This, combined with the challenges posed by RTGS operating hours discussed above, can result in long time lags for cross-border payments.

Compounding the challenges stemming from the legacy platforms and standards of the RTGS and financial market infrastructure, many banks also have legacy processing applications and hardware in their own organizations. Often designed and developed decades ago, these systems have been enhanced from time to time as needed to match payment processing capabilities and the requirements of the jurisdiction's domestic payment systems. Rather than changing their underlying architecture, banks have opted to use middleware solutions to integrate upgrades or changes. To illustrate, according to IBM, 92 of the world's top 100 banks continue to use mainframes for critical applications because of their ability to process huge numbers of transactions efficiently.[21] The cost of maintaining such platforms, however, is high, and the challenges of updating, renewing or rationalizing them are significant.

Much like many RTGS platforms, these legacy intra-bank payment system infrastructures need adequate downtime to perform updates, end-of-day processes or other essential functions. This system unavailability determines the operating hours for the commercial banks to process payments, and thus their ability to offer services to their customers. Therefore, these banks are revamping their payments infrastructure (upgrading and/or optimizing their legacy systems as required) to strengthen their system capacities to support increasing cross-border trade, and faster or near-real-time payments and transaction volumes within the next two decades.[22] These upgrades not only seek to improve customer experience but also are vital to improve resiliency, particularly in the face of the growing threat of cyber-attacks.

Foreign exchange considerations

A vital element of cross-border payments involving different currencies is the FX transaction.[23] To enact a cross-border transaction, the originating bank may have to source the relevant currency from the FX market; this activity underpins the cross-border payment process. Ideally these payments would be settled on a payment-versus-payment (PvP) basis to reduce Herstatt risk.[24] In the wholesale markets for major currencies, this is done via the Continuous Linked Settlement (CLS) service. CLS offers PvP settlement to 60 settlement banks in only 18 different currencies.[25] CLS calculates a net pay-in and pay-out schedule for each of these currencies, allowing banks to settle FX trades in a liquidity-efficient manner. Nevertheless, CLS is constrained by the market in which it operates. The main CLS window is not always available for spot trades and may be short as it needs to coordinate with the opening hours of participating RTGS systems. Further, the limited range of currencies is dictated by the ability for a given RTGS operator to participate in the system, requiring significant legal and operational effort. These FX risks could be reduced by banks prefunding sufficient liquidity in different foreign currencies. But this would simply increase the liquidity costs of the cross-border payment.

3.3 Challenges for end-users

End-users in this context are defined as individuals or businesses that send or receive funds across borders. This report focuses on corporate users, although retail users may face similar challenges.[26] End-users desire transparency, timeliness of transaction processing, and availability of the service, and they are sensitive to these factors when selecting a service provider.

Lack of transparency regarding payment status and cost

End-users desire security and transparency when undertaking cross-border transactions. Some senders may be penalised by their beneficiary if the payment is late. The lack of transparency when funds are in transit therefore causes worry and fear of possible financial loss, which are exacerbated when transactions take a long time to complete.

This lack of visibility during processing arises because the payment route is structured by the correspondent banks along the chain and is not known to the originating bank. Until recently, it has not been possible to track cross-border payments while these transactions are routed through multiple banks, each with different processing times (leading to potential delays in the funds reaching the beneficiary).[27] The originating bank is able to guarantee and share information only regarding its own stage of the payment process. Once the payment enters the next bank, the originating bank loses sight of the payment.

There is also a lack of transparency and visibility regarding the fee charged by the chain of correspondent banks in the payment process, and this increases the financial exposure of the end-user. Transparency about both the time it takes for the beneficiary to receive a cross-border payment and the amount that the beneficiary will receive is also of high importance to the users at both ends of the cross-border transaction given that this information allows for accurate forecasting of days sales outstanding (DSO) and days payable outstanding (DPO),[28] reduces the payment-reconciliation burden and reduces costs by allowing the sender of the payment to both avoid penalties due to late payments and accrue incentives for making payments on time.

Delays in payment processing

Originating banks, beneficiary banks and correspondent banks have separate internal

Key challenges for senders and beneficiaries of high value payments include lack of payment status and visibility, delays in payment processing and lack of round-the-clock service availability

guidelines and processes for cross-border payments. Each bank across the payment value chain will individually undertake its own processes to meet regulatory requirements, such as sanctions screening and assessment of collateral requirements as well as ensuring that the payment message format and content[29] are correct. For certain payments and currency corridors, many correspondent banks can be involved. The combination of banks' payment processing times and differing operating hours results in a time lag in cross-border payment processing.

As discussed above, some payments are also delayed by manual processing, which may be needed because a payment fails automated compliance checks or because differing messaging, account or data standards require a payment to be repaired before it can be sent to the next bank in the chain.

Service availability across multiple jurisdictions.

Because operating hours vary across multiple jurisdictions, cross-border payment processing is not usually available 24 hours a day. Cross-border payments are subject to stipulated cut-off times; payment instructions received after the specified times are processed the next working day. These times are driven by the availability of both the RTGS systems operated by central banks and the systems operated by commercial banks. This places a restriction on cross-border payments to be processed round the clock.

4.0

KEY CHALLENGES AND ROOT CAUSES

4.0 Key Challenges and Root Causes

The table below lists the key challenges associated with cross-border payments and settlements today. It describes the impact each of these has on the different participants in the payments value chain, i.e., the end-users (senders and beneficiaries), commercial banks and central banks. It also attempts to outline the degree of impact (high, medium or low) on each of these. In addition, the table lists the underlying root cause of the challenge outlined. The purpose of identifying the root cause is to help identify the capabilities required to address the root cause and the associated challenge. Note that the key challenges are not ranked.

Impact on monetary policy and financial markets	Description and degree of impact on different participants *(H = High impact, M = Medium impact, L = Low impact)*	Root Cause
1 **Lack of transparency regarding payment status, visibility and certainty of outcome** • End-users and banks cannot see the status of the payment in the value chain. • The exact route of the payment is not known upfront because routing is not determined by the originating bank but by correspondent banks along the chain	**End-users** (Sender and Beneficiary) H • Lack of payment status visibility • Uncertainty about whether and when the beneficiary will be credited with funds • Charges applied to payments are not known upfront **Commercial Banks** H • Inability to provide current payment status to customers • Cost involved in manually tracking payment status across the value chain • Reduced resilience against fraud or payment error **Central Banks** N / A	**Lack of a standardized payment status notification capability across the common payment messaging network used by banks** *(**Note**: The SWIFT global payment initiative (gpi) has enabled this feature for participating banks along with other efficiency benefits for banks.)*
2 **Limited availability of cross-border payment services** • Cross-border payments are subject to cut-off times, which reduces the likelihood that payment instructions will be received and processed and payment sent to the beneficiary or correspondent bank the same day. • Payment instructions received after the cut-off time are processed the next working day. • Cross-border payment services may not be available on weekends.	**End-users** (Sender and Beneficiary) L • Limits the availability (and perceived flexibility) around when payment transactions are completed and funds credited • Reduces the efficiency of working capital and the optimization of cash flows **Commercial Banks** H • Must ensure adequate liquidity in correspondent bank accounts to meet payment obligations within cut-off times (if same day) • May limit effective deployment of bank liquidity as funds are tied up longer • Limited overlap of service times with other jurisdictions • Increased associated operational costs (e.g., balance sheet management) **Central Banks** M • Limited windows to extinguish settlement risk between banks may cause risks to build up in the system during limited operation windows • Potential drag on overall economic activity due to in-efficient deployment of liquidity and reduced efficiency of working capital	▪ **Mismatch in the operating hours of RTGS systems and commercial banks systems across different jurisdictions and time zones, driven in part by legacy infrastructure** ▪ **Reliance on multiple intermediaries (with associated cost and complexity) for cross-border payments and settlements spanning multiple jurisdictions**

D High M Medium I Low

Impact on monetary policy and financial markets	Description and degree of impact on different participants *(H = High impact, M = Medium impact, L = Low impact)*	Root Cause
3 **Time taken for payment processing**	**End-users** (Sender and Beneficiary) M • Delay crediting funds to the beneficiary • Requests for additional information to satisfy due diligence or regulatory requirements **Commercial Banks** M • Inability to straight-through process payments • Increased cost of end-to-end payments processing through manual intervention e.g. sanctions screening for exceptions, payment repairs, reconciliation etc. • Investment in message mapping protocols between different payment networks • The longer payments take, the longer participants are exposed to Herstatt risk from their correspondents **Central Banks** L • The drivers - in particular, limited interoperability between payment systems - can reduce financial resilience	Regulatory requirements to undertake processes such as sanctions screening, collateral requirements, payments message details (clearing codes, purpose of payment), etc., can prevent straight-through processing of payments. Requirements are often duplicated across multiple entities and jurisdictions **Lack of consistency or interoperability across jurisdictions for common payment standards and regulatory requirements.**[30] Lack of local-language processing capability may be mitigated through the adoption of ISO 20022 standards. **Reliance on multiple intermediaries (with associated cost and complexity) for cross-border payments and settlements**

4
High costs associated with the correspondent banking model
• Costs can be separated into (i) balance sheet costs, such as trapped liquidity; and (ii) operating costs, such as managing diverse messaging standards, dealing with complex infrastructure and complying with regulatory requirements
	End-users (Sender and Beneficiary)
	H
	• Significant cost of cross-border payments passed on to end-users
	
	Commercial Banks
	H
	• Increased costs (explicit and implicit)
	• These costs are a result of:
	  • Opportunity cost of liquidity trapped in nostro accounts maintained with correspondent banks (the counter to this is pre-funded vostro ac-counts)
	  • Periodic KYC and customer due diligence (CDD) on correspondent banks
	  • Counterparty credit risk and settlement risk
	• Costs are relatively higher for local banks due increased reliance on correspondent banking arrangements
	
	Central Banks
	H
	• High costs are causing banks to consider the viability of correspondent banking, lowering financial resilience by concentrating services in a smaller number of systemic firms.
		Reliance on multiple intermediaries (with associated cost and complexity) for cross-border payments and settlements
		
		Lack of consistency across jurisdictions for common payment standards and regulatory requirements
		
		Challenges associated with legacy payments infrastructure across networks, central banks and commercial banks
		
		Restrictive central bank policies on access

D High M Medium I Low

Impact on monetary policy and financial markets	Description and degree of impact on different participants *(H = High impact, M = Medium impact, L = Low impact)*	Root Cause
5 **Challenges associated with legacy payments infrastructure across networks, central banks and commercial banks.** • There is an increase in the scale, nature and sophistication of new types of risks to payment systems like RTGS (e.g., cyber-attacks) • There are technical barriers to entry to central banks for smaller banks and non-bank payment service providers	**End-users** (Sender and Beneficiary) M • Risk to business operations arising from payment system outages • Limited availability of innovative new services and business models **Commercial Banks** H • Risk to operations arising from payment system outages • Significant cost and complexity of incorporating new technology into existing architecture estate **Central Banks** M • Risk to financial sector stability resulting from payments system failure • Restrictions on ability to enable innovation at industry level due to technical restrictions imposed by existing infrastructure	**Cost and capacity to incorporate new technology and changes to current systems**

D High M Medium I Low

4.1 Current Initiatives: a critical assessment

Domestic RTGS enhancements

Several RTGS operators are looking at modernizing and renewing their payments infrastructure in order to facilitate change in payments and settlement. A key driver for these renewal projects is to ensure the ongoing resilience of the system in the face of new threats. However, renewal projects also give RTGS operators the opportunity to consider how their systems might interact with new, innovative platforms such as those using DLT. Driving change at the centre can also incentivise (or require) firms to invest in renewing their own legacy infrastructure.

As part of these projects, several RTGS operators across the world are moving towards ISO 20022 messaging standards. Through coordination and cooperation, these initiatives can help to harmonise standards and help to improve straight-through processing rates between systems.

Some jurisdictions have introduced initiatives to broaden access to RTGS to allow new types of firms to access central bank money settlement. One example of this is the Bank of England opening access to settlement accounts for non-bank payment service providers. This can drive innovation and change in the way service is provided to end-users, hopefully lowering costs, as well as reducing points of systemic risk. Nevertheless, there will still be barriers to accessing such services that will continue to exist and to restrict eligibility. Access to settlement in central bank money will be encouraged, but only within the risk tolerances of each central bank.

Additionally, some operators are exploring extending their operating hours in response to demand from commercial banks.[31] Longer operating hours would extend the windows of time when multiple systems are open. This should reduce the number of instances when cross-border payments are held up waiting for the next payment system in the chain to open.

Several RTGS operators are working with or encouraging collaboration with private sector initiatives. Such collaboration can enable the integration of new and emerging technology with existing infrastructure. Examples of this include the Bank of England exploring synchronization technology, linking payments or asset movements together, which could enable cross-border payments.[32]

However, developing RTGS systems in domestic jurisdictions is only part of a solution to solve some of the cross-border payment issues. For example, increasing RTGS operating hours is a precursor to improving payment processing for end-users, not a panacea. It must be accompanied by enhancements to commercial bank systems and changes to operational processes so that they can maintain longer operating hours, and the availability of FX and money markets so that liquidity can be found when needed.

The varying stages of development of domestic financial infrastructures create a challenge for broader and deeper international harmonization. Bilateral agreements between system operators may provide little value to the wider financial system. A consideration for cross-border developments is the inclusion of the infrastructure underpinning major currencies, particularly the US dollar and the euro. One consequence of this is that currency corridors in which less trade or fewer transaction flows occur may see limited benefit from these innovations and thus develop little appetite to change.

A number of initiatives both planned and underway look to resolve pain points associated with cross-border payments today. However the majority of these are either specific to a particular jurisdiction(s) or a limited set of member banks and are focused on specific aspects of cross-border payments only

ISO 20022 messaging standards

The most common standard for cross-border payments is the SWIFT MT standard. The MT (Message Types) standard was developed in the 1970s. With advances in technology and changing business needs, this standard is becoming outdated, and a new ISO 20022 standard has been proposed. By 2023, the ISO 20022 messaging standard is expected to be about 79 per cent of all high-value payments, and there are proposals to migrate the SWIFT cross-border network to this standard by 2025.[33] One of the main benefits of the wide coverage of the SWIFT network is its potential to drive harmonised data standards. The widespread implementation of this agnostic, data-rich and highly structured messaging standard could help overcome several issues.

Agnosticism means that ISO 20022 could be implemented in systems connected to domestic and international payment networks, boosting interoperability between systems and reducing costs and complexity for banks using these systems.

The richness of the data contained within ISO 20022 messages can enhance KYC and other due diligence functions and improve the sanctions screening process. This can reduce compliance costs and in turn reduce the price of cross-border payments and improve the availability of correspondent banking services.

More structured data could support more automated processing and reconciliation, delivering benefits throughout the value chain and further reducing the cost of cross-border transactions for correspondent banks and their customers.

Finally, the process of implementing ISO 20022 in legacy infrastructure is likely to require modernization of systems from RTGS operators, network providers, commercial banks, overlay service providers and large corporates. This process could drive improvements in efficiency and resiliency.[34]

However, implementing ISO 2002 across multiple jurisdictions creates challenges. The flexibility offered by the new standard means that each jurisdiction could implement a variation of the standard that is unique and specific to its individual needs. This could reduce the expected efficiency benefits that widespread adoption of the same standard is expected to bring. Without clear global governance and meaningful enforcement of data standards, it could be challenging for banks to achieve the full range of efficiency and data-driven benefits that are expected.

ISO 20022 can be introduced alongside other data standards, such as the Legal Entity Identifier (LEI). The LEI can provide a globally standardized mechanism for identifying parties in a transaction. This may improve AML/CTF compliance processes and drive cost and time savings.[35] This can help alleviate some of the pressure of de-risking.[36]

Additionally, the scale of implementation can be a challenge for large financial institutions and represents a serious barrier to implementing new data standards. Each new data element has an impact across core banking platforms, data warehousing and client-facing channels. The cost of such change could mean that jurisdictions or institutions with less developed financial infrastructure or less incentive to change choose not to migrate to the new standards.

Continuous Linked Settlement (CLS) developments

Approximately US$6.51 trillion is traded daily in FX markets.[37] According to CLS, approximately US$1.55 trillion is traded on average across the CLS system, removing settlement risk across 18 major currencies and for over 60 settlement members and 20,000 third-party clients. As discussed above, however, the main CLS service is not always available for spot trades, nor can it help reduce risks for banks seeking to source a currency other than the 18 currencies covered.

CLSNow is a product CLS plans to offer that would expand the scope of its existing USD/CAD same-day service to more CLS currencies (initially CAD, CHF, EUR, GBP and USD).[38] Developments such as this may help participants to source currency at shorter notice, which should help to speed up larger cross-border payments. Nevertheless, the benefits will largely be driven by uptake and may be limited until more currencies are included.

Payment visibility and speed: SWIFT gpi

The SWIFT global payment initiative (gpi) aims to resolve issues surrounding payment speed and status visibility.[39] SWIFT gpi enables visibility of a payment across the SWIFT network. This feature is available to SWIFT participants who sign up to the service. Banks that have signed up can pass tracking information to clients, giving end-to-end visibility on the status of a payment transaction from the moment it is sent to the point it reaches the beneficiary's account, with a credit confirmation provided as soon as the beneficiary has been paid. There are plans to increase the range of features, including stop and recall, and to widen access to gpi to corporates.

Additionally, SWIFT gpi aims to provide transparency regarding bank fees charged and the FX rates applied. SWIFT has suggested this innovation will result in savings of as much as 50 per cent on client enquiry costs.[40]

A challenge for gpi is that it is available only to SWIFT member banks. This restricts the number of users who can benefit from this functionality. However, SWIFT gpi Service Level Agreement (SLA) dictates a "same day use of funds" policy to speed up payment processing, thereby reducing overall cross-border payment and settlement times for gpi-enabled transactions.[41]

Centralized customer due diligence utility

KYC and customer due diligence (CDD) utilities are one mechanism to improve the sanctions screening that firms must undertake. These platforms, managed by third parties, can save cost and time in the collection and management of the data needed to undertake KYC screening.

Harmonizing and standardizing the quality and types of data a firm can access regarding a client enhances KYC processes for banks. Furthermore, centralizing such utilities provides a vehicle for firms to share information about the data they hold and the screening they have undertaken on an end-user, with the intention of reducing costly and inefficient repetition of processes by banks in the correspondent chain.

These initiatives have so far fallen short of the desired expectations in both intent and implementation, and uptake by the participating banks has been low. One challenge that has been identified is that differing regulatory requirements in different regions can complicate efforts at standardizing CDD data. Moreover, it remains to be seen whether banks are willing to bear the risk of trusting what their counterparties have said they are doing about conducting CDD activities. Banks' regulators may not support relying on counterparties' CDD, either.

Conclusion

Sections 3 and 4 demonstrate that substantial positive change is taking place to improve cross-border payments. This change is driven by the integration of new technology into the existing infrastructure. This report focuses on the prospect of a wider-scale transformational change in the infrastructure used to deliver cross-border payments.

Across these initiatives and our hypothetical future-state models, there is a cross-cutting theme of international coordination to deliver harmonization and standardization. This will help to lower barriers to entry on a global level, bring down operational costs and increase the speed and transparency with which cross-border payments are carried out. Today, the costliest, slowest, least-transparent payments are often the result of the fragmented development of the international financial system. It is therefore vital that any future-state models are developed on an international level, include a broad spectrum of countries and are managed via an appropriate international governance framework.

The rest of this report seeks to explore future-state solutions with a fundamental paradigm shift, enabled through new technology platforms, as a means of supporting this required level of international harmonization.

5.0

POTENTIAL FUTURE STATE

5.0 Potential Future State

The table below lists the capabilities that must be delivered by any future model for cross-border payments and settlement to solve the root causes identified above. The table also presents the resulting benefits to each of the participants involved in the payment value chain.

Root causes of pain points	Future-state model capability needed	Benefits delivered to:
1 **Lack of a standardized payment status notification capability across the common payment messaging network used by banks**	**Network-agnostic payment status visibility for participants and users** • End-to-end visibility of the status of the payment for all participants at any point across the transaction flow[42] • Notification on receipt of the funds by the beneficiary • Ability to do this over disparate networks and across international and domestic payment systems	**End-users** (Sender and Beneficiary) • Transparency and certainty of outcome enables originator and beneficiary to better manage their liquidity and cash flows • Increased transparency and certainty allow for improved customer service **Commercial Banks** • Ability to offer better services to clients and at a less cost than manually tracking down payment status location, etc. • Greater visibility of incoming and outgoing funds and the potential to manage liquidity more effectively **Central Banks** • The data provided from tracked payments could provide great insight into the workings of cross-border payments, allowing further research into addressing remaining issues, as well as wider economic analysis
2 **Mismatch in operating hours of RTGS systems and commercial banks systems across different jurisdictions and time zones**	**Extended availability of domestic and international payment capability** • Increased operating hours allow extended payment cut-off times for domestic and cross-border payments facilitated by extended RTGS operating hours across jurisdictions. • Commercial banks to make their operations and systems available to support such ex-tended operating hours.	**End-users** (Sender and Beneficiary) • Ability to initiate and have cross-border payments processed when required based on business needs • Greater flexibility to optimize liquidity and cash flow positions • Increased ability to determine payment "velocity" and the speed with which funds can be credited to the beneficiary[43] **Commercial Banks** • Ability to deliver and settle cross-border payment services led by end-user's (customer's) operating hours and business requirements • Greater flexibility to settle in central bank money, thereby reducing exposures and settlement risk **Central Banks** • For those with broad economic activity mandates, this offers the potential to increase economic activity and business transactions.[44] • Ability to offer settlement in support of commercial bank operations thereby reducing settlement risk building up in the financial system

Root causes of pain points	Future-state model capability needed	Benefits delivered to:
3 **Lack of common, consistent payment standards (technical and operational) and regulatory requirements across jurisdictions**	**Rich and consistent payments data standards (technical and operational) and reduced regulatory divergence across jurisdictions**[45] • interoperable, standardized payment message and data formats across both domestic and international payment systems[46] • Messaging standards contain rich, structured data and are agnostic to the network being used • Common operational standards and processing Service Level Agreements (SLAs) to provide consistency in payments services • Appropriate governance structure required for introducing and maintaining common standards across multiple jurisdictions • Where possible, cross-jurisdictional regulatory requirements are harmonized or aligned to reduce duplication of activities (e.g., sanctions screening lists, payment purpose codes etc.)	**End-users** (Sender and Beneficiary) • Reduced delays in processing payments and in crediting funds to the beneficiary due to consistency of requirements • Greater capacity to enable data-driven processes in back offices across corporate users of systems, (e.g., automated reconciliation) • Receipt of more advanced data-driven services from payment service providers **Commercial Banks** • Enhanced payment straight-through processing via standardization of data and automation of processes • Enhanced payment data content to support KYC and AML checks, sanctions screening • Enhanced and standardized data which can enable the development of data-driven services • Interoperability between local payment networks across jurisdictions which can reduce costs from back office functions and drive efficiency for payment service providers. This can be passed on to end-users • Potential to reduce payment delays due to missing regulatory information if jurisdictional divergence can be reduced **Central Banks** • For those with broad economic activity mandates, this offers the potential to increase business activities due to reduction in payment delays. • Interoperability between payment systems can enhance resilience across the financial system • Rich and consistent data enables detailed analysis and insight into the international payments system and individual firm activities
4 **Reliance on multiple intermediaries (with associated cost and complexity) for cross-border payments and settlements**	There are several future state capabilities that could overcome this reliance. The models in Section 6 explore the possibility of introducing **direct, peer-to-peer payment and settlement** between originating and beneficiary bank. Alternative options include: • **Synchronized payment vs. payment** where correspondent banks continue to be part of the payment value chain • **Single and global overarching payment operator** to govern, regulate and process cross-border payments and settlements, modelled on the concept of card payment network operators	**End-users** (Sender and Beneficiary) • Reducing the length of a payment chain can limit the likelihood of delays. This provides a faster service with greater certainty of outcome. **Commercial Banks** • Release trapped liquidity (earning no interest or income) in correspondent bank accounts, enabling bank capital to be deployed more productively for funds to earn income. In turn, this allows banks to pass cost savings on to end-users. • Reduction in payment settlement risk and overall counterparty credit risk • Reduced operating costs associated with maintaining correspondent bank relationships e.g. KYC and CDD, fees and charges. However this may be countered by the increased need to undertake due diligence on any counterparty when undertaking peer-to-peer transactions **Central Banks** • Increased resilience of the financial system to the consequences of correspondent bank(s) failure • Reduction in the risk of de-risking removing banking services from 'hard-to-reach' jurisdictions

Root causes of pain points	Future-state model capability needed	Benefits delivered to:
5 **Challenges associated with legacy payments infrastructure across networks, central banks and commercial banks**	**Modernized, flexible technical payment system infrastructure –** • Upgrading systems across market infrastructure and commercial payments service providers can enable flexibility to adapt and react efficiently to future demand and requirements (future-proofing payment systems).	**End-users** (Sender and Beneficiary) • Reduction in the technical barriers associated with legacy infrastructure can underpin advances in the services that end-users experience. This can help deliver the capabilities listed above. **Commercial Banks** • Increased stability and predictability of operations resulting in reduced risk of outages • Reduced costs of operating and managing complex and ageing systems • Increased capacity to integrate and interoperate with new technology as it emerges **Central Banks** • Improved security, stability and resilience of the overall payment market infrastructure • Facilitate innovation delivering improvements in services for end-users and increasing stability across the payments ecosystem • Widened access for smaller banks and non-bank payment service providers to ensure increased range of transaction settling in central bank money (CeBM) and reducing the number of points of systemic risk in a payments network

6.0 POTENTIAL FUTURE STATE MODELS FOR CROSS-BORDER PAYMENTS AND SETTLEMENTS

6.0 Potential Future State Models for Cross-Border Payments and Settlements

This section explores the current cross-border payment and settlements model and two potential future models for cross-border payments and settlements that leverage the power of the central infrastructure to drive change. Our proposals are hypothetical, intended to enable an analysis of the relative merits and challenges of different models. These models are not exhaustive, nor does their discussion here reflect an intention to implement, or an endorsement of, any specific future approach. We seek to explore whether these models might deliver any of the future-state capabilities and benefits identified in the report. Where they do not, we identify the technical or non-technical barriers requiring additional technical and policy exploration.

- **Model 1**: is the collection of current and planned industry initiatives, which we consider to be the baseline for these discussions.
- **Model 2** is based on an expanded role for in-country RTGS operators that act as "super-correspondents" for settling cross-border payments instead of relying on intermediary banks as correspondent banks.
- **Models 3a, 3b and 3c** are variations based on the settlement of cross-border payments between banks using W-CBDCs[47]. These are a tokenized, limited-access form of central bank liabilities used for wholesale interbank payment and settlement transactions.

These models are by no means exhaustive; various other models and technologies could potentially address many of the pain points identified earlier in this report, and new proposals will emerge to enhance the current state. We choose to focus on W-CBDC approaches in this report primarily because of the knowledge and experience gained via projects such as the Bank of Canada's Jasper project and the Monetary Authority of Singapore's Ubin project, which have previously explored this approach to domestic payments scenarios.[48] [49] We now explore whether this approach may have merits in cross-border payment and settlements.

Theoretically, there are several conceptual models that leverage W-CBDCs,[50] but we consider just three of these models that use this approach.

For each proposed model, a high-level description is accompanied by a pictorial illustration and a list of key considerations and dependencies. Examples of more detailed transaction flows are included in the Appendix (Sections 8.6 and 8.7). A summary table compares each of the proposed models against the pain points identified earlier in the report.

It is possible that the underlying technology for these W-CBDC models could be DLT. However, DLT remains an unproven technology from the standpoint of a wide-scale, live system implementation. It is also possible that these models could be implemented using technologies that are not dependent on DLT. It is outside the scope of this report to compare the various technology options that could enable any of these models.

Considerations when reviewing the models

The key message conveyed by the analysis below is around the need to explore further both the technical and the policy challenges associated with cross-border payments.

Our analysis of Model 1 suggests that there is a role for centrally orchestrated change to comprehensively address the challenges identified. Analysis of Model 2 highlights the limits to the feasibility of radical changes in the responsibilities of RTGS operators. Models 3a, 3b and 3c assess the capacity for a W-CBDC technical solution to address each pain point drawn out in Sections 3 and 4 and explore how differing implementations of a W-CBDC encounter different policy challenges.

Any new financial market infrastructure would need to comply with the PFMI.[51] These apply to all systemically important market infrastructures and set minimum standards internationally.

Models 3a, b and c are based on the concept of a Wholesale Central Bank Digital Currency (W-CBDC) and expand on previous work on this concept by exploring the benefits and considerations of using CBDCs for cross-border payments and settlements

6.1 Future state models

6.1.1 Model 1: Current and planned initiatives within and across jurisdictions

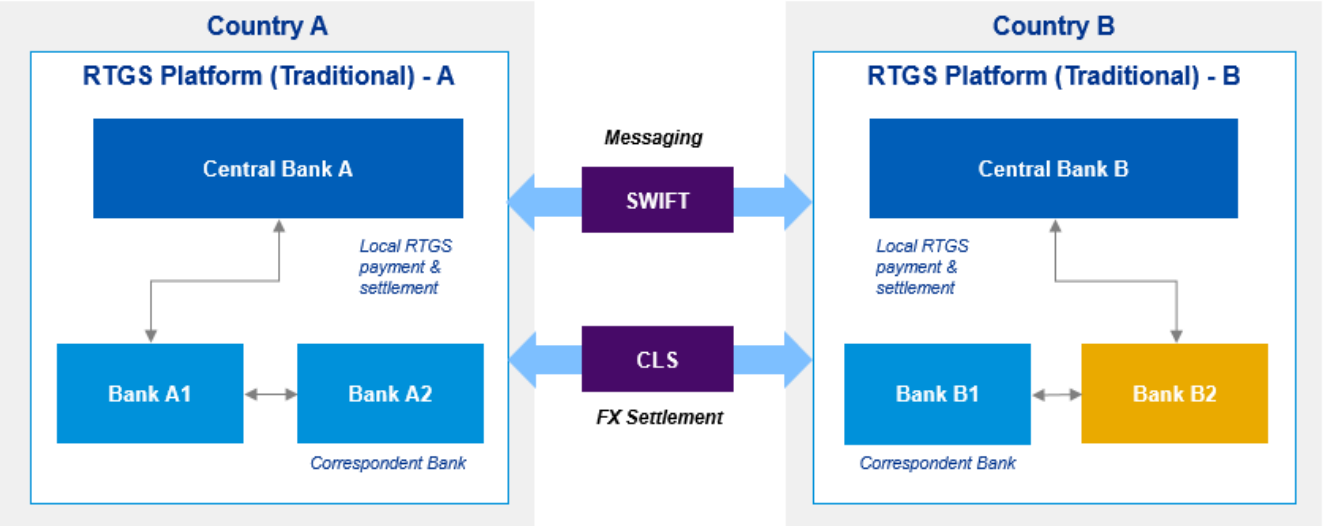


Figure 1

Model description:

This model is based on ongoing and planned enhancements to existing payments and settlements systems and infrastructure within and across jurisdictions. These include for example:

- Enhancements to in-country RTGS (e.g. the United Kingdom[52], Canada[53], Hong Kong, India) that are trying to expand operating hours (the United States has moved to 21.5 hours of operation), enhance payment status notification (India with NEFT), improve standards (IBAN for Europe), and reduce frictions (SEPA for the European Union) along with other improvements
- Adoption of common messaging standards (ISO20022)
- Payments tracking and status visibility (SWIFT gpi)
- SWIFT KYC registry platform for SWIFT members to share KYC data in a standardized format
- Initiatives to link domestic payments infrastructures such as Directo - (linking US and Mexican infrastructures[54]) , Arab regional payment system (scheduled for delivery in 2020)[55], and East African Payment System (EAPS)[56]
- International Payments Framework Association (IPFA) and SWIFT High Value Payment Plus (HVPS+) set up to facilitate the establishment of common rules and standards for cross-currency/ cross-border payments.

Further detail on many of these initiatives is set out in Section 4. This model assumes that cross-border payments and settlements are primarily based on the correspondent banking model, as is the case today. Transaction flows are therefore assumed to be the same as those used today for cross-border payment and settlement using the correspondent banking model and based upon rules defined by each respective payment network today such as SWIFT, CLS and RTGS.

Key considerations and dependencies

Model 1 can deliver some of the future capabilities identified in Section 5. For example, SWIFT gpi will enable payments tracking and status visibility for member banks; RTGS operating hours may be extended in some jurisdictions (e.g., the United Kingdom) to provide for greater overlap with other jurisdictions; ISO 20022 will deliver common payment standards and is a significant step towards increased inter-operability between payment systems. These initiatives may improve the transparency of the cross-border process, catalyze improved availability in some currency corridors and hopefully reduce some of the cost of providing cross-border banking services as set out in Section 4.1.

Nevertheless, this model may not address all the associated challenges outlined previously. Furthermore, while these initiatives may provide the basis for future enhancements, they are somewhat fragmented in their implementation, and challenges around renewing, replacing or interoperating with legacy infrastructure will persist.

The implementation of ISO 20022 provides some insight into this. The standard was originally introduced in 2004 and for many years saw limited uptake globally. One reason for this is the preponderance of network effects and the potential cost penalty associated with being the early adopters of a given initiative, which can slow wide-spread adoption until critical mass has been reached. This in turn can dampen the impact a given innovation has on the market because the market may have moved on or an alternative solution may have been found. There can also be further interoperability challenges as competing solutions tackle the same problem.

However, recent projections indicate that critical mass has been reached and that within the next five years c.80 per cent of high-value payments will be based on the ISO 20022 messaging standard.[57] Key to this has been decisions made by important market infrastructure operators such as the European Central Bank, the Federal Reserve Bank of New York, the Bank of Jamaica, the Bank of England and ultimately SWIFT to migrate to the standard. In recognition of the positive impact that operators of critical central infrastructure can have in overcoming network effects, the models that follow focus on centrally orchestrated change.

6.1.2 Model 2: RTGS operators as "super correspondents"

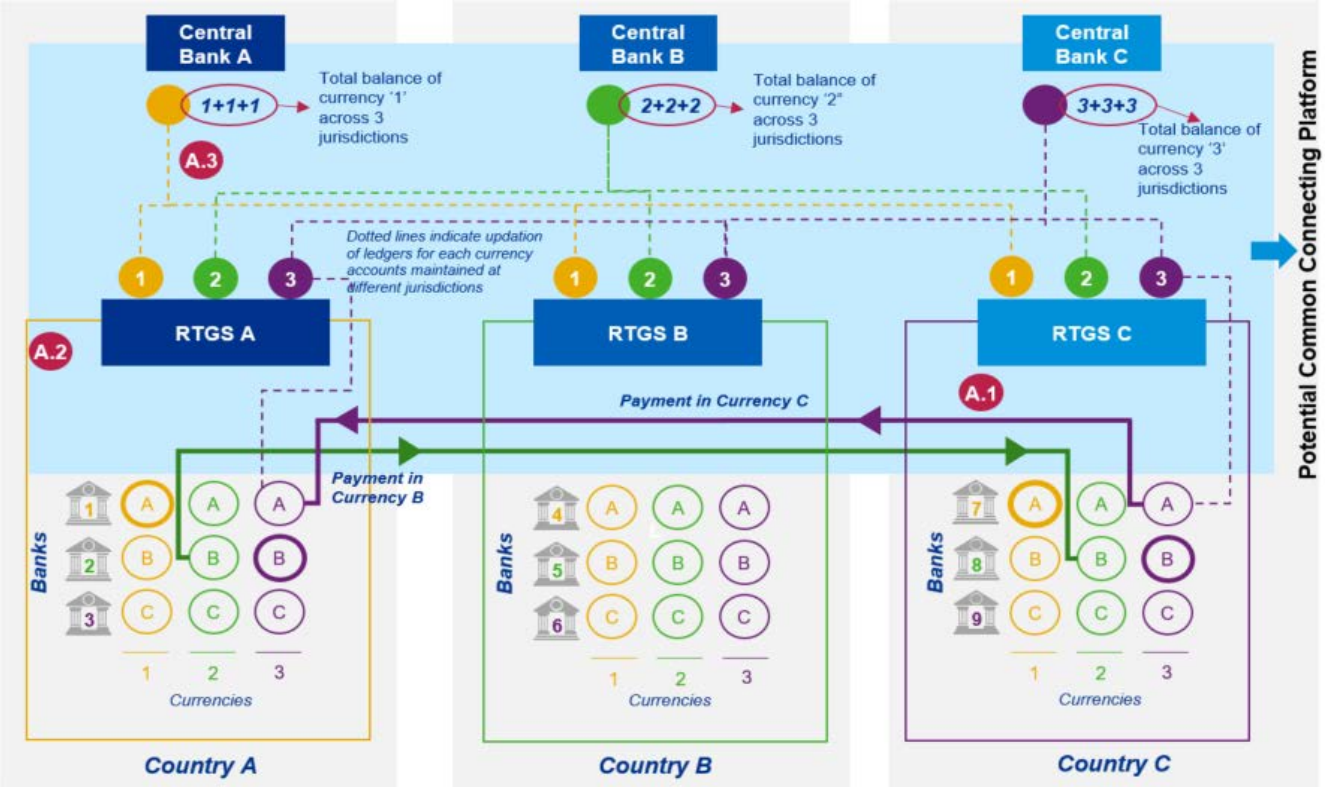


Figure 2

Model description

Central banks allow RTGS operators of different jurisdictions to open accounts in their (central bank's) books in the currency of the given RTGS operator. For example, the Monetary Authority of Singapore could open a Singapore-dollar account in the Canadian RTGS system.

The central bank money for each currency will reside in home jurisdictions only. Domestically, RTGS operators have a mirror account reflecting their balances with other central banks at the central bank of their home jurisdiction.

This enables RTGS operators to effectively hold multicurrency clearing accounts for their member banks without the need for the latter to open nostro/vostro accounts globally. The aggregate balance of all member holdings across these currencies is the total in the RTGS operator's ledger.

The various RTGS operators are linked, potentially via a common shared platform.

This model is not dependent on the use of DLT, although it could utilize a DLT plat-form to enable a consistent view of accounts across different RTGS systems. This would require an analysis of the relative merits of various technological approaches, including those based on DLT, for this specific scenario; however, this is out of scope for this report.

In this model, RTGS operators act as correspondent agencies (or super-correspondent) for their member banks and act on behalf of but under the instruction of their members for cross-border payments[58]. Member banks can act as agents for non-RTGS participants.

RTGS member banks maintain specific currency ledgers related to the respective participating jurisdictions. Cross-border transactions conducted between banks will update the specific currency ledgers for all the participants, and this could be facilitated by a common shared platform. When banks need to fund their nostro accounts, the process is similar to the process today; i.e., the commercial banks still take the risk and source the funds. The only difference here is that the nostro accounts are now with the RTGS operator and not with a correspondent bank. By consolidating multiple commercial banks' nostro accounts, this model may result in a more liquidity-efficient system because the "overfunding" of multiple nostro accounts will be eliminated and banks can pool all their funds required for cross-border payments into a single account.

The consequence of this is a reduction in the number of entities in a payment trans-action and a significant reduction in settlement risk. For this model, we expect that the FX market will continue to function at the commercial bank level. This model does not inherently disintermediate this market function.

Key considerations and dependencies

The most significant implication of this model is the requirement for RTGS operators to open accounts in different jurisdictions, thus altering the constitution of their balance sheets. This is a significant departure from present-day RTGS operation and monetary policy implementation, and presents a challenge for central bank balance sheet management and monetary policy.

To have a meaningful impact on the KYC burden, this model would transfer the requirement for these checks to the RTGS operators. This would need careful consideration by central banks, particularly in the context of expanding access to domestic systems. While central banks currently undertake their own due diligence on account holders, they do not have explicit requirements to do so because they rarely have obligations to end-users. This could therefore be a significant shift in responsibility and liability. The model implies a further shift in role where the central bank undertakes functions traditionally done by commercial banks. There may be some questions around disintermediation of the banking market where this model may fall outside of the risk tolerance of some central banks.

A significant benefit is that commercial banks would not need to have a direct presence in a jurisdiction to transfer funds there; the network of super-corresponding central banks could facilitate this without needing to broaden access on a global level.

From the perspective of access to settlement accounts, each central bank maintains its own rules and eligibility criteria. This means a central bank does not need to have overarching jurisdiction elsewhere, but it needs to adhere to the rules in the foreign jurisdiction to be a member of that currency operator. To deliver this model, central banks may need to consider how to adjust their existing policies to ensure that access to their systems could be granted to other RTGS operators.

The level and volatility of balances that would stay in the settlement account overnight may also have a large impact on the management of the central bank's balance sheet, which in effect has an impact on the implementation of monetary policy and liquidity management within the banking system (e.g., the requirement for banks to net out their balances to zero overnight). This model may therefore require changes to central banks' monetary policy implementation frameworks.

A key pain point this model does not address is that it relies on conventional payment and settlement system technologies, which restricts its flexibility and ability to respond to changing demands. It is further restricted by the operating hours of the RTGS systems participating in this model. This can restrict payment operation windows across borders unless the participating jurisdictions agree to extend RTGS operating hours.

This model would require consensus between participating central banks and respective RTGS operators on various aspects of the model, including the potential for a common platform, an operational framework, governance and a dispute resolution mechanism. Additionally, for data, messaging standards and visibility, this model does not provide a direct mechanism to address these issues beyond Model 1.

Moving RTGS operators onto a potential common shared platform could entail significant cost and process change for all the participants involved. However, there are examples of global commercial banks operating such a system, e.g., Citibank WorldLink and Standard Chartered Bank TBFX. Their experience could be leveraged when deploying similar systems at the central bank level.

6.1.3 Models 3a, 3b and 3c: Introduction

We examine three variations of a model based on W-CBDCs.

- **Model 3a** is based on currency-specific W-CBDCs where these W-CBDCs can be transmitted and exchanged only ***within their home jurisdictions*** and cannot be transmitted outside their home jurisdictions. In this model, each central bank pro-vides wallets for W-CBDC only in their own currency. This would require commercial banks to open wallets with multiple central banks if they wish to hold multiple currencies.
- **Model 3b** is similar to Model 3a but based on currency-specific W-CBDCs that can be transmitted and exchanged ***beyond their home jurisdictions***. In this model, commercial banks can hold multiple W-CBDC wallets with their home central bank (e.g., a bank based in Canada could hold W-CBDC in Canadian dollars, pounds sterling and Singapore dollars in a wallet with the Bank of Canada). This would require each central bank to support multiple W-CBDC tokens.
- **Model 3c** is based on a universal W-CBDC that is backed by a basket of currencies and accepted by all participating jurisdictions. In other words, this model does not involve the use of multiple currency-specific W-CBDCs like Model 3a and Model 3b do; rather, it involves a single universal W-CBDC.

In the models below, we will consider two countries, A and B; each country has a central bank (Central Bank A and Central Bank B, respectively), and one or more commercial banks (A1, A2, B1, B2, etc.). The scenario being considered is that bank A1 (the originating bank) based in Country A needs to make a payment across the border to Bank B1 (the beneficiary bank) based in Country B, and that Bank B1 needs to ultimately receive currency B.

Bank A1 has a settlement account with Central Bank A. Similarly, Bank B1 has a settlement account with Central Bank B. Both these countries have their existing RTGS platforms - RTGS platform A and RTGS platform B, respectively - for interbank payments and settlements within their jurisdictions.

Additionally, in both countries, a new platform is created for the issuance, exchange, redemption and cancellation of W-CBDCs (referred to as "W-CBDC platforms" in the discussion below). For this report, we assume that W-CBDC platforms are based on DLT; however, it is possible that W-CBDC platforms could be deployed using a variety of technologies, including non-DLT solutions.

Key considerations arising from Model 3

Some considerations about using a W-CBDC platform are common to all three variants of Model 3.

As Section 4.1 sets out, this report focuses on transformational change of central infrastructure as a means of solving present-day constraints. A W-CBDC platform is one such possible solution. We hypothesize that developing a solution that addresses service availability and payment visibility and that uses harmonized and data-rich messaging standards from inception can be more successful in delivering widespread change than the fragmented approach of Model 1.

Implementing a new platform is not guaranteed to deliver the above benefits. Across each variant of Model 3, greater availability, wider access, interoperability and data-rich messaging standards are assumed. The challenge associated with delivering this in multiple jurisdictions should not be underestimated.

One key counter-argument is that the cost of implementing any of the Model 3 variants in countries with less developed financial market infrastructure may prove prohibitive. This is likely to reduce the probability that Model 3 can alleviate all the fragmentation and pain points identified in the current model. We hope that delivering a solution to all challenges at the same time will make developing this new platform an at-tractive proposition to a wide range of jurisdictions.

The creation of W-CBDCs may have an impact on money supply and monetary policy within a jurisdiction. This will be pertinent if the value of outstanding W-CBDCs is significant. This will be a vital consideration for central banks in assessing the viability of these models, and further study will be needed to understand the potential impact.

To further enable interoperability between W-CBDC platforms, consensus will be required between the participating jurisdictions around a governance framework, common standards, cyber security requirements, etc. It is unlikely that all jurisdictions will participate at the outset. The onus will therefore be on the founding jurisdictions to ensure that frameworks and requirements are agreed upon in such a way that they do not create further complexity and challenges when other jurisdictions want to participate in this model in the future.

As the central bank undertakes the role of the W-CBDC platform operator, this model implies an enhanced role for the central banks to process the

issuance, tracking and redemption of W-CBDCs both within and beyond their jurisdictions. The governance structure for operating the W-CBDC platform would need to be evaluated and defined appropriately.

A point to note is that this model does not address the issue around access for non-banks or smaller banks to such central bank payment systems, i.e., the W-CBDC payment platform. Access policies will remain a decision for each RTGS operator.

Peer-to-peer exchange between originating and beneficiary banks will depend on both entities being participants on the W-CBDC platform; otherwise, payments will need to be settled through intermediary banks. Such a relationship will have an applicable KYC/CDD cost and resource requirement to reach widespread adoption for payments.

There would undoubtedly be an impact on existing commercial and central bank back-office processes, systems and infrastructure for the acceptance, transmission and redemption of W-CBDCs. Legacy payment system infrastructure architecture would need to be updated or overhauled to integrate with W-CBDC platforms and incorporate new requirements, as needed.

6.1.4 Model 3a: W-CBDCs that can be held and exchanged only in their home jurisdictions and not beyond

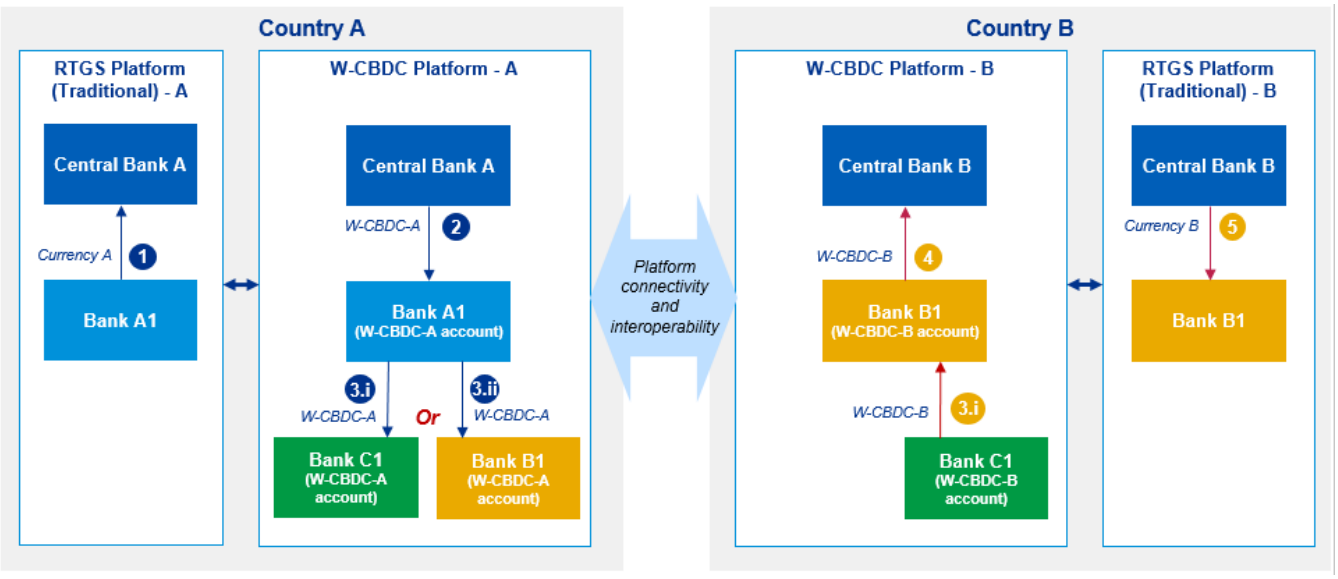


Figure 3

Model description

Each central bank issues its own W-CBDC against its country's local currency. These W-CBDCs are issued to the participating banks in their respective jurisdictions.

Central Banks A and B form an agreement that allows participating banks from one jurisdiction to maintain a W-CBDC account (wallet) with the central bank of the other jurisdiction denominated in the currency of that jurisdiction.

Other intermediary banks (e.g., Bank C1) could also maintain W-CBDC wallets in each jurisdiction. This would be similar to a tokenized version of correspondent banking, where the use of these tokens allows the central banks to retain greater control over the money supply in their respective jurisdictions.

In the above illustration, both Bank A1 and Bank B1 can maintain a W-CBDC-A wallet in Country A and a W-CBDC-B wallet in Country B. These wallets can hold only one digital currency. Alternatively, there could be an intermediary bank, such as Bank C1, which has a W-CBDC-A and W-CBDC-B wallet in Countries A and B, respectively, and offers correspondent services to A1 and B1.

An originating bank would transfer W-CBDCs (issued by the central bank in the jurisdiction of the originating bank) to the beneficiary bank's wallet or an intermediary bank's wallet maintained with the central bank in the same jurisdiction. Using the illustration above, if Bank A1 needs to remit W-CBDC-A to Bank B1, it will transfer the W-CBDC-A to Bank B1's account maintained with Central Bank A or an intermediary Bank C1 wallet maintained in the same jurisdiction. This can be effected via an atomic, synchronized transfer of W-CBDC-A from Bank A1 to Bank C1 and of W-CBDC-B from Bank C1 to Bank B1.

Key considerations and dependencies

Without broader access policies, this technical solution maintains a dependency on intermediary (i.e., correspondent) banks for cross-border payments and settlement. It is effectively a tokenized form of the existing model. The development of a new platform for cross-border payments could deliver some relief from pain points, particularly around interoperability between members, transparency for users, and 24-7 availability. It is important to note that this relief is because of the new platform, not the use of W-CBDC.

Correspondent banks will need to ensure adequate funding of W-CBDC accounts to be able to honour payment obligations. This implies the monitoring of positions and appropriate balance sheet management similar to current practices. Trapped liquidity will remain a significant issue for banks with networks of nostro/vostro accounts.

Furthermore, credit risks arising from the use of correspondent banks remain despite the use of W-CBDCs.

6.1.5 Model 3b: W-CBDCs that can be held and exchanged beyond their home jurisdictions

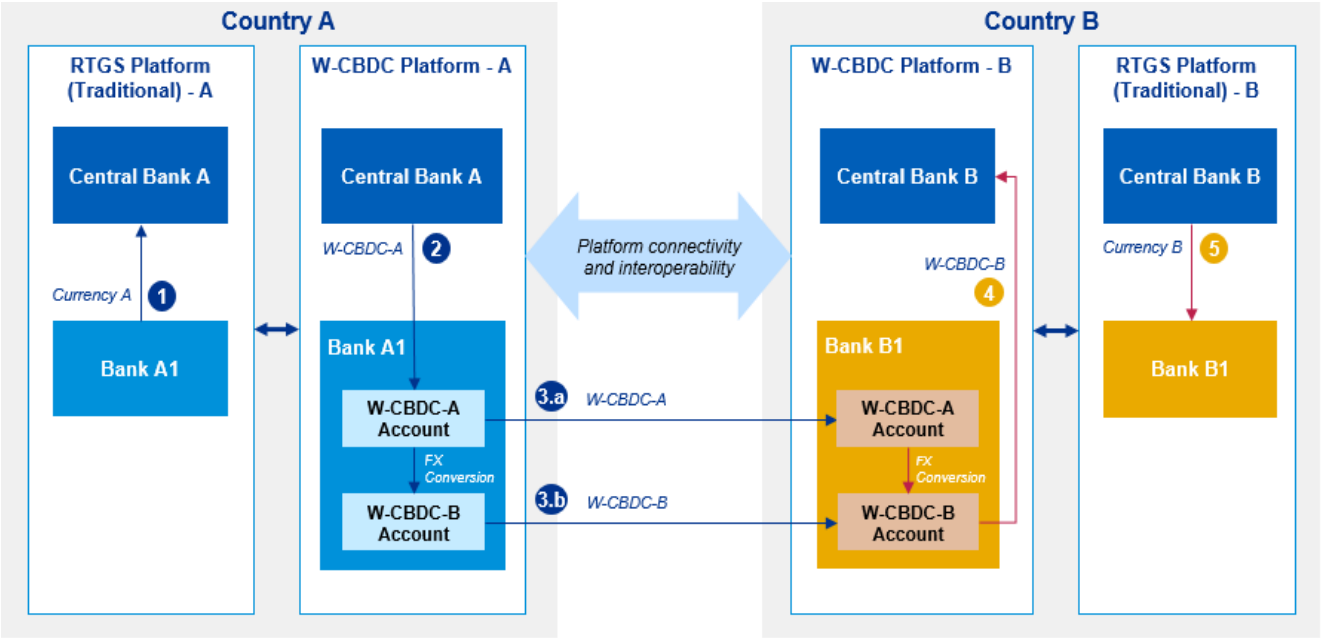


Figure 4

Model description

Central Banks A and B form an agreement that allows participating banks in both countries to hold and exchange the W-CBDCs issued by both central banks with each other. (i.e. W-CBDC tokens issued by Central Bank A (W-CBDC-A) can be held by banks in Country B; and W-CBDC tokens issued by Central Bank B (W-CBDC-B) can be held by banks in Country A).

Each participating bank maintains W-CBDC accounts (or wallets) for different currencies with the central bank of its own jurisdiction to allow payment and receipt of different W-CBDCs as part of cross-border transactions with other banks.

In the illustration above, Bank A1 maintains W-CBDC-A and W-CBDC-B in one or more wallets on W-CBDC platform A -- and likewise for Bank B1 with Central Bank B. The conversion of W-CBDCs denominated in different currencies could take place through a new W-CBDC-specific FX market.

W-CBDC platforms may be designed to be operational 24 hours a day, seven days a week and operate in parallel with the existing RTGS platform for the purpose of transacting in W-CBDCs between banks and central banks within a certain jurisdiction and between banks across jurisdictions.

Key considerations and dependencies

This version of Model 3 must further consider the impact of the creation of W-CBDCs on monetary supply and monetary policy when W-CBDCs are circulated in other jurisdictions. In addition, the liability framework for a participating central bank to hold another central bank's W-CBDC on their balance sheet intraday and potentially overnight would need to be established. Both considerations are significant.

To address challenges around access highlighted in Model 3a, Model 3b allows W-CBDC denominated in a given currency to be held by parties that do not have accounts at the central bank responsible for issuing that currency. This enables a settlement account holder in Country A to hold a digital wallet in Country B without having to go through the on-boarding process for the RTGS system of Country B. Participating central banks will therefore need to agree to a defined set of eligibility criteria for this new platform.

Bank A's holding of digital currency B would be collateralized via its reserves held at Central Bank A. An exchange rate risk will therefore emerge, which will need to be carefully managed by central banks and participants. This raises fundamental questions for central banks about control over the money supply, exposure to exchange rate risk and the relationship between tokenized central bank money and reserves. The scale of these policy challenges may impact the willingness of a jurisdiction to join the W-CBDC scheme, limiting the uptake of the solution and thus its overall success. Mitigating this risk would require all participants to open accounts at all participating central banks. If this could be achieved, the requirement for the W-CBDC platform would be negated.

In a scenario where the system is widely used, there may be an increase in the complexity of the system because every bank would need to hold many W-CBDC ac-counts in many currencies. In addition, the technical challenges of synchronizing the transactions across two or more W-CBDC platforms would need to be considered.

A parallel market for the exchange of W-CBDCs within each jurisdiction may spring up in addition to the existing currency exchanges that take place. Further analysis would be required to understand the impact of this.

6.1.6 Model 3c: A single, universal W-CBDC backed by a basket of currencies

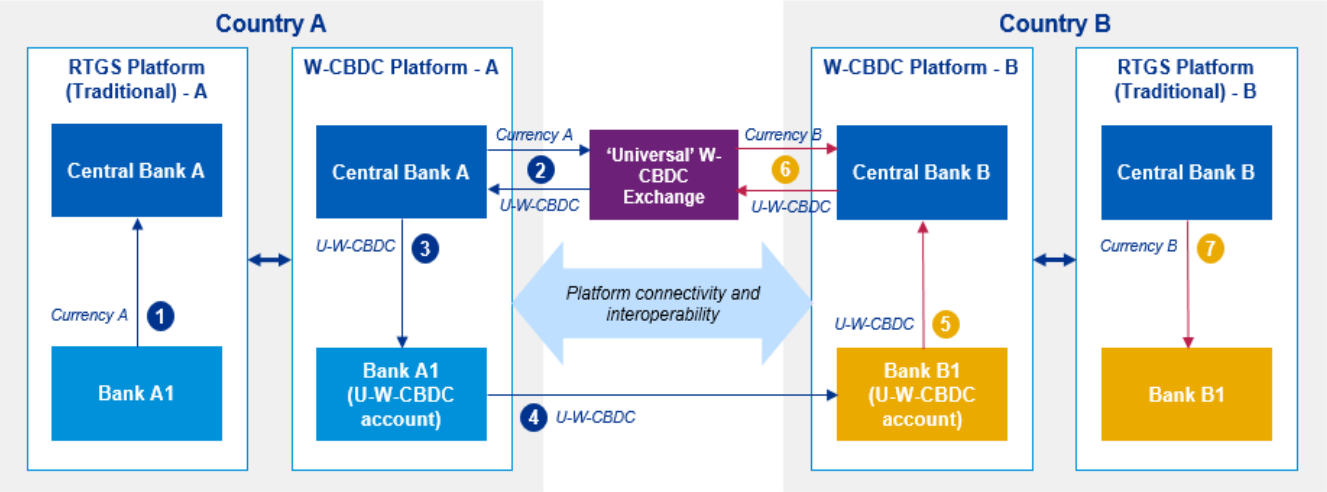


Figure 5

Model description

Several participating jurisdictions, through either their respective central banks or a global multilateral institution, agree to create a "universal" Wholesale CBDC (U-W-CBDC). This U-W-CBDC will be backed by a basket of currencies issued by the participating central banks. This U-W-CBDC would be issued via an exchange specifically created to allow for issuance and redemption of such U-W-CBDCs.

The conversion of a jurisdiction's currency into the U-W-CBDC would create an exchange rate between that currency and the U-W-CBDC. A framework for how this is managed would need to be collectively determined by the participating central banks.

Banks can use these U-W-CBDCs with other banks to settle peer-to-peer cross-border transactions.

W-CBDC platforms could be designed to be operational 24-7 and to operate in parallel with the existing RTGS platform to transact in U-W-CBDC between banks and central banks within a certain jurisdiction and between banks across jurisdictions.

Key considerations and dependencies

While this model seems to most comprehensively address the pain points identified in this report, we should not underestimate the scale of the policy questions it raises for authorities, and how these may limit its feasibility as a future-state model.

Aside from the fundamental questions for central banks, adoption of this model is likely to be slow given the huge change required and the likely frictions in onboarding a new currency to the basket of currencies backing the U-W-CBDC.

Under this model, central banks would need to further manage and monitor the supply of funds in cash, domestic RTGS and international U-W-CBDC. There will need to be frameworks to ensure adequate collateralization of U-W-CBDC with central bank re-serves in the face of a potentially volatile intraday exchange rate.

The potential creation of a U-W-CBDC exchange introduces a single point of failure in the model that is not present in the other variants of Model 3. This exchange would facilitate the trading and use of the U-W-CBDC for purposes other than transactions. As a result, the U-W-CBDC could take on the properties of a financial asset rather than those of a simple medium of exchange - speculation and hoarding in particular could impact the price and thus the utility of such a token as a medium of exchange.

6.2 Model comparison against root causes of pain points

The following table compares how the future-state models described earlier help solve the root causes of the pain points afflicting cross-border payments and settlements.

Root causes of pain points	Mismatch in operating hours of RTGS systems and banks across different jurisdictions and time zones	Reliance on multiple intermediaries (with associated cost and complexity) for cross-border payments and settlements
	1	**2**
Future State	Extended availability of domestic and international payment capability	Direct, peer-to-peer payment and settlement
Model 1 Existing and planned initiatives	• Achieving this requires changes across numerous RTGS operators. These changes must be matched by commercial banks driving changes in infrastructure to offer services to clients who demand greater availability of payment services.	• Continued reliance on the correspondent banking model, as current and planned payment initiatives do not fundamentally shift the model, but rather seek to improve it. • Domestic RTGS developments may allow for synchronous movements between domestic systems based on messaging networks; development of this capacity will be determined on jurisdiction by jurisdiction.
Model 2 Expanded role for in-country RTGS operators without DLT / W-CBDCs	• Similar to Model 1, achieving this requires changes across numerous RTGS operators. These changes must be matched by commercial banks driving changes in infrastructure to offer services to clients who demand greater availability of payment services.	• Reduces the number of entities involved to effecting cross-border payments. • The position of central banks as 'super correspondents' would make their role much more active than is currently the case.
Model 3a Jurisdiction-specific W-CBDCs where these W-CBDCs can be transmitted and exchanged only in their home jurisdictions and not beyond	• The starting intention is to design a platform to enable 24-7 payment and settlement. Therefore the model would not be limited by the operating hours of the existing RTGS platform. • Commercial banks will need to match this with infrastructure changes in order to offer services to clients. • If this is achieved independently of extending RTGS operating hours then mechanisms for collateralizing positions outside of operating hours will be needed. This may impact the liquidity efficiency of the model.	• Correspondent banks performing cross-border payments; however, a reduced number of intermediary banks are involved in the process. • It may be possible to set up a synchronous settlement mechanism in this model, which would minimize settlement risk.
Model 3b Jurisdiction-specific W-CBDCs where these W-CBDCs are exchanged beyond their home jurisdictions	• Similar to Model 3a, however, there is likely to be an added challenge in operating multicurrency W-CBDC wallets if RTGS operating hours do not align.	• Enables peer-to-peer cross-border payments between banks using W-CBDCs as long as both sending and beneficiary banks hold wallets in the relevant central banks. • To achieve this, there must be some mechanism for customer due diligence or KYC checks to be undertaken between banks in order to exchange peer-to-peer payments. • It may be possible to set up a synchronous settlement mechanism in this model, which would minimizing settlement risk.
Model 3c Using a single, universally accepted W-CBDC	• A U-W-CBDC would not rely on the availability of domestic RTGS systems. Nevertheless, the platform supporting the exchange would need to operate close to 24-7 and the participating banks would need to have near 24-7 operational capability to reap the benefits.	• Enables peer-to-peer cross-border payments between banks using U-W-CBDCs. • To achieve this, there must be some mechanism for customer due diligence or KYC checks to be undertaken between banks in order to exchange peer-to-peer payments. • It may be possible to set up a synchronous settlement mechanism to be set up in this model, which would minimize settlement risk.

Root causes of pain points	Lack of common, consistent payment standards (technical and operational) and regulatory requirements across jurisdictions
Future State	Consistency of payment standards (technical and operational) and regulatory requirements across jurisdictions

3

Model 1 Existing and planned initiatives	• Achieving this requires the adoption of current and evolving standards for payment data, format and process by existing payment system infrastructures (ISO 20022, etc.).
Model 2 Expanded role for in-country RTGS operators without DLT / W-CBDCs	• Achieving this requires the adoption of current and evolving standards for payment data, format and process by existing payment system infrastructures (ISO 20022 etc.).
Model 3a Jurisdiction-specific W-CBDCs where these W-CBDCs can be transmitted and exchanged only in their home jurisdictions and not beyond	• This model could be designed to support current and evolving payment data and format standards (ISO 20022 etc.) and to integrate with existing payment system infrastructures. • If standards evolve independently in domestic jurisdictions and develop differences, how jurisdictions interact with the platform will have to be managed. Any difference across the W-CBDC platforms in different jurisdictions will introduce cost and complexity for banks with multiple W-CBDC accounts. • It is possible that designing a platform to comply with current and evolving data standards from the outset presents less of a technical challenge than migrating existing infrastructure (as per Models 1 and 2), but the challenge of integrating this platform with legacy architecture does persist. • If all participating banks in the platform must use current and evolving data standards at the point of implementation, the adoption of the standard is more certain than in Models 1 and 2.
Model 3b Jurisdiction-specific W-CBDCs where these W-CBDCs are exchanged beyond their home jurisdictions	• This model could be designed to support current and evolving payment data and format standards (ISO 20022 etc.) and to integrate with existing payment system infrastructures. • To exchange and hold tokens in multi-currency wallets, it will be necessary for technical and operational standards to remain highly aligned and harmonized across all W-CBDC platforms. • It is possible that designing a platform to comply with current and evolving data standards from the outset presents less of a technical challenge than migrating existing infrastructure (as per Models 1 and 2), but the challenge of integrating this platform with legacy architecture does persist. • If all participating banks in the platform must use current and evolving data standards at the point of implementation, the adoption of the standard is more certain than in Models 1 and 2
Model 3c Using a single, universally accepted W-CBDC	• This model could be designed to support current and evolving payment data and format standards (ISO20022 etc.) and to integrate with existing payment system infrastructures. • To exchange and hold a U-W-CBDC globally, it will be necessary for technical and operational standards to remain completely aligned and harmonized across all W-CBDC platforms. • It is possible that designing a platform to comply with current and evolving data standards from the outset presents less of a technical challenge than migrating existing infrastructure (as per Models 1 and 2), but the challenge of integrating this platform with legacy architecture does persist. • If all participating banks in the platform must use current and evolving data standards at the point of implementation, adoption of the standard is more certain than in Models 1 and 2.

Root causes of pain points	Lack of a standardized payment status notification capability across the common payment messaging network used by banks **4**	Challenges associated with legacy payments infrastructure across networks, central banks and commercial banks **5**
Future State	Payment status visibility to participants and certainty of outcome	Modernized flexible technical payment system infrastructure
Model 1 Existing and planned initiatives	• Initiatives such as SWIFT gpi look to provide end-to-end payment status visibility across the payment chain – however the service is limited by the speed of adoption of this feature and availability to only member banks.	• While this does not directly address legacy payment infrastructure issues, new initiatives may encourage invest-ment and renewal in both commercial and central bank systems.
Model 2 Expanded role for in-country RTGS operators without DLT / W-CBDCs	• Could address the payment visibility issue depending on details of model implemented.	• Does not directly address issues arising from legacy payment systems infrastructure.
Model 3a Jurisdiction specific W-CBDCs where these W-CBDCs can be transmitted and exchanged only in their home jurisdictions and not beyond	• Could potentially enable end-to-end visibility of cross-border payment transactions across the payment chain (perhaps using DLT or related technology). However this would require an account-to-account tracking mechanism (enabled by DLT or otherwise). Deeper investigation and analysis are needed for an appropriate technical solution to deliver this. • Further work would also be needed to ensure that this solution can apply across disparate networks and both domestic and international payment systems which would be required to give complete end-to-end visibility.	• Likely to require large systems changes at both central banks and commercial banks. This should lead to more flexible, scalable systems that encounter fewer problems than current legacy infrastructure. • Development of a new platform concentrates operational risk in a new market infrastructure; this could create a significant point of failure. • The integration of any new platform into the financial system will rely on legacy infrastructure. This may encourage investment and renewal, as per Model 1 or replace current platforms, but it will still rely on existing infrastructure.
Model 3b Jurisdiction specific W-CBDCs where these W-CBDCs are exchanged beyond their home jurisdictions	• Could potentially enable end-to-end visibility of cross-border payment transactions across the payment chain (perhaps using DLT or related technology). However, this would require an account-to-account tracking mechanism (enabled by DLT or otherwise). Deeper investigation and analysis are needed for an appropriate technical solution to deliver this. • Further work would also be needed to ensure that this solution can apply across disparate networks and both domestic and international payment systems which would be required to give complete end-to-end visibility.	• Likely to require large systems changes at both central banks and commercial banks. This should lead to more flexible, scalable systems that encounter fewer problems than current legacy infrastructure. • Development of a new platform concentrates operational risk in a new market infrastructure; this could create a significant point of failure. • The integration of any new platform into the financial system will rely on legacy infrastructure. This may encourage investment and renewal, as per Model 1 or replace current platforms, but it will still rely on existing infrastructure.
Model 3c Using a single, universally accepted W-CBDC	• Could potentially enable end-to-end visibility of cross-border payment transactions across the payment chain (perhaps using DLT or related technology). However, this would require an account-to-account tracking mechanism (enabled by DLT or otherwise). Deeper investigation and analysis are needed for an appropriate technical solution to deliver this. • Further work would also be needed to ensure that this solution can apply across disparate networks and both domestic and international payment systems which would be required to give complete end-to-end visibility.	• Likely to require large systems changes at both central banks and commercial banks. This should lead to more flexible, scalable systems that encounter fewer problems than current legacy infrastructure • Development of a new platform concentrates operational risk in a new market infrastructure; this could create a significant point of failure. • The integration of any new platform into the financial system will rely on legacy infrastructure. This may encourage investment and renewal, as per Model 1 or replace current platforms, but it will still rely on existing infrastructure.

From the comparative assessment above, we can make the following observations:

In Model 1, existing and planned industry initiatives can solve some of the cross-border challenges; thus Model 1 presents a fragmented approach to delivering future state capabilities. Section 4 highlights how this approach relies on network effects and alignment of incentives, which means that far-reaching benefits may not be delivered without widespread uptake. Given this, we are considering a contrasting approach where solutions to these challenges can be considered holistically, rather than with separate initiatives. We focus on the potential for change driven at the centre by RTGS operators, through fundamental change in the rails for cross-border payments. Given the fundamental shift this would require, we do not envisage this change occurring in the short to medium term, but rather over a longer term.

Model 2, which is based on enhancing the role of RTGS operators as 'super-correspondents', eliminates the need for individual banks to function as correspondent banks. This transfer of risk to the RTGS operator is a significant change from the present day. Although this model for undertaking cross-border payments may provide some relief from some challenges currently faced by banks, particularly in reducing the cost of trapped liquidity, it is likely that the required change of policy and operations for RTGS operators is too substantial. Notwithstanding the technical challenges that account mirroring across RTGS systems might present, while the model achieves the necessary operational resilience, it fails to address key pain points around transparency and standardization.

Models 3a, 3b and 3c are based on the settlement of cross-border payments between banks using a tokenized form of central bank liabilities, leveraging experience from research by the Bank of Canada and Monetary Authority of Singapore in using DLT. While all three variants offer some solutions to the challenges associated with cross-border payments, our analysis highlights the limitations of such technical innovation in the face of some intractable challenges across all three models.

- Model 3a, where a W-CBDC cannot be held or exchanged beyond the home jurisdiction, effectively represents the tokenization of the existing correspondent banking model and the delivery of benefits like 24-7 operations through the design of the new platform. To substantially address the challenges of the status quo would require broadened access to settlement accounts, to enable entities to hold W-CBDC wallets in each RTGS system. This remains a decision for each participating central bank to take. Without broader access this model may end up presenting many of the challenges associated with the current correspondent banking model in which banks with liquidity in multiple digital currencies will offer services to those without.
- In Model 3b, a W-CBDC can be held beyond the home jurisdiction. This extension offers the possibility of greater efficiency, with reduced reliance on the correspondent banking model via peer-to-peer exchange. However, it requires the opening or holding of multicurrency wallets in each RTGS. This is a significant departure from the status quo and would require RTGS operators to consider the impact on balance sheet liabilities and for central banks to consider the monetary policy implications of having a tokenized form of their reserves available in foreign jurisdictions. There would be larger policy questions for central banks and regulators to answer around broadening access to central bank reserves, how institutions could be onboarded into this ecosystem and where responsibilities for compliance checks would sit.
- Model 3c, in which a universally accepted and traded W-CBDC is used for cross-border payments, offers a solution tha potentially could be more easily implemented in many jurisdictions as it lacks many of the policy challenges outlined in Model 3a and Model 3b. However, because it requires backing by a basket of currencies, the W-CBDC in this model is subject to volatility, potential manipulation and investment activity. Additionally, our analysis indicates that the pace of adoption could be hampered by the complexity of adding new currencies into the basket backing the W-CBDC.
- By moving cross-border payments away from existing correspondent banking channels and into new rails, these models help to overcome problems of multiple intermediaries, fragmented standards and poor availability. However, across all three variants of Model 3, there is the risk of taking outcomes such as 24-7 or wider access for granted. It is clear that a new platform can be designed and implemented to achieve these two criteria but it is not necessarily the case that this is easier to achieve with new market infrastructure rather than by enhancing and renewing the existing infrastructure. Additionally, widespread interoperability, standardization of data, end-to-end visibility and removal of reliance on legacy infrastructure in Model 3 are worthy goals but very challenging outcomes to achieve

and maintain. It should not be taken as given that the new platform would be able to deliver all of these outcomes, nor that it would have the widespread uptake required to dramatically improve the status quo.

This analysis highlights that while there are interesting ideas to be considered when it comes to innovative new technology, there are wider issues underlying some of the pain points that cannot be addressed simply by overhauling the correspondent banking model.

First, to deliver maximal benefits, all models require widespread adoption, ideally in a harmonized way, across jurisdictions. The more fundamental the change required, the less likely the model is to be implemented on a truly global level.

Second, none of these models addresses the differing regulatory standards across jurisdictions that add time, complexity and cost to the cross-border payment process. While reducing the number of intermediaries required will help, this is not an issue that can be addressed by technology alone; rather, it requires an international collaborative effort.

6.3 Model comparison against non-technical considerations

The above analysis has identified some limits to what technical innovation alone can achieve. The following table compares the potential future-state models outlined above against a set of key non-technical considerations for the main stakeholders. To compare the future-state models (Model 2 and Model 3) with the current model (Model 1), Model 1 is given a baseline rating (No Rating—NR). The future-state models are then rated as follows:

- Unchanged (U) – If the model is no better or worse than the current state
- Improved (I) – If the model can be considered better than the current state
- Degraded (D) – If the model performs worse than the current state

	1 Governance Framework	2 Counterparty Credit Risk
Model 1 Existing and planned initiatives	NR • Existing governance models and framework remain unchanged (or are modified) in view of current and forthcoming payments and settlement market initiatives (e.g., enhancements pertaining to ISO 20022, SWIFT-gpi etc.).	NR • Counterparty credit risk models remains in this model, as it assumes continuation of existing payments and settlement flows, with persisting dependency on the correspondent banking model.
Model 2 Expanded role for in-country RTGS operators without DLT / W-CBDCs	D • A governing body to manage and regulate RTGS operators across jurisdictions will be required. D • Complexity is directly related to the number of participants in this model, and the time taken to agree on a cross-jurisdictional governance framework between participating central banks and RTGS operators.	U • Counterparty bank credit risk is transferred from the correspondent banks to the RTGS operators, who perform a role similar to that of a single correspondent for all banks in that jurisdiction.
Model 3a Jurisdiction specific W-CBDCs where these W-CBDCs can be transmitted and exchanged only in their home jurisdictions and not beyond	D • A governing body (e.g. a supra-national body, or an association) – for managing W-CBDC platforms will be required to ensure ongoing harmonization and standardization. D • Complexity is directly related to the number of participants in this model, and the time taken to agree on a cross-jurisdictional governance framework between participating central banks.	U • Counterparty credit risk continues in this model, given its reliance on a framework similar to the correspondent banking model where liquidity (provided in this model via tokens) needs to be maintained in correspondent bank nostro accounts.
Model 3b Jurisdiction specific W-CBDCs where these W-CBDCs are exchanged beyond their home jurisdictions	D • A governing body (e.g. a supra-national body, or an association) – for managing W-CBDC platforms will be required to ensure ongoing harmonization and standardization. D • Complexity is directly related to the number of participants in this model, and the time taken to agree on a cross-jurisdictional governance framework between participating central banks.	I • A peer-to-peer direct payment mechanism (using W-CBDCs) allows the reduction of counterparty credit risk between the originating and beneficiary banks on the W-CBDC platform, thereby moving away from a correspondent model.
Model 3c Using a single, universally accepted W-CBDC	D • Greater complexity involved is in this model given: ▪ Possible establishment of two bodies – one for the management of the U-W-CBDC exchange and the other for the W-CBDC platforms. ▪ The number of participants and the time taken to agree on a cross-jurisdictional governance framework – for each of the U-W-CBDC exchange and W-CBDC platforms.	I • A peer-to-peer direct payment mechanism (using U-W-CBDCs) allows the reduction of counterparty credit risk between the originating and beneficiary banks and any correspondent banks on the W-CBDC platform, thereby moving away from a correspondent model.

NR No Rating U Unchanged I Improved D Degraded

	3 Payments and settlement risk	4 Widened Access
Model 1 Existing and planned initiatives	NR • Settlement risk exists in this model given the chance that the remitting bank will fail to fulfill its payment obligation.	NR • Some new initiatives look to provide broader access to the RTGS platform to non-banks (e.g., the Bank of England allows non-bank payment service providers to hold accounts in its RTGS system).
Model 2 Expanded role for in-country RTGS operators without DLT / W-CBDCs	U • Failure of any one of the participating RTGS operators in a jurisdiction will impact payment and settlement obligations for that jurisdiction. This risk exists today.	U • This model allows access only by the existing participants in the RTGS systems, although central banks could choose to review access policies in light of the changing landscape. NR • Widening access to foreign RTGS operators would likely require further policy thought to permit central banks as "super-correspondents" to access accounts in various systems across the world.
Model 3a Jurisdiction specific W-CBDCs where these W-CBDCs can be transmitted and exchanged only in their home jurisdictions and not beyond	I • A synchronous settlement mechanism can be set up in this model, thereby minimizing settlement risk. U • Dependency on domestic RTGS systems would be replaced with a dependency on the W-CBDC platform.	I • A W-CBDC platform could enable broader access for non-banks that do not have direct access to RTGS—given the relatively lower costs for participation on W-CBDC platforms as compared with RTGS systems. This assumes that central bank analysis would be based on access to the W-CBDC platform being considered separately from access to central bank reserves.
Model 3b Jurisdiction specific W-CBDCs where these W-CBDCs are exchanged beyond their home jurisdictions	I • A synchronous settlement mechanism can be set up in this model, thereby minimizing settlement risk. U • Dependency on domestic RTGS systems would be replaced with a dependency on the W-CBDC platform.	I • A W-CBDC platform could enable broader access for non-banks that do not have direct access to RTGS—given the relatively lower costs for participation on W-CBDC platforms as compared with RTGS systems. This assumes that central bank analysis would be based on access to the W-CBDC platform being considered separately from access to central bank reserves.
Model 3c Using a single, universally accepted W-CBDC	I • A synchronous settlement mechanism can be set up in this model, thereby minimizing settlement risk. D • The U-W-CBDC exchange would become a new single point of failure.	I • A U-W-CBDC platform could enable broader access for non-banks that do not have direct access to RTGS—given relatively lower costs for participation on W-CBDC platforms as compared with RTGS systems. This assumes that central bank analysis would be based on access to the U-W-CBDC exchange and settlement platforms being considered separately from access to central bank reserves.

NR No Rating U Unchanged I Improved D Degraded

5 Future Role of Central Banks compared with existing structure

Model 1

Existing and planned initiatives

NR

- There is no foreseeable impact on the existing role of the central bank.

Model 2

Expanded role for in-country RTGS operators without DLT / W-CBDCs

D

- Central banks would take on far greater roles and responsibilities in this model, which may fall outside of their risk tolerance, both from a liability perspective and from a disintermediation of the banking market perspective.

I

- This role may, however, give central banks the opportunity to understand more about the underlying drivers of payment value/volume and the key currency corridors from their jurisdiction. This would be valuable for wider economic analysis.

Model 3a

Jurisdiction specific W-CBDCs where these W-CBDCs can be transmitted and exchanged only in their home jurisdictions and not beyond

U

- Central banks retain their current role of providing services only to their respective jurisdictions.

NR

- Remit would broaden in terms of a new role in defining rules and eligibility criteria for accessing W-CBDC.

D

- Assuming a broader access model, central banks may need to conduct KYC on new institutions looking to participate on the W-CBDC platform within their jurisdiction leading to potential regulatory and compliance risk for the central bank.

Model 3b

Jurisdiction specific W-CBDCs where these W-CBDCs are exchanged beyond their home jurisdictions

D

- Given that central bank issued tokens can be used outside of their issuing jurisdictions, central banks may lose some control over the use of the W-CBDC compared with the electronic reserve or settlement balances they already issue.

NR

- Remit would broaden in terms of a new role in defining rules and eligibility criteria for accessing W-CBDC.

D

- Assuming a broader access model, central banks may need to conduct KYC on new institutions looking to participate on the W-CBDC platform within their jurisdiction leading to potential regulatory and compliance risk for the central bank.

I

- Assuming central banks can retain some view on where issued W-CBDC was being held, this model may give them the opportunity to understand more about the underlying drivers of payment value/volume and the key currency corridors from their jurisdiction. This would be valuable for wider economic analysis

Model 3c

Using a single, universally accepted W-CBDC

NR

- Given that the U-W-CBDC's value is intrinsically linked to exchange rates through the basket of currencies, central banks may need to take a more active role than they currently have in managing exchange rates. This may support or conflict with other policies of that jurisdiction.

NR

- Remit would broaden in terms of a new role in collectively defining rules and eligibility criteria for accessing U-W-CBDC.

NR

- Consideration would need to be given to governance and oversight of the U-W-CBDC exchange.

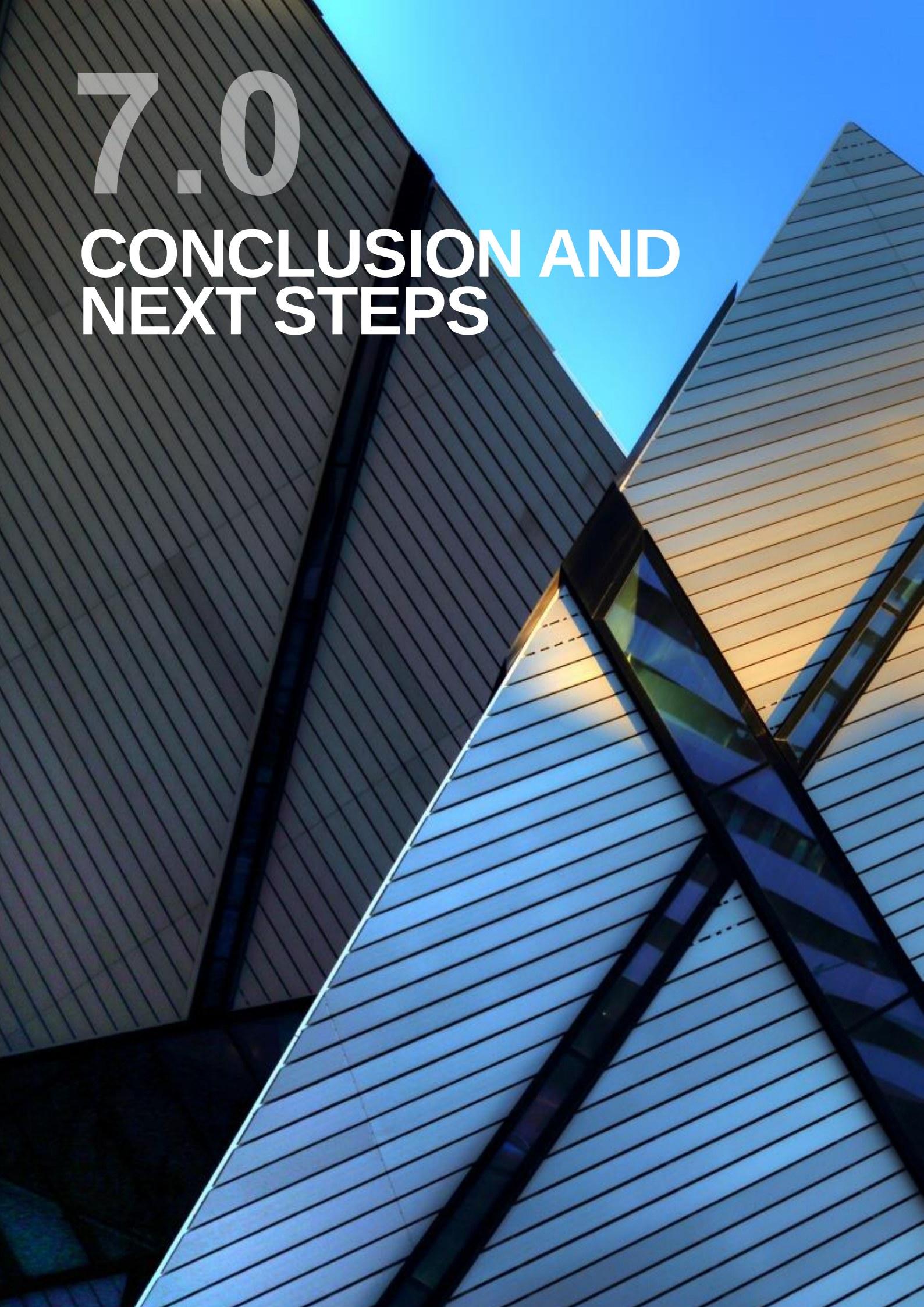
I

- Central banks would likely be able to gather richer data to understand more about the underlying drivers of payment value/volume and the key currency corridors from their jurisdiction. This would be valuable for wider economic analysis

NR No Rating U Unchanged I Improved D Degraded

	6 Impact on monetary policy and financial markets	7 Scale of implementation challenge
Model 1 Existing and planned initiatives	NR • Current monetary policy and financial markets experience limited or no impact from current payment market initiatives (e.g., SWIFT gpi, ISO 20022 etc.).	NR • The complexity, coverage, cost and timelines of implementation will vary with each initiative.
Model 2 Expanded role for in-country RTGS operators without DLT / W-CBDCs	U • Monetary policy implementation frameworks may need to be updated to ensure control from a central bank balance sheet management perspective. U • Existing FX models and conversion methods remain unchanged as the "super-correspondents" are merely accounting platforms but the FX trade continues as it is today between the FX trading partners.	D • The scale of implementation will depend on the number of participating jurisdictions and RTGS operators. However, implementing Model 2 would be less complex than implementing Model 3 because Model 2 is based on existing payments infrastructure and does not involve the use of W-CBDCs.
Model 3a Jurisdiction specific W-CBDCs where these W-CBDCs can be transmitted and exchanged only in their home jurisdictions and not beyond	NR • Central banks' roles will expand as they will now need to manage and monitor the supply of funds in W-CBDC in addition to their current task of managing the supply of cash and funds in domestic RTGS. D • The intermediary banks enabling the "swap" of W-CBDCs between originating and beneficiary banks are in a position to determine the FX rates for the payment transaction, allowing them to play the role of the FX market maker, thus possibly exploiting their market power.	D • Implementation is more complex than for Model 2 given the creation of a new platform, but potentially less complex than for Model 3b because the exchange of W-CBDCs is restricted to the home jurisdiction.
Model 3b Jurisdiction specific W-CBDCs where these W-CBDCs are exchanged beyond their home jurisdictions	NR • Central banks' roles will expand as they will now need to manage and monitor the supply of funds in international W-CBDC, in addition to their current task of managing the supply of cash and funds in domestic RTGS. NR • Further analysis would be required to understand the full implications of "off shore" W-CBDC on the transmission of monetary policy. NR • A parallel market for the exchange of W-CBDCs within each jurisdiction may spring up in addition to the existing currency exchanges that take place. Further analysis is required to determine the impact of this.	D • Implementation is more complex relative to Models 2 and Model 3a as this model involves the creation of a new platform for the exchange of W-CBDCs including across borders, which would place increased demands on central banks in terms of tracking home currency W-CBDCs and cross-border issuance and redemption.
Model 3c Using a single, universally accepted W-CBDC	D • Central banks' roles will expand as they will now need to manage and monitor the supply of funds in international U-W-CBDC in addition to their current task of managing the supply of cash and funds in domestic RTGS.	D • The scale of implementation is the most complex across all models because this model involves not only the creation of new in-country platforms, but also the creation of a U-W-CBDC exchange and the participation of multiple jurisdictions to achieve meaningful scale.

NR No Rating U Unchanged I Improved D Degraded



7.0 CONCLUSION AND NEXT STEPS

7.0 Conclusion and Next Steps

Cross-border payments and settlements have not kept pace with advances in domestic payments and continue to be based on the correspondent banking model, which has not evolved materially over the decades. Managing issues in the cross-border payment and settlement space is a more challenging proposition than domestic payments and settlements because of the lack of standardization between jurisdictions in terms of regulatory requirements, data standards and operating hours. In particular, a collective action problem exists in the cross-border payment and settlement space that does not occur on the same scale in the domestic payment and settlement landscape.

Based on current cross-border payment and settlement flows, this report identified some key challenges affecting end-users, commercial banks and central banks:

- End-users of cross-border payments do not have clarity on the time required for payments to complete or on the fees that will be imposed. Transaction processing and settlement occurs within a limited time frame due to restrictions on operating hours and payment processing cut-off times. End-users also experience uncertainty around the status of payment transactions.
- Commercial banks are unable to provide this visibility and require manual operational efforts to process such transactions. Cross-border payments today work on the correspondent banking model, which involves multiple banks and ties up significant liquidity. The fragmented settlement infrastructure and a lack of common payment message standards lead to a need for manual intervention. The inability to deliver straight-through processing capabilities results in increased cost for end-to-end payments processing for banks.
- Central banks provide the domestic RTGS systems that are essential for the pro-cessing of cross-border payments. However, these systems were developed with different membership requirements, standards and technical requirements, creating a barrier for all but the largest banks to join multiple RTGS systems and in-creasing the need for and the number of intermediaries required to complete a cross-border payment. Central banks also face a trade-off between broadening access to their balance sheet to address some of the challenges with the correspondent banking model (particularly the declining number of correspondents) and their own risk preferences.

This report identifies the future-state capabilities expected of a cross-border payment system model to address these challenges and resolve underlying root causes.

- **Extended availability** of domestic and international payment capabilities, **visibility** of payment statuses, and **certainty of outcome** benefit end-users and banks by helping them manage their liquidity and cash flows more efficiently.
- **Consistency of payment standards and greater transparency** of regulatory differences and regulatory requirements across jurisdictions, as well as **direct, peer-to-peer payment and settlement** (synchronized PvP) between originating and beneficiary banks and to enable commercial banks to streamline their payment processing operations and reduce end-to-end processing costs.
- **Enhanced technical infrastructure** of payments systems (RTGS) increase stability and resilience, widen access and foster innovation.

Any future-state model for cross-border payments and settlements should be set up to achieve the capabilities identified above. A common theme across these models is that their success is dependent upon uptake, both across jurisdictions and across a breadth of firms within each jurisdiction. The report discusses five such potential future-state models:

- Model 1 emphasises the challenges associated with a fragmented approach. While each of the initiatives can go some way to addressing some of the pain points, our analysis suggests that a centrally orchestrated overhaul of the existing model is worth further thought, particularly if it can encourage more innovative solutions to some of the existing challenges.
- Model 2 leverages existing infrastructure, but requires a radical change of role for RTGS operators, including accepting far more risk than they do today. Outside of the question of technical feasibility, this policy question about the fundamental role of a central bank presents the greatest concern for the viability of this model. Furthermore, it is not clear that this model addresses the universe of challenges associated with correspondent banking–particularly around operational efficiencies and transparency for end-users. The model does make some headway on improving some of the pain points around trapped liquidity for commercial banks.

Models 3a, 3b and 3c are based on the settlement of cross-border payments be-tween banks using tokenized forms of central bank liabilities, W-CBDCs that can be exchanged between banks through a DLT-enabled platform built to facilitate cross-border payments. By starting afresh outside of the constraints of existing domestic RTGS systems—as opposed to patching over the top as in Model 1—it becomes possible to build features such as 24-7 availability and payment tracking in the central infrastructure. The scale of the technical challenge to implement each of these models should not be underestimated.

- Model 3a allows W-CBDCs to be exchanged only within their respective home jurisdictions, and not across borders. In comparison with Model 3b, this model gives central banks greater control over the issuance and redemption of W-CBDC within their jurisdiction. However, the current dependency on intermediary banks to settle cross-border payment obligations would persist. The benefits of this model are therefore driven entirely by the improved technological capabilities of the platform.
- Model 3b involves the exchange of W-CBDCs between banks across borders. This shows a marked shift away from simply tokenizing the existing correspondent banking model. However, its success is dependent on widespread uptake to reduce the number of intermediaries required to complete a cross-border payment. The model raises fundamental questions regarding legal, regulatory and monetary policy considerations for central banks.
- Model 3c is based on the use of a U-W-CBDC that is recognized and accepted by each participating jurisdiction for interbank payments and settlements. This model requires the set-up of a central, global entity for the issuance and redemption of U-W-CBDCs. Theoretically and technically, this model may seem to be the one that most comprehensively addresses today's challenges; however, given the scale of change required, this model also poses the greatest challenges in implementation, from both a technical and a policy perspective.

This report provides a starting point for further analysis of these potential future models. Further consideration should be given to the following topics:

- The legal and regulatory requirements and risks associated with each model
- The necessary cross-jurisdictional governance framework required to ensure harmonized standards—both in definition and in implementation
- The impact on monetary policy and the degree to which the central bank will con-tinue to exercise control over it
- Legislative changes required to recognize W-CBDCs as legal tender for interbank payments and settlements
- Eligibility criteria for financial institutions and payment system participants to become direct participants in these models, including coordination between central banks to align eligibility criteria
- Industry adoption of the selected model via incentives and regulatory changes.

Moving forward from this report, we envisage three areas of focus for policy-makers and service providers.

The first is to conduct further research and experimentation to better evaluate the different models, in particular the hypothesis that a holistic approach to infrastructure change can deliver more far-reaching benefits than incremental improvements to the current model. This could include the creation of a technical proof-of-concept solution aimed at assessing the delivery of future-state capabilities.

The second is to consider further the policy implications of some of the more radical changes outlined in this report, particularly the impacts on the transmission mechanisms for monetary policy, whether broader access to central bank money settlement could drive improvements without large-scale infrastructure change, and the role of the RTGS operator in the future state.

Finally, while this report has focused on change driven through revolution in the central payment infrastructures, further thinking could be done on how policy-makers and industry could work together on private sector innovation to address, in the shorter term, the challenges faced by users of cross-border payments identified in this report.

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8.0
APPENDIX

8.1 RTGS Renewal Programme, Bank of England

In May 2017 the Bank of England published a blueprint for a renewed Real-Time Gross Settlement (RTGS) service for the United Kingdom. The RTGS Renewal Programme was mobilized at the same time, and work has since continued on plans to rebuild the United Kingdom's RTGS service from the ground up.

In its initial steps to enhance RTGS, the Bank of England has issued new criteria to enable non-bank payment service providers to access RTGS directly. The Bank of England is also committed to reducing the connectivity and operational costs incurred by users as part of a package of measures to encourage competition and in-novation while not diminishing resilience.

While the existing infrastructure has undergone various upgrades, the Bank of England is of the view that fundamental change is now required. The Bank has therefore conducted work to allow the renewed RTGS service to interact with distributed ledger technology (DLT) systems should demand emerge. This work has taken the form of a proof of concept that was launched in early 2018. The results, published in July 2018, showed that potential DLT participants could connect and settle with the renewed service.

The RTGS Renewal Programme will adopt ISO 20022-based messaging for payments. This will lead to the creation of a Common Credit Message in the United Kingdom and ensure that most of the content in high-value and retail payments is aligned. This will enhance interoperability and streamline processes for payment service providers.

8.2 Project Jasper (Canada)

Project Jasper started in March 2016 as a collaborative initiative between Payments Canada, the Bank of Canada, the R3 consortium and several domestic financial institutions. The aim of this initiative is to understand how the use of DLT might deliver greater benefits to interbank payments. In its overarching role, the Bank of Canada ensures that systematically important systems, such as Payments Canada's Large Value Transfer System (LVTS), which clears and settles billions of dollars each day, operate with risk-management standards that help promote stability in their national financial system.

Since the initiation of the project, there have been three phases of experimentation and the development of a proof of concept leveraging W-CBDCs[59] and DLT, which has provided a better understanding of how such systems can be used for interbank payment settlements.

In Phase 1 of the project, an Ethereum-based interbank transfer prototype was developed and focuses on uncovering the potential and implications of DLT and W-CBDCs for interbank payments.

Phase 2 addressed shortcomings of Phase 1, especially in settlement finality, trans-action throughput, privacy and cost of liquidity. These include developing a Corda-based interbank settlement system with a liquidity-saving mechanism (LSM)[60] system to allow for queueing and netting of transactions.

Phase 3 extended the Phase 2 proof-of-concept scope to include settlement of exchange-traded equities, where the notion of an integrated end-to-end settlement process for securities payments was explored. The proof of concept allowed for immediate clearing and delivery-versus-payment settlements, demonstrating the possibility of completing post-trade settlement on a DLT platform. The ability to settle transactions immediately significantly reduces counterparty risk and frees up collateral.

Payments Canada, the operator of the Canadian LVTS, is currently modernizing the core Canadian payment systems; the Bank of Canada is supporting this endeavour. These modern payment systems will provide new opportunities to enhance the daily payment interactions of Canadians as well as secure and strengthen the core of the Canadian financial system and make it more efficient. While insights learned from Project Jasper are expected to inform modernization, and vice versa, it is important to confirm that the project is separate from the modernization agenda, and there are no plans to include DLT as part of the improvements being contemplated when this paper was written.

8.3 Project Ubin (Singapore)

Project Ubin started at the end of 2016 as a collaborative effort between the Monetary Authority of Singapore and other financial and non-financial institutions. The aim was to evaluate the implementation of real-time fund transfers using

DLT within Singapore, with the long-term goal of implementing the technology for cross-border securities and payments settlement. The objective was to develop simpler and more efficient alternatives compared with existing payment processes.

Phase 1 of Project Ubin was a proof of concept developed on a DLT platform to test the feasibility of using a W-CBDC for interbank payments and settlements.

Phase 2 looked at the issues surrounding the deployment of DLT for specific RTGS functions, focusing on LSM, while maintaining the privacy of transactions.

8.4 Central bank liabilities, including central bank digital currencies

Claims on central banks (i.e., central bank liabilities or "central bank money") exist in two forms today: physical currency such as banknotes; and electronic means[61] such as reserve accounts (or inter-day settlement accounts) held by commercial banks with the central bank. At the time of writing, only the latter qualified as *digital* central bank liabilities.

In addition, CBDCs are viewed as either a tokenized or a non-tokenized variation of central bank liabilities. These could be specific-use tokens issued by the central bank on a one-to-one basis in exchange for "physical" currency or central bank reserves. Each CBDC token effectively replaces an equivalent amount of actual currency or reserves held within the central bank. This means that the overall money supply is unaffected by the issuance of CBDC tokens since there is no net increase in fiat currency claims on the central bank. In this context, one token is equivalent to a unit of physical currency; hence, the two forms can be "exchanged" when required.[62]

CBDCs can be of two types:

- **Retail CBDC**: A tokenized version of central bank liability that can be accessed directly by entities beyond commercial banks, including corporates and individuals *(outside the scope of this report).*
- **Wholesale CBDC (or Wholesale Central Bank Digital Currencies):** Limited-access tokens representing legal tender for wholesale, interbank payment and settlement transactions *(within the scope of this report).*

Features of CBDCs[63]:

- **Availability**: Currently, the availability for requesting instructions to process CBDC is limited to central bank operating hours-traditionally less than 24 hours a day and usually five days a week. CBDCs could be available 24 hours a day and seven days a week or during certain specified times (such as the operating hours of large-value payment systems). CBDCs could be available permanently or for a limited duration; for example, they could be created, issued and redeemed on an intraday basis. On this basis, the use of CBDCs can address the current challenges of service availability across time zones.
- **Anonymity**: CBDCs can, in principle, be designed to provide different degrees of anonymity or privacy similar to private digital tokens. The degree of anonymity or privacy vis-à-vis the central bank needs to be balanced with, among other things, concerns relating to money laundering, financing of terrorism and privacy.
- **Transfer mechanism:** The transfer of cash is conducted on a peer-to-peer basis, while central bank liabilities are transferred through the central bank, which acts as an intermediary. CBDCs may be transferred either on a peer-to-peer basis or through an intermediary, which could be the central bank, a commercial bank or a third-party agent.
- **Counterparty credit risk:** As with all central bank liabilities, the exchange of CBDCs between banks occurs without credit risk for participants because
  - CBDCs are binding claims on the central bank's currency; and
  - Participants do not face credit risks associated with claims on the central bank currency because the central bank is not subject to default.

The BIS report "Central Bank Digital Currencies (March 2018)" identifies the benefits of utilizing CBDCs for payments. These include: replacement of cash as an alternative, safe payment instrument, greater traceability and visibility to central banks, and enriching options for the central bank's monetary policy toolkit. At the same time, the report identifies potential challenges associated with CBDCs and issues that need further investigation such as an enhanced role for central banks, cross-jurisdictional harmonization, etc.

DLT is being explored as a potential underlying technology for CBDCs. In essence, CBDC does not necessarily need to be implemented using DLT (theoretically, traditional centralized technologies may suffice). However, a DLT-based system may facilitate the CBDC-based payment settlements process by potentially providing an enhanced technology for asset transfers, authentication, record-keeping, data management and risk management.[64]

8.5 Cross-border payment methods

There are two key methods by which cross-border payments can be completed. These are the **Serial** and **Cover** methods:

- **Serial method** is used by banks that do not have a SWIFT bilateral arrangement (Relationship Management Application-RMA) with a beneficiary bank[65]. It involves the originating bank sending a SWIFT MT103 message to the correspondent bank (and subsequent correspondent banks as required) in a series of MT103[66] messages along the bank chain until it reaches the beneficiary's bank to credit the funds into the beneficiary's account.
- **Cover method** requires the originating bank to have a SWIFT arrangement (RMA) with the beneficiary bank to send an MT103 message directly to the beneficiary bank and subsequently, forward a SWIFT MT202 COV[67] message to the intermediary correspondent banks. It should be noted that key changes were made to the Cover method messaging standards in November 2009. This involved enhancing the MT202 message by introducing the MT202 COV and was driven by regulatory concerns that the acceptance of cover payments could expose banks to fraudulent or terrorist activities, even without participants being aware of such an involvement. Further, intermediary banks could not tell the difference between an MT202 message that related to covering a payment versus any other bank-to-bank request to settle an FX trade or interest payment. The MT202 COV message for third-party payments re-solved this potential exposure by enabling information on both the originator and the beneficiary to be included in the message.

Of note, the Serial method did not expose participants to this issue because an MT103 message contains information on both the originator and the beneficiary, and this is shared with all intermediary banks in the transactions chain. The disadvantage of this method, however, is the time lag needed for the message to be passed to each intermediary in the chain. In contrast, the Cover method is quicker and more efficient, but it requires the investment in RMA's with beneficiary banks. The decision on which method is best lies with the business. It depends on each relationship, the frequency of transactions and requirements, and whether the transaction speed justifies the investment in the RMA.

8.6 Payments and settlement flows

Below is a high-level representation of the current state for cross-border payments and settlements. It assumes that the originating bank is not SWIFT-enabled i.e. the originating must remit funds to a local correspondent bank that is SWIFT enabled, which in turn will send the SWIFT transfer messages to the beneficiary bank or the beneficiary's correspondent banks on behalf of the originating bank.

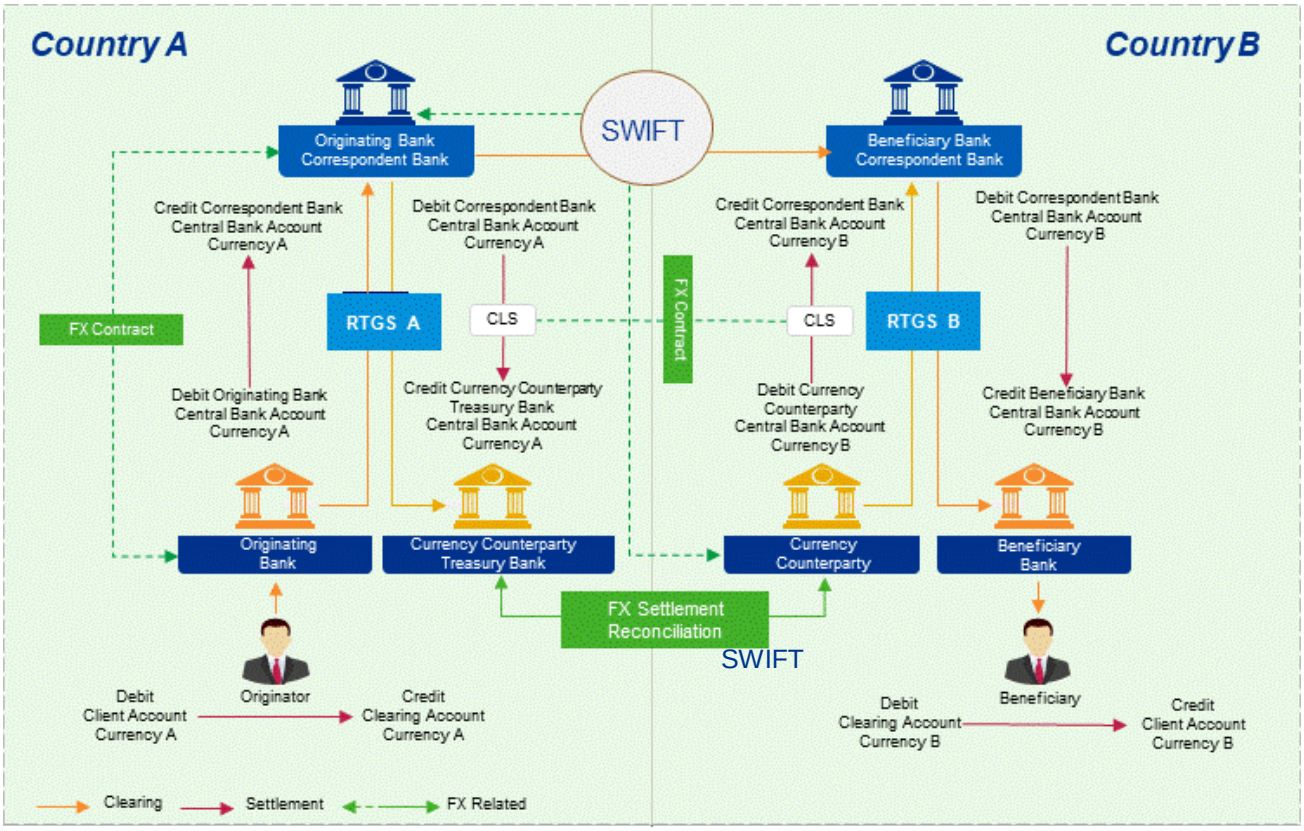

Figure 6

8.7 Payment flows – activity view

The process review below provides some situational perspective for the key challenges described earlier in this report. Banks involved in the cross-border payments carry out a number of activities involved in the processing of the payment. The accompanying illustration is a generic representation of the various activities seen in a typical cross-border payment processing across the value chain.

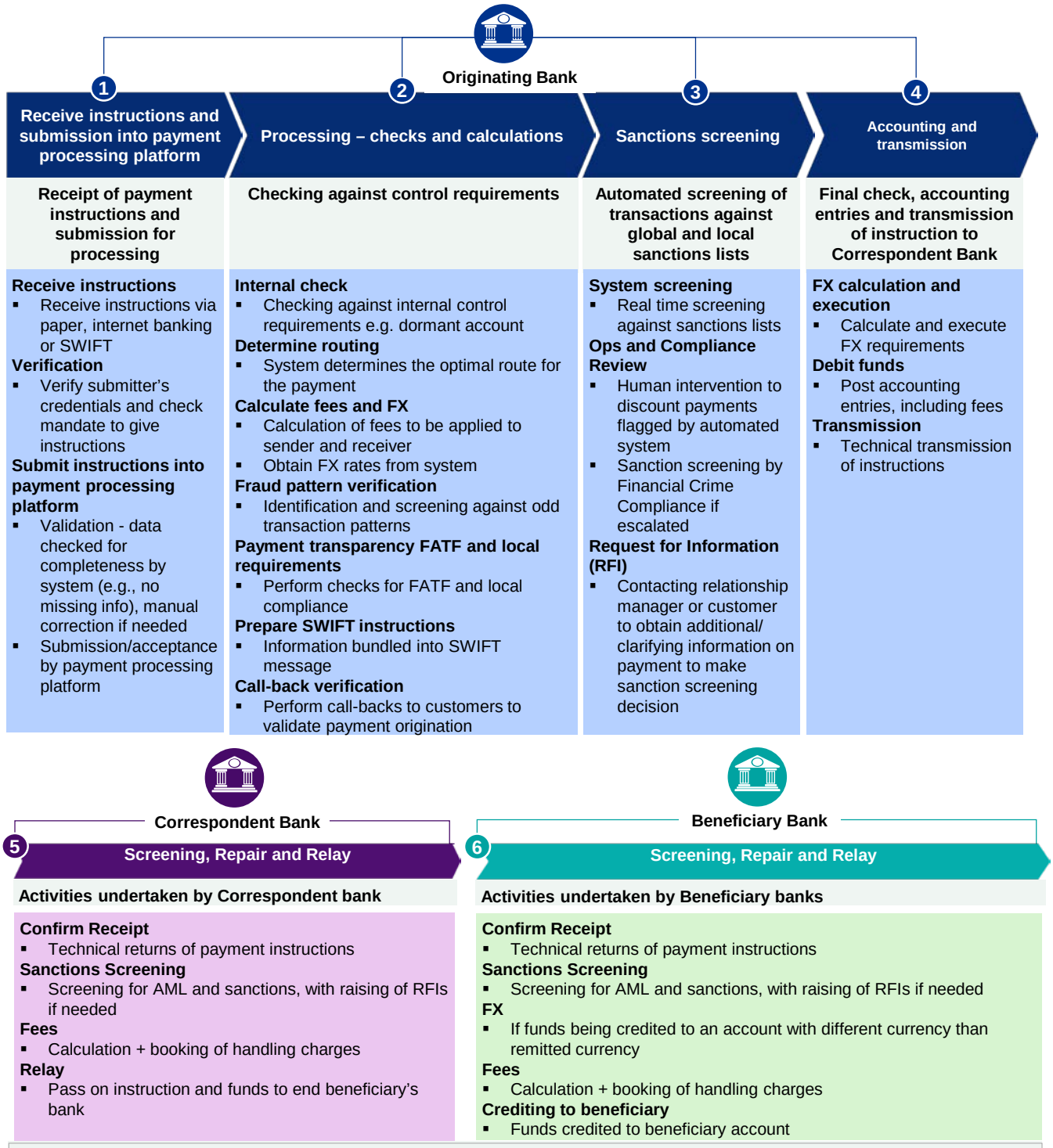

Figure 7

1. Upon receiving payment instructions and verifying the sender's credentials, the originating bank submits these instructions to its payment processing platform.
2. The platform:
   - carries out a number of checks, such as the sufficiency of funds and fraud pattern behaviours, and determines the optimal route for the payment to be executed; and
   - calculates fees and charges for the transaction, including applicable FX rates and prepares a SWIFT instruction to be transmitted to the correspondent bank and beneficiary bank depending on whether the Serial or Cover method is to be used.
3. Further, a sanctions screening is conducted in line with global and local requirements.
4. On successful completion of the above, the bank transmits the SWIFT instruction to the beneficiary bank.
5. Upon receiving the SWIFT instruction, a correspondent bank included in the payment chain conducts its own sanctions screening. Further, after passing the necessary accounting entries within nostro and vostro accounts, accounting and transmission process updates to ensure cash positions are validated and maintained for both liquidity and regulatory requirements etc., it relays the instruction to the beneficiary bank or the beneficiary bank's correspondent bank. Each sub-sequent bank in the payment chain will conduct this set of activities, which is necessary in this current-state process.
6. The beneficiary bank then conducts its sanctions screening, calculates the fees, and charges—and the appropriate FX if the beneficiary account is not in the same currency as the payment received—posts the relevant accounting entries and credits funds to the beneficiary's bank account.

8.8 Model Transactions flows

This section contains descriptions of the transaction flows for Models 2 and 3, which are described in section 6.1.2 to 6.1.5:

Model 2 - High-level transaction flow:

1. Bank C1 in Country C needs to make a payment in currency C to Bank A1 in Country A. Bank C1 performs the cross-border transfer via the common shared platform. The platform facilitates the transfer and updates the ledger balances for the currency concerned in the books of both Bank C1 and Bank A1.
2. Simultaneously, the balances of the currency ledgers maintained at the RTGS operators of each country are updated based on the transaction(s) performed between the banks. This is facilitated by the platform shared by all the participants across these two countries.
3. The shared platform allows the central banks in each country to have an over-arching view of the total balances of their currency ledgers across different jurisdictions.
4. Similar steps above would also apply to, for example, Bank A2 in Country A transferring currency B to Bank C2 in Country C. These ledgers of the specific currency B would then be updated for all participants in these transactions that are facilitated by the common shared platform.

Model 3a - High-level transaction flow:

Example: Bank A1 (originating bank) wishes to send 500 currency A to Bank B1 (beneficiary bank), which ultimately wishes to receive currency B. The description be-low shows the ledger transactions that take place in the W-CBDC platforms. The pledging of fiat currency and redemption on the traditional RTGS platform take place as per existing processes.

The following is a summary of the transaction flows for this model:

1. Bank A1 places a request to Central Bank A to issue, for example, 1,000 W-CBDC-A and pledges an equivalent amount of currency A into its cash collateral account maintained with Central Bank A—using the traditional RTGS plat-form.
2. Based on the receipt of applicable currency A, Central Bank A issues 1,000 W-CBDC-A to Bank A1, which is credited to the requesting bank's specific W-CBDC-A accounts.
3. Bank A1 subsequently sends 500 W-CBDC-A to Bank B1. However, the latter wants to receive W-CBDC-B. One way to achieve this would be to transfer the 500 W-CBDC-A to an intermediary bank—Bank C1—which maintains

a W-CBDC-A account with Central Bank A and a W-CBDC-B account with Central Bank B. Bank C1 would then be able to help Bank B1 receive the equivalent amount of W-CBDC-B in Country B, against a receipt of W-CBDC-A in Country A. This could be per-formed via an atomic swap or transfer.

Model 3b - High-level transaction flow:

This model is a two-step process:

- The first step is the process of issuing W-CBDCs by the central bank on a W-CBDC platform. This process is expected to be similar to the pledging and issuance process that was explored in Phase 2 of both Ubin and Jasper. Each central bank issues its own W-CBDC against its jurisdiction's local currency in the respective W-CBDC platform to the participating banks in the respective jurisdictions. There can also be a scenario where a central bank issues W-CBDCs of another jurisdiction (under appropriate permissions, agreements, approvals and validations) into the W-CBDC platform within its jurisdiction.
- The second step is the process whereby the W-CBDCs issued are transacted within and across W-CBDC platforms in different jurisdictions.

Example: Bank A1 (originating bank) wishes to send 500 W-CBDC-A to Bank B1 (beneficiary bank) which ultimately wishes to receive currency B of Country B (in this illustration, an exchange rate of 2 W-CBDC-A : 1 W-CBDC-B is assumed). The description below shows the ledger transactions that take place in the W-CBDC platforms. The pledging of fiat currency and redemption on the traditional RTGS platform takes place as per existing processes. This can also be facilitated via an omnibus ac-count held by the W-CBDC operator.

The following is a summary of the transaction flows for this model:

1. Bank A1 places a request to Central Bank A to issue 1000 W-CBDC-A and 'pledges' an equivalent amount of currency A into its cash collateral ac-count maintained with Central Bank A using the traditional RTGS platform.
2. Based on the receipt of applicable currency A, Central Bank A issues Bank A1 1,000 W-CBDC-A, which is credited to the requesting bank's specific W-CBDC-A account using the W-CBDC-A platform.
3. If Bank A1 needs to send 500 W-CBDC-A to Bank B1,
   a. Bank A1 transfers 500 W-CBDC-A to Bank B1 by a connectivity set up between W-CBDC-A and W-CBDC-B platforms. An outward transfer of W-CBDC-A from Country A will be recorded as an inward transfer of W-CBDC-As into Country B.
   b. The W-CBDC-A is then transferred to the beneficiary, i.e., Bank B1's W-CBDC-A account. The connectivity between the two W-CBDC platforms allows for this transfer to happen, thus facilitating a cross-border peer-to-peer transfer using W-CBDCs.
4. Given that Bank B1 has received 500 W-CBDC-A but in fact needs currency-B, Bank B1 needs to 'exchange' the W-CBDC-A received with other participants (say another bank, Bank B2) in the market (FX market for W-CBDCs), and receive a specific amount of W-CBDC-B (from Bank B2), based on the market exchange rate that is determined for the W-CBDC-A / W-CBDC-B pair.
5. Bank B1 redeems the W-CBDC-B with Central Bank B using the W-CBDC-B platform. Central Bank B in turn pays Bank B1 the equivalent currency-B into Bank B1's cash collateral account in the traditional RTGS B platform.

Note:

An alternative approach to step 3.b in the transaction flow (*See Figure 4 earlier in the report*) is that Bank A1 exchanges the W-CBDC-A it has with other market participants for a specific amount of W-CBDC-B, which it then sends to Bank B1 through the W-CBDC platform. The ex-change rate between the two types of W-CBDCs is determined by the market.

Model 3c - High-level transaction flow:

Example: Bank A1 (originating bank) wishes to send 500 U-W-CBDC to Bank B1 (beneficiary bank), which wishes to receive currency B. The description below shows the ledger transactions that occur in the respective W-CBDC platforms. The pledging of fiat currency and redemption on the traditional RTGS platform take place as per existing processes. The transactions between the central banks and the U-W-CBDC exchange are assumed to be outside of the W-CBDC platforms and hence are not depicted below. It is further assumed that

the multilateral arrangement for U-W-CBDCs allow each bank to maintain U-W-CBDC accounts in the books of the central bank.

The following is a summary view of the transaction flows for this model:

1. Bank A1 places a request to Central Bank A to issue 1,000 U-W-CBDCs and pledges an equivalent amount of currency A into its cash collateral account maintained with Central Bank A using the RTGS traditional platform.
2. Central Bank A exchanges this collateral with the U-W-CBDC exchange and obtains the equivalent U-W-CBDC. The U-W-CBDC exchange determines the ex-change rate for the conversion of currency A to U-W-CBDC.
3. Based on the receipt of applicable U-W-CBDC from the exchange, Central Bank A issues 1,000 U-W-CBDC to Bank A1.
4. If Bank A1 needs to send 500 U-W-CBDC to Bank B1, it will send it by a connectivity set up between W-CBDC-A and W-CBDC-B platforms. An outward transfer of U-W-CBDC from Country A will be recorded as an inward transfer of U-W-CBDC into Country B.
5. The U-W-CBDC will then be transferred to the beneficiary, i.e., Bank B1's U-W-CBDC account. The connectivity between the two W-CBDC platforms allows for this transfer to happen, thus facilitating a cross-border remittance using W-CBDC.
6. Bank B1 redeems the U-W-CBDC with Central Bank B using the W-CBDC-B plat-form.
7. Central Bank B in turn pays Bank B1 the equivalent applicable currency B into Bank B1's cash collateral account in the traditional RTGS B platform—after exchanging the U-W-CBDC with the U-W-CBDC exchange and receiving applicable currency B in return. The exchange rate applicable for this conversion is determined by the U-W-CBDC exchange.

Note:

1. Periodic balancing of each jurisdiction's U-W-CBDC Inward / Outward Transfer account takes place, and the account balances are transferred to the respective jurisdiction's U-W-CBDC general ledger account. This process helps a jurisdiction's central bank track the overall balance of the U-W-CBDC present in that jurisdiction.

9.0 ACKNOWLEDGEMENTS

Participating Institutions

No.	Organization	Name	Designation
1	Bank of Canada	Scott Hendry	Senior Director
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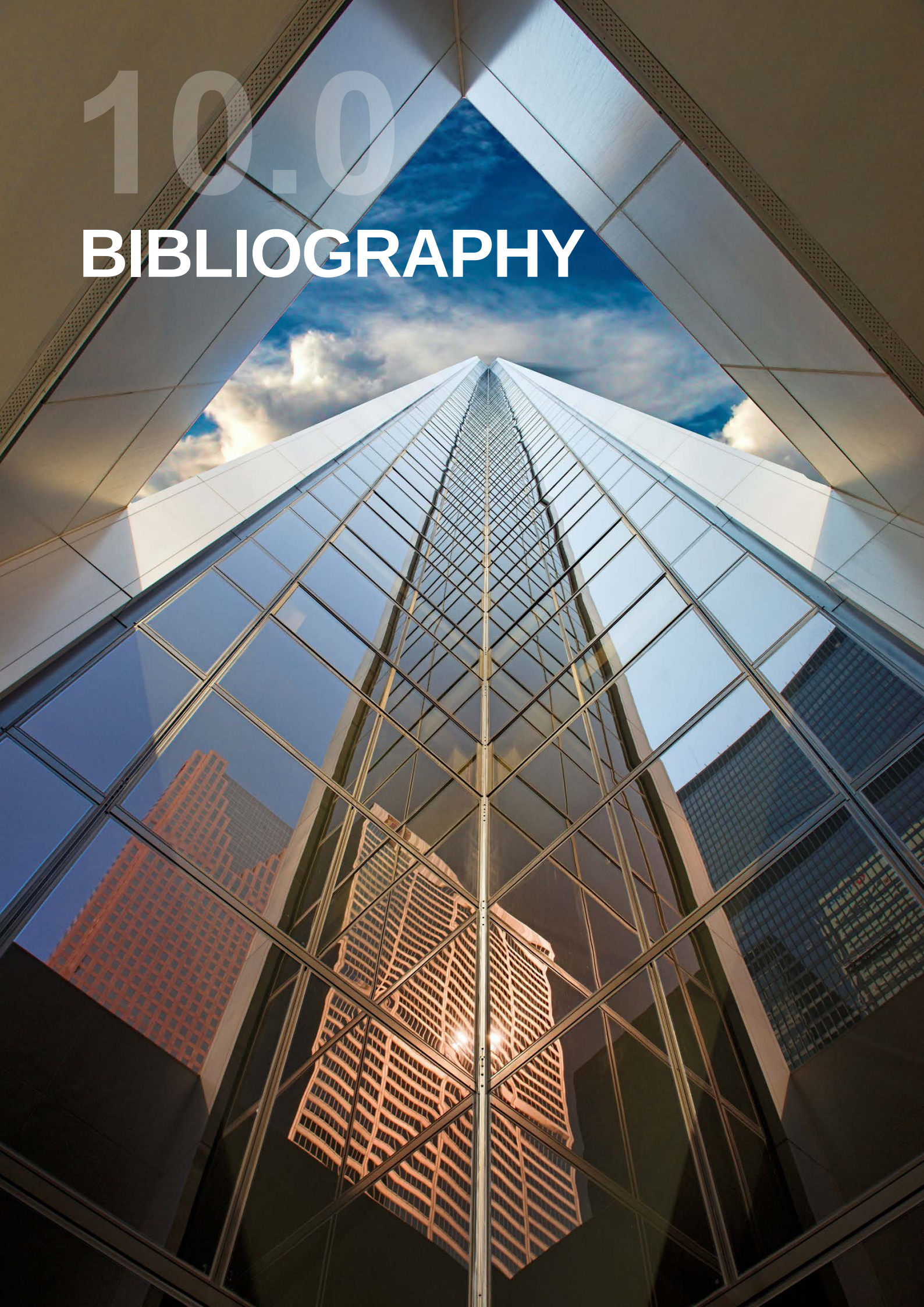

10.0 BIBLIOGRAPHY

1. Accenture “International Payments in a Digital World”
2. http://www.fsb.org/wp-content/uploads/P060318.pdf
3. McKinsey “McKinsey on Payments June 2016”
4. A bank’s ability to have presence in multiple jurisdictions will depend on a multitude of factors. These are not limited to the bank’s ability to satisfy requirements of the local payment system and the bank’s appetite for cost and/or business case to have a correspondent presence as opposed to relying on a provider.
5. The Economist research: https://www.economist.com/finance-and-economics/1999/12/23/those-medici
6. Report Contributor groups included representatives from Trade Finance, Securities, Liquidity and Cash Management, Payments and Transaction Services and Risk and Compliance
7. Further information on the facility can be found at U-Collaborate@KPMG.co.uk
8. SWIFT “SWIFT ISO 20022 Migration Study: Consultation” 2017
9. This is distinct from access to reserve accounts and the use of other central bank facilities, such as long term lending, overnight lending, intraday liquidity, etc.
10. McKinsey “Global Payments 2016”
11. Correspondent banking network banks generate net interest income from the funds “trapped” in the vostro accounts used by their participating correspondent banks. This interest cost is what is being referred to here as the “cost of trapped liquidity”.
12. IMF “Recent Trends in Correspondent Banking Relationships: Further Considerations” April 2017
13. https://risk.thomsonreuters.com/content/dam/openweb/documents/pdf/risk/report/cost-of-compliance-special-report-2018.pdf
14. “Regulatory Divergence: Costs, Risks, Impacts. An International Financial sector study by the OECD and International Federation of Accountants Report (Feb 2018)”. This study is based on a sur-vey of 250 senior leaders in financial institutions around the world.
15. Regulatory Divergence: Costs, Risks, Impacts (Feb 2018)
16. FSB Report: “Correspondent Banking Data Report”
17. http://www.fsb.org/wp-content/uploads/P060318.pdf
18. http://www.fsb.org/wp-content/uploads/P040717-4.pdf
19. Anecdotal reference from banks: End-to-end time for a cross-border payment is estimated to be between one and three days
20. http://www.fsb.org/wp-content/uploads/P040717-4.pdf
21. IBM The Next Generation Platform For Banks https://www.ibm.com/industries/banking-financial-markets/resources/modern-platform-for-innovation/
22. World Trade Organization: “World Trade Statistical Review, 2017”
23. Note: Not all cross-border transactions require a currency exchange
24. Named after a small German bank (Bankhaus Herstatt) that failed in June 1974 when it was supposed to settle a contract after having received the payment from the counterparty. That failure caused a string of cascading defaults in a rapid sequence, totaling a loss of $620 million to the international banking sector.
25. CLS currencies are (as at end October 2018): AUD, CAD, DKK, EUR, HKD, HUF, ILS, JPY, MXN, NZD, NOK, SGD, ZAR, KRW, SEK, CHF, GBP and USD.
26. One reason is that corporate users have fewer choices for large-value cross-border transactions than do individuals with smaller-value transactions who can opt to use new, emerging providers of payment services.
27. See section 4.1 discussion on the SWIFT gpi initiative.
28. The DPO indicates the average number of days it takes for a company to pay its own outstanding invoices. The DSO indicates the number of days needed to receive payment for sales made or ac-counts receivable
29. Examples are Clearing Code, Purpose of Payment Code.
30. There is not a complete lack of consistency: more countries are in the process of adopting the necessary legislations and policies that would enable them to implement PFMI standards. More details on these are available here: https://www.bis.org/cpmi/level1_status_report.htm
31. Bank of England RTGS Blueprint
32. https://www.bankofengland.co.uk/-/media/BoE/Files/payments/rtgs-call-for-interest-synchronised-settlement-in-central-bank-money

33. SWIFT “SWIFT ISO 20022 Migration Study: Consultation” April 2018
34. FSB: http://www.fsb.org/wp-content/uploads/P160318-2.pdf
35. CPMI. July 2016. “Correspondent Banking.” https://www.bis.org/cpmi/publ/d147.pdf
36. Payment Markets Practice Group. November 2017. “LEI in the Payments Market.” file:///C:/Users/hend/Downloads/swift_paper_pmpg_lei_paper_industryupdate.pdf
37. BIS Triennial Central Bank Survey: https://stats.bis.org/statx/srs/tseries/TRIENNIAL/A.U.A.B.5J.A.5J.A.TO1.TO1.A.A.3.B?t=d11.1&c=&p=2016&i=31.1
38. https://www.cls-group.com/products/settlement/clsnow/ The CLSNow service will be launched subject to regulatory approval.
39. SWIFT gpi: https://www.swift.com/our-solutions/global-financial-messaging/payments-cash-management/swift-gpi
40. SWIFT gpi: https://www.swift.com/our-solutions/global-financial-messaging/payments-cash-management/swift-gpi
41. SWIFTgpi SLA dictates a “Same Day Use of Funds” policy to speed up payment processing. Ninety per cent of gpi transactions settle in less than 24 hours, 43 per cent in less than 30 minutes. Source: SWIFT gpi Key Stats and Members, May 2018.
42. Standardization of payment data and message formats can support this point. Greater adoption of ISO20022 payment messaging standards will enable payment system operators to provide consistent, transparent payment data across the payment processing chain.
43. Payment “velocity” is measured as the overall time taken from the time the payment is initiated by the client or customer until the time the funds are credited to the beneficiary’s account
44. This is based on a general and anecdotal assessment that an ideal-state cross-border payment systems model would ease and increase cross-border payments processing, thus reducing the cost of such operations and thereby encouraging and supporting an increase in cross-border business and transactions. Quantifiable and economic assessment to this point has not been included in the scope of this report.
45. From the most ideal-state perspective, achieving common standards across jurisdictions is a first best, but a realistic approach acknowledges being transparent about (and having payment systems cater to) regulatory differences that would persist across jurisdictions.
46. ISO20022 payment standards are aimed at addressing payment data and format standardization. The extent and speed of its adoption across payment system operators will enable interoperability and support the inter-connectivity of RTGS systems between jurisdictions.
47. Please refer to the Appendix 7.4 on more details on Central Bank Digital Currencies (CBDCs)
48. Bank of Canada, Project Jasper Phases 1, 2 and 3: https://www.bankofcanada.ca/research/digital-currencies-and-fintech/fintech-experiments-and-projects/ ; See also Appendix 8.2 in this report.
49. Monetary Authority of Singapore, Project Ubin Phases 1 and 2: http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/Project-Ubin.aspx ; See also Appendix 8.3 in this report.
50. R3 paper on “Cross-Border Settlement Systems: Blockchain Models Involving Central Bank Money”
51. https://www.bis.org/cpmi/publ/d101e.pdf
52. Bank of England’s RTGS Blueprint, 2017; also, see Appendix 8.1 in this report
53. See Payments Canada’s “Modernization Target State” (2017).
54. http://www.banxico.org.mx/payment-systems/directo-mexico-remittances-ba.html
55. https://www.amf.org.ae/en/content/board-governors-arab-monetary-fund-amf-approved-creation-regional-entity-clearing-and
56. https://www.bou.or.ug/bou/bou-downloads/press_releases/2013/Dec/EAPS-Press-Release.pdf
57. SWIFT ISO consultation
58. An alternative model concept on these lines can be based on a more centralised approach, where a special purpose vehicle (SPV) or utility can be created which would have accounts in participating RTGS systems, and maintain multi-currency accounts for participating banks (equivalent of CLS receiving pay-ins but not necessarily making pay-outs to net their RTGS balances to zero). The funds would stay in the utility’s accounts and can be used to make payments. This SPV would be the nostro for all participating FIs, and avoids the need for RTGS operators to open accounts in different jurisdictions – thereby providing this SPV with high systemic importance.

59. Called “digital depository receipts” in Project Jasper, these are used by participants in the system to exchange and settle interbank payments.
60. LSMs are queuing arrangements for payments that operate alongside traditional RTGS systems. LSMs allow banks to condition the release of queued payments on the receipt of offsetting or partially offsetting payments. As a result, banks are less inclined to delay the sending of payments. Source: Federal Reserve Bank of New York “An Economic Analysis of Liquidity Saving Mechanisms”
61. Settlement of payment obligations happens in “digital” central bank liabilities.
62. “Project Ubin: SGD on Distributed Ledger” (2017).
63. “Central bank digital currencies” https://www.bis.org/cpmi/publ/d174.pdf
64. For a detailed discussion of the use of DLT in interbank payments and settlements please refer to the R3 white paper, “Cross-Border Settlement Systems: Blockchain Models Involving Central Bank Money”.
65. SWIFT enabled banks can bilaterally send certain SWIFT messages to each other without an RMA in place. Source: Wolfsberg Group Guidance on SWIFT RMA 2016 https://www.wolfsberg-principles.com/sites/default/files/wb/pdfs/wolfsberg-standards/7.%20SWIFT-RMA-Due-Diligence.pdf
66. Note that MT 103 is not one of these permitted messages
67. MT103 is a SWIFT message type for notification of a cash transfer from a financial institution and includes information regarding both originator and beneficiary.
68. MT202COV is a SWIFT message type to order the movement of funds to the beneficiary via another financial institution or financial intermediary. It also contains information on the originator and beneficiary.

11.0 GLOSSARY

Glossary of Terms

AML	Anti-Money Laundering
BOC	Bank of Canada
BOE	Bank of England
CBDC	Central Bank Digital Currency
CCM	Common Credit Message
CDD	Customer Due Diligence
CeBM	Central Bank Money
CLS	Continued Linked Settlement
CTF	Counter Terrorist Financing
DLT	Distributed Ledger Technology
DPO	Days Payable Outstanding
DSO	Day Sales Outstanding
ECB	European Central Bank
FRBNY	Federal Reserve Bank of New York
HSBC	Hongkong And Shanghai Banking Corporation
IPFA	International Payments Framework Association
KYC	Know Your Customer
LEI	Legal Entity Identifier
LVTS	Large Value Transfer System
MAS	Monetary Authority of Singapore
NBPSP	Non-Bank Payment Service Provider
OCBC Bank	Oversea-Chinese Banking Corporation
PFMI	Principles for Financial Market Infrastructures
PoC	Proof of Concept
PvP	Payment-versus-payment
RMA	Relationship Management Application
RTGS	Real Time Gross Settlement
SLA	Service Level Agreement
SME	Subject Matter Expert
STP	straight-through Processing
SWIFT	Society for Worldwide Interbank Financial Telecommunication
TD Bank	Toronto-Dominion Bank
UOB	United Overseas Bank

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