



Blueprint for Central Bank Digital Currencies in Post-Trade Settlement

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Foreword

In 2020, ISSA launched a Distributed Ledger Technology (DLT) survey to understand the realities of DLT adoption within the market. One of the advantages highlighted was the ability to settle securities against Wholesale Central Bank Digital Currencies (CBDC).

CBDC and stablecoins (SC) are being investigated, experimented with and, in some cases, already in use within the capital markets (see Appendix 3). The adoption of CBDC and SC offers potential advantages over today's settlement methods. This is particularly apt when discussing the settlement of securities on DLT, as the simultaneous exchange of CBDC/SC and securities tokens (aka atomic settlement) is a key attribute of a DLT solution and the creation of a Delivery versus Payment 1 (DvP1) (in central bank money or commercial bank money) settlement solution.

Interest in CBDC and SC is growing across the globe, with several central banks embarking on CBDC investigations and projects, often in conjunction with the Bank for International Settlements (BIS). SC are continuing to come to market in a variety of designs and are under regulatory focus as innovation in this space takes shape. SC are not the focus of this report but they are debated as they may, and in some cases already do, form part of the securities ecosystem.

It is therefore of paramount importance that the securities sector within the financial services industry gains as complete a picture as possible of the potential use cases, opportunities, threats, and considerations of adopting CBDC or SC within the industry. There is also a considerable amount of material which is being published on an almost daily basis, making the subject potentially overwhelming and challenging to digest in a concise and simplified manner. Although there are tangential references to Commercial Banking, Payments and FX issues in this report, its focus is not about the impact of CBDC on those industries.

Given the amount of press on a weekly basis either concerning DLT, CBDC, or SC for securities services, the sheer volume of these publications can make it difficult to formulate a framework as to their application in the industry. Therefore, the purpose of this report is to provide ISSA Members, and the industry, with a digestible and concise, point-in-time summary of the potential application of CBDC, and to a lesser extent SC, in the existing and future capital markets post-trade landscape, as perceived by this Working Group, with a specific focus on the value chain in securities settlement arrangements. This report will provide a broad overview of key use cases, opportunities, and considerations for market infrastructures, custodians, intermediaries and service providers to consider.

In addition, it will provide a plausible, if extreme, blueprint which will outline for the reader the roles (including the possible changes of current roles), challenges, opportunities and potential changes that the impact of CBDC & SC could have on the banking, fintech, and securities industry.

The report also alludes to several factors that central banks and politicians may wish to consider in relation to the impact of introducing CDBC, but it is primarily focused on the impacts for the securities markets. It is not intended to be an exhaustive resource for debating the merits, or otherwise, of introducing a CBDC.

Acknowledgements

This report is the result of efforts by a team of experts drawn from the ISSA Operating Committee Members and other ISSA participating Member Firms. All participants have supplied invaluable market information and input into this report. The names of participating Member Firms and the individual contributors are listed in Appendix 4. The ISSA Executive Board wishes to thank all supporters for their contributions, as well as their firms who have enabled their participation.

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1. Introduction

In 2019, the ISSA DLT Working Group published a paper, [Crypto Assets: Moving from Theory to Practice](#). This paper addressed several topics relevant for DLT. The most pertinent of those topics for this follow-up paper is the section in Chapter 3 titled ‘Settlement of Securities transactions on DLT’, which addresses the challenges of on-ledger settlement, and the experiments with CBDC and SC which took place in 2019. This paper was followed by the 2020 ISSA & Value Exchange [DLT in the Real World survey](#), which concluded that one of the biggest enablers of DLT adoption (along with the need for clear regulation and proof that the technology could work at scale) was the introduction of CBDC, an interface to a Real-Time Gross Settlement System (RTGS), or a SC. A second ISSA DLT survey (2021) confirmed the findings of the first one: i.e., that CBDC is still a most viable option as a potential enabler for DLT adoption.

Both the initial paper and the subsequent empirical evidence agreed upon the need for the securities services industry to collaborate and create a blueprint for how CBDC (and SC) might allow an optimal adoption of DLT in the wholesale capital markets. ISSA commissioned and initiated the CBDC Working Group (WG) to address this industry need.

Recently, in 2021 the Bank of International Settlements (BIS) stated that the foundation of the monetary system was ‘trust in the currency’. Financial Market Infrastructures (FMIs) live by the same mantra as echoed by the BIS (2012) in the Principles for Financial Market Infrastructures (PFMIs)¹. These principles are adhered to so as to provide the appropriate levels of confidence and trust for all stakeholders. At the inception of innovation and development of digital assets such as CBDC, it is vital that trust should be the cornerstone of any planned development, thereby creating safer, more efficient, and more liquid financial capital markets.

As yet, the adoption of CBDC within the securities markets is extremely limited. This is largely because very few CBDC have been issued for use within the wholesale markets. The current focus upon the rapid pace of research and development (R&D) within the central banking community, and the changing type and growth of SC offerings have made the publication of this report very timely, providing the perfect opportunity for the securities services industry to be heard.

It should be noted that, given the continuous ongoing R&D and pilot schemes, this report is a point-in-time assessment and will almost certainly need to be revised in the future, probably sooner rather than later. Also note that this report does not use CBDC and SC synonymously, since they have different properties, will be regulated differently, and can apply to different use cases.

Central banks are currently very busy examining and experimenting to identify the potential risks and benefits of CBDC which are unique to each jurisdiction’s circumstances. Ultimately, it will be both a central bank and a national decision to decide whether to proceed or not with CBDC. There are many political issues to consider, as well as the fact that central

¹ Bank of International Settlements 2012: <https://www.bis.org/cpmi/publ/d101a.pdf>

banks must weigh important policy, public interest and monetary considerations. During this phase, the securities servicing industry continues its review of the implications.

The purpose of this report is to deliver a concise summary of the potential application of (primarily) CBDC in the existing capital markets post-trade landscape. Where applicable, ISSA has also referenced SC more explicitly. This report provides a broad overview of key use cases, opportunities, threats and considerations for market infrastructures, custodians, intermediaries and service providers to consider.

Additionally, this report will aim to provide a blueprint which will outline roles within the securities industry (including potential changes to current roles), challenges, opportunities and any other potential changes to allow the reader to gauge the possible impact of CBDC (and to a lesser degree SC) on the securities industry.

While the use of DLT is not necessarily a prerequisite for a CBDC, this report has taken the approach of assuming DLT as the underlying technology for potential CBDC deployments.

The research effort is based around primary use cases which were identified at the start of the research effort, namely primary issuance and redemption, settlement, and secured finance and collateral management. These key areas cover the length and breadth of the capital markets' post-trade ecosystem and have been chosen based on their widespread impact and touch points across the securities market.

A glossary of terms can be found in Appendix 1 and quoted sources in Appendix 2

2. Summary of Key Findings

As the pilot schemes and experiments continue, changes to regulatory attitudes globally are enabling or envisaging the use of CBDC in the context of securities markets. The use of CBDC can provide several benefits including:

- a. faster settlement finality
- b. liquidity and integrity²
- c. atomic settlement
- d. reduced operational work to reconcile between many different systems (including the possibility of aligning securities and cash on a single platform)
- e. programmability (e.g., to detect and call out on the potential of systemic liquidity gridlock,...etc)
- f. process and responsibility changes to reduce risk and increase efficiency

The use of CBDC may also present new risks for the ecosystem.

The WG believes that the present market ecosystem is reasonably efficient and, in many instances, allows settlement in central bank money. There are opportunities to further improve efficiency and reduce risks, and some of these opportunities could be realised, potentially, through the introduction of technology including DLT solutions to improve the existing infrastructure. To maintain the benefits of true DvP1 settlement in central bank money, it is logical to conclude that a CBDC using DLT as the underlying technology would be an enabler for this.

One of the potential opportunities for a transformation from the existing market structure to a CBDC-enabled securities settlement mechanism is that the roles of various parties in the ecosystem could be transformed as a result of their adoption, and new roles, better adapted to the new technologies, could emerge. As well as new roles, the WG believes that changes to existing securities processes are required to allow meaningful progress to occur. The WG agrees with the statement within the Euroclear and Banque de France paper: *Experimenting settlement of French government bonds in Central Bank Digital Currency with blockchain technology* to quote:

“Our experiment also highlighted that the full value of blockchain cannot be realized by simply replicating ‘as is’ the securities settlement operations processes. However, enabling direct access by end investors on the blockchain platform via their custodians and/or removing the current post trade processing breaks, would allow blockchain technology to significantly improve post-trade operations. This could then remove reconciliation processes, reduce the overall cost and increase the efficiency of the capital markets.”

² Bank of International Settlements 2021 <https://www.bis.org/publ/arpdf/ar2021e3.pdf>

To make the most of the potential efficiencies in cross-border transactions, the WG believes that Central Banks should consider the following CBDC attributes to prevent the fragmentation of market practices and approaches which currently bedevil the existing securities markets:

- token standardisation
- designed for interoperability
- programmability
- designed for fast adoption (be that open source, using existing infrastructure and existing platforms, or other solutions)
- ability to auto-convert between CBDC in the currency of choice; i.e., not a “global” coin, but convertible coins

The WG’s view is that for the smooth functioning of the securities industry and the capital-raising capabilities of local companies, it is imperative that CBDC solutions are designed to be interoperable. This means interoperable not only between CBDCs, but also between existing securities platforms and ecosystems, since a period of co-existence is likely. The WG would also support interoperability with environments (including SC platforms) which meet the appropriate prudential criteria.

A key finding of the WG is that the potential implementation of CBDC using DLT as the underlying technology within the wholesale securities markets will become the catalyst for the development of DLT adoption in securities ecosystems.

SC, specifically those which meet the prudential standards and which are backed by a fiat currency or CBDC, can offer a useful method of progression to the adoption of digital assets. To be genuinely useful, SC need to be regulated and offer both consumer protection and financial stability: i.e., be a store of value which is easily convertible. As yet, the regulation for SC is at an immature state, but that has not prevented a number of SC underpinning the Decentralised Finance (DeFi) environment.

The potential adoption of SC echoes the current environment where the activities of Settlement Banks have been superseded by Central Bank money for settlement over the decades. However, it should be noted that settlement venue regulations and rules rather than investor choice will govern the settlement venue’s appetite for SC.

The following report provides a good summary of the US stablecoin market: [*The President’s Working Group on Financial Markets, the Federal Deposit Insurance Corporation and the Office of the Comptroller of the Currency:*](#)

It is the WG’s belief that the full authorization/control to hold CBDC must be with the central banks, as they do today in the RTGS systems.

3. Terminology

In this report, the WG refers to several concepts which are ambiguously used across the industry. To that end, the key elements of taxonomy (i.e., classification) which are required to understand this report are detailed below (note: there is also a substantial glossary to be found in Appendix 1).

The WG recommends a broader harmonization of taxonomy and terminology across the industry and regulators should be created. ISSA has contributed to the Global Blockchain Business Council Global Standards Mapping Initiative 2.0 (GBBC GSMI 2.0) taxonomy initiative and recommends convergence to this taxonomy. <https://gbbcouncil.org/gsmi/gsmi-2/>

Additionally, ISSA has published an ‘Asset Definition’ template for completion by ‘Standards Authorities’ to compare and contrast the offerings and upcoming deliveries of those Standards Authorities in respect of tokenised assets. This can be found at the following link: <https://issanet.org/dlt-asset-identifiers/>

Digital Asset: an asset in binary form that comes with a right to use, that has clearly defined notions of issuance (minting), destruction (termination or conversion back into fiat currency), ownership, and transfer of ownership, a definable monetary value, which may be between specific counterparties, and which may be based on a right to use or may be based on the principle of limited supply. A digital asset is not necessarily analogous to a security and does include CBDC and SC.

Central Bank Digital Currency: CBDC are sovereign liabilities of a country (or currency bloc). A CBDC is analogous to the fiat currencies which exist today in electronic and physical form. These can be either tokenised or account-based (see glossary). Each CBDC will be dependent on individual use cases, legacy frameworks, CBDC starting points, and go-to market decisions. Some of the fundamental decisions to be made by each respective central bank will be whether the CBDC’s focus is domestic or cross-border, and wholesale or retail (serving banked and unbanked). This is before the central banks address additional important topics such as remuneration or holding limits, which will in turn affect monetary policy.

Borrowing from the BIS Annual Report 2021:

- **“Retail (or general-purpose) CBDC:** a CBDC for use by the general public.
- **Wholesale CBDC:** a CBDC for use by financial institutions (wholesale transactions) that is different from balances in traditional bank reserves or settlement accounts.
- **Tokenised Securities:** a term used to distinguish tokens regulated as securities from tokens which are not regulated as securities. However, they can encompass asset classes that are not generally securitised, such as fine art and real estate.

- **Stablecoin:** a class of crypto-currency designed to eliminate the price volatility of crypto-currencies by backing them with real assets, fiat currencies or a mixture of both. A SC whose price reference is the US Dollar, for example, could be backed 1:1 by US Dollars in a cash account, or money market funds, or commercial paper in a custody account. The aim is that investors redeeming the SC would receive one US Dollar for each SC. In the present regulatory environment, the design and backing of SC requires the application of the principles of caveat emptor. This is because the mechanics of the SC may ultimately impact their respective liquidity and ability to be promptly redeemed against fiat currency (digital or otherwise).”

The WG has chosen to use the singular to imply both the singular and plural as applicable within the context of the sentence.

4. Background

CBDC has potential benefits and raises potential risks, both within the monetary sphere but also within the securities industry. The innovation within this sphere has been ignited by private firms challenging the traditional concept of money being a fiat instrument and providing the platforms needed to accelerate change. Central banks are aware of the potential benefits and associated risks of the underlying technology, if not of CBDC itself, and are largely non-committal as they complete their analysis of various use cases.

There are pilot projects and even ‘go-lives’ in some jurisdictions including, most notably, China and The Bahamas. Larger central banks remain open to the idea of partnering with private sector solutions once concerns over the various risks have been alleviated, since the private sector can leverage its competitive strengths to supplement or even enable the aims of central banks in issuing CBDC.

There are instances where the analysis suggests that SC can facilitate many of the use cases where CBDC is being proposed. One of these examples is from the Federal Bank of NY ([Liberty Street economics](#)), the other is from [Randal Quarles](#), but speaking at a conference in June 2021: *“In offering my views on this and other issues related to CBDCs, I am speaking for myself as a member of the Board of Governors, and not for the Board itself or any other Fed policymakers.”*

To quote from Quarles’ speech:

“But these concerns are eminently addressable—indeed, some stablecoins have already been structured to address them. When our concerns have been addressed, we should be saying yes to these products, rather than straining to find ways to say no. Indeed, the combination of imminent improvements in the existing payments system such as various instant payments initiatives combined with the cross-border efficiency of properly structured stablecoins could well make superfluous any effort to develop a CBDC.”

This report addresses the use of wholesale CBDC in the securities industry. The impact of the choices made in the detailed design of a CBDC will affect securities services, especially those with a global footprint, and they will have a need to connect to many of these currencies as they come online. The BIS has identified 80+ CBDC experiments and proof of concepts harking back to 2014³. It is highly unlikely that the multitude of CBDC offerings will be designed or operate in the same manner. It is imperative to the smooth functioning of the securities industry, and the capital-raising capabilities of the local companies, that the CBDC solutions are designed to be interoperable.

³ Bank of International Settlements 2021 <https://www.bis.org/publ/arpdf/ar2021e3.pdf>

5. Research Blocks

5.1 CBDC – Background

As a country transitions to a final state of adoption of CBDC, and digital assets more widely, CBDC is likely to be only one component of the money supply. There will be changes to the roles and responsibilities of incumbent intermediaries within the financial system, and brand-new roles and responsibilities to be fulfilled.

The Currency Supply Chain is a representation of how a currency is transmitted through the economy. The central bank remains as the foundation of the payments system while assigning customer-facing activities to payment service providers (BIS, 2021). Commercial banks are regulated, licensed and connected to central banks and RTGSs and, therefore, typically have fiduciary responsibilities to maintain these banking licenses in the jurisdictions where their clients are based. Ultimately there will be a cost to adoption and distribution of CBDC and these costs are likely to be borne by banks and passed onto consumers. Increased complexity, differing designs and lack of standards have the potential to make these costs prohibitive.

In most economies there is a fractional reserve banking system. This is where the banks take deposits from their clients and hold a proportion of those assets in cash or other liquid instruments (the reserve requirement), then lend the remainder to their borrowers, often at longer maturities. This approach to banking increases the money supply within the economy. Fractional banking is conceptually at odds with CBDC. By design, the CBDC unit is unique and hence cannot be used to underpin a fractional banking system. This has implications for the Currency Supply Chain and the costs of funding for the economy if CBDC are widely adopted and the fractional banking system is not maintained. As noted in the introduction, this report does not address further the policy points raised by CBDC in the banking and payments systems.

A particular challenge is the current, widely adopted state, of promoting a hybrid public-private innovation and cooperation with CBDC development built on different technology ‘sandboxes’. This has meant that there is a proliferation of many different consortia, infrastructures, approaches and technologies which increases the likelihood of complexity and prohibitive costs, which will in turn impact adoption rates.

If a wholesale CBDC is to be used in a cross-border use case then careful consideration needs to be given in the transition to, and interoperability of, different CBDCs. The following factors require detailed analysis:

- technology
- infrastructure
- standards
- programmability
- interoperability between technologies and platforms
- policy
- legal (including, but by no means exclusively, bankruptcy laws)
- rule books

- privacy
- public or private networks
- geopolitical and sovereignty sensitivities
- CBs control of their CBDC
- CBs approval of participants in their CBDC

The policy concerns above and, in particular, those such as interoperability, legal and operational harmonization, have not been solved in the existing market interactions. They are also open questions in cross-border CBDC use cases. The WG believes that the role of a cross-border ‘traffic cop’ is a question that also needs to be addressed, in particular, whether a cross-border ‘traffic cop’ is needed to ensure that the protocols required to address the aspects listed above are set up and adhered to. In the present securities market typically the ‘traffic cop’ role is undertaken by the Financial Market Infrastructures (FMI) within a distinct jurisdictional framework. However, given the scopes, different forms, and sovereign sensitivities involved in digital assets, combined with the complexity of wholesale and retail distribution, this role needs further considered thought and analysis.

BIS, in its recent papers, proposed three potential multiple CBDC (M-CBDC) models:

1. **Enhanced Compatibility:** compatible technical and regulatory standards with overlapping participation
2. **Interlinking:** through shared technical interfaces by use of a (centralised or decentralised) common clearing mechanism
3. **Integration into a single platform:** multiple CBDC can be run on a single platform (M-CBDC bridge)

According to BIS (2021), wholesale CBDCs are intended for the settlement of interbank transfers and related wholesale transactions (this includes settlement and related-use cases which are covered in this report). The aim of wholesale CBDC can be summarized as making financial systems faster, more liquid and safer. This could be enabled by reducing counterparty risk, reducing settlement times, provision of a digital cash asset of the highest quality that unlocks the door to a broader ecosystem of use cases within the economy. CBDC have the potential to provide:

- Faster settlement, reducing credit/counterparty risk (the quicker the settlement, the less opportunity there is for your counterparty to default) if extended operating hours are offered
- Cheaper settlement (the removal of intermediaries should reduce cost)
- Extended settlement hours: potentially a 24 hours by 7 days operating environment
- True DvP1
- Direct linkage of securities/FX platforms to cash platforms, eliminating settlement risk
- Increased efficiency of liquidity through real time monitoring capabilities and reduction in intermediaries/counterparties. This could be adversely impacted by prefunding requirements, and venue fragmentation
- Addition of ‘smart’ features such as earmarking of funds, conditional interest rates...etc.
- Increased system resilience as compared to centralised systems

5.2 Stablecoin – Background & Approaches

The term stablecoin (SC) is used to refer to digital coins issued by private companies. SC are a type of digital asset that, if properly designed and implemented, use a stabilization mechanism to attempt to maintain price stability with an existing national currency or other asset. Most SC leverage public blockchain infrastructure, such as Bitcoin, Ethereum and Tron4.

There are many use cases for SC, many of which are applicable to CBDC, but given the agility of SC ecosystems, the lack of regulation and consumer demand, there are currently more SC in circulation across the globe than there are CBDC. The SC ecosystems are more prevalent as the issuance of a SC is a relatively quick process. This lack of oversight and regulation does mean that SC are significantly riskier than CBDC. The unregulated use of SC has also been flagged by the Financial Stability Board as potentially generating financial stability risks, particularly if adopted at significant scale. Use cases and potential use cases, include, but are not limited to, settlement of automated financial products, means of payment for online purchases ('ecommerce'), peer-to-peer, micro-payments, cross-border payments, crypto on/off ramps, decentralized finance (DeFi) use cases, delivery versus payment, and payment versus payment. SC underpins the present increase in DeFi use cases due to its agility – whether this continues to be the case in the longer term if CBDC grows is outside the scope of this report.

Work to regulate SC is underway in multiple jurisdictions globally, including Canada, the UK, the EU and the US. Separately, ongoing crucial work at the international level includes the Basel Committee on Banking Supervision's (BCBS's) preliminary proposals for the prudential treatment of banks' crypto-asset exposures, and the proposed application of the Principles for Financial Market Infrastructures (PFMI) to SC. The regulatory landscape for SC is complex and shifting rapidly, but the general position adopted by the G20 and the Financial Stability Board is that global SC arrangements are expected to adhere to all applicable regulatory standards and to address risks to financial stability before commencing operation, and to adapt to new regulatory requirements as necessary. Listed below are three examples of frameworks that have already been published:

1. [The Bank of Canada report](#) defines stablecoin arrangements in three categories: coin structure, transfer system and financial service. Furthermore, it uses the following framework to further define the stablecoin: a) the mechanics of the coin, system or service, b) any regulatory frameworks that apply, and c) the potential drivers of adoption.
"Defining the attributes in these broad three categories will ensure a full understanding of the stablecoin arrangement, including the risks, liabilities and incentive interactions between issuer, transfer system and financial service provider."
2. The [report](#) from EU MiCA (Market in crypto-asset regulation) defines crypto-assets as digital assets that may depend on cryptography and exist on a distributed ledger. A basic taxonomy distinguishes between:
 - payment tokens (means of exchange or payment)
 - investment tokens (have profit rights attached); and
 - utility tokens (enable access to a specific product or service)

“The Commission is of the view that, where crypto-assets are not covered by EU financial regulation, the absence of applicable rules to services related to such assets leaves consumers and investors exposed to substantial risks. In addition, the fact that some member states have put in place bespoke rules at national level for crypto-assets that fall outside current EU regulation, leads to regulatory fragmentation, which distorts competition in the Single Market, makes it more difficult for crypto-asset service providers to scale up their activities cross-border and gives rise to regulatory arbitrage. Lastly, the crypto-asset subset of ‘stablecoins’ can raise additional challenges if it becomes widely adopted by consumers.”

3. The FSB [report](#), “...sets out high-level recommendations for the regulation, supervision and oversight of ‘global stablecoin’ (GSC) arrangements. GSC arrangements are expected to adhere to all applicable regulatory standards and to address risks to financial stability before commencing operation, and to adapt to new regulatory requirements as necessary.”

Below is a table of SC, categorised by their collateralization method:

Table 1: Type of stablecoin by collateralization method (Source: Consensus)

Type	How it Works	Examples
Fiat-collateralized	“Centralized” stablecoin / backed by fiat currencies, or equivalent collateral-backed	Tether, USD Coin, Gemini, and Digix, Diem, JPMCoin
Crypto-collateralized	“Decentralized” stablecoin / backed by crypto and/or multiple assets, collateral-backed	MakerDAO, Steem, and Alchemint
Non-collateralized	Seigniorage Shares / Decentralized Bank / Algorithmic stabilization mechanisms	Terra, Ampleforth, and Element Zero

5.3 Use Case – Introduction

The report’s research effort is based around primary use cases which were identified at the start of the research effort, namely primary issuance and redemption, settlement, and secured finance and collateral management. These key areas cover the length and breadth of the capital markets post-trade ecosystem and have been chosen based on their widespread impact and touch points across the market.

Digital currencies – both CBDC and SC – are being increasingly explored for use in securities issuance and settlement. Over the last few years, at least ten CBDC and commercial bank money SC initiatives have involved securities use cases and have spanned primary issuances, secondary trade settlements and corporate actions processing across asset classes. These can be seen highlighted in Table 2 and links to the public project documentation can be found in the References section (Appendix 2).

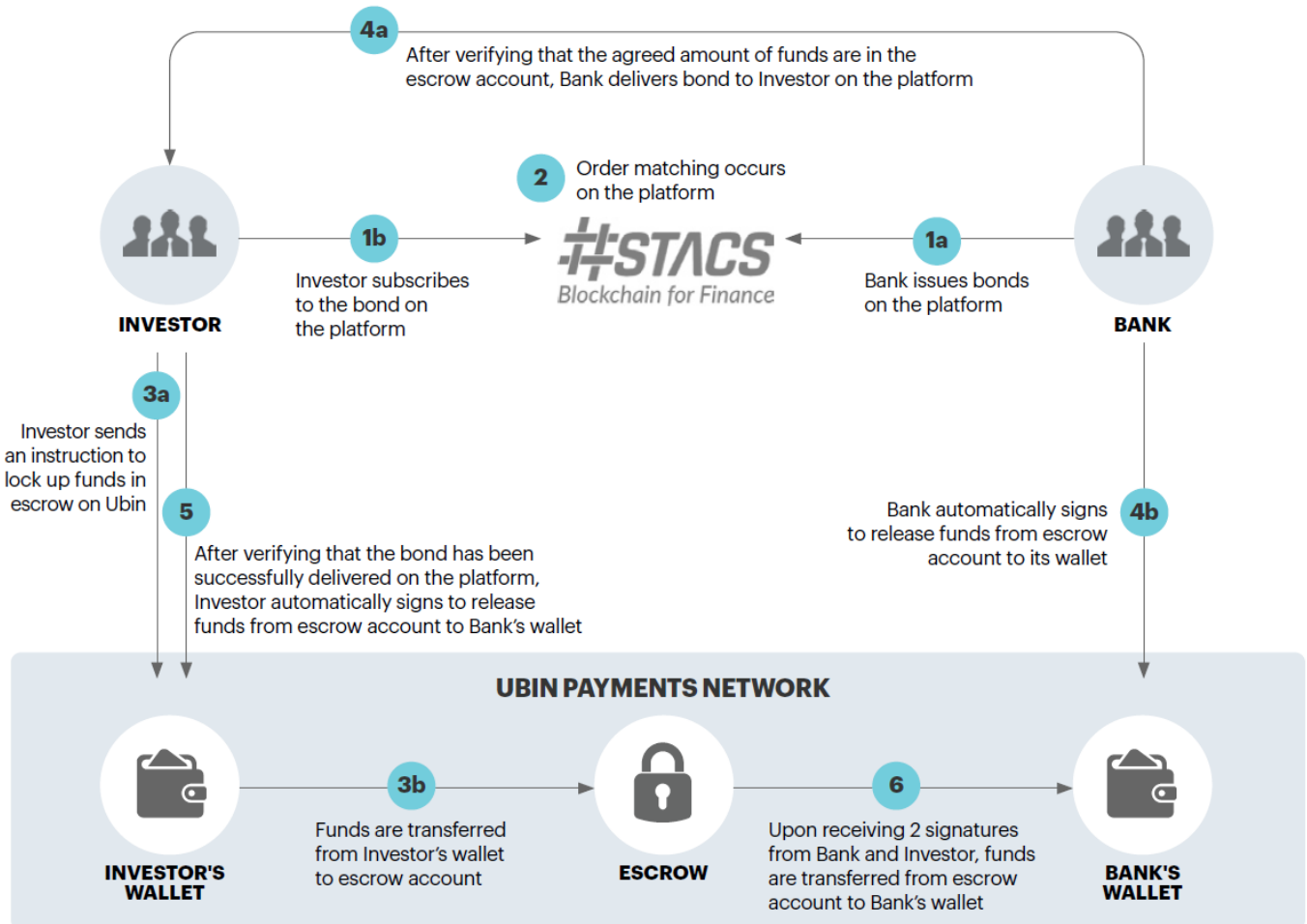
Table 2: Public experiments with CBDC and SC (Source: ISSA Working Group)

With Central Bank Money (CBDCs)	With Commercial Bank Money stablecoins
Project Jasper – Bank of Canada	WorldBank (Bond-I) securities issuance
Project Ubin – MAS	SocGen & Santander-Ethereum securities issuances
Project Stella – ECB and Bank of Japan	CommerzBank & Deutsche Boerse – collateral settlement on DLT
Project Helvetia – SIX and Swiss National Bank	Intraday Repo settlement with JPMCoin
Euroclear and Banque De France Digital Euro experiments – funds settlement against CBDCs	
EIB SocGen, Santander, GS – digital bond issuance & settlement against CBDC	
Project Inthanon (Bank of Thailand) / LionRock (HKMA)	

In the research blocks, the WG looked at real examples of the utilization of a CBDC within an issuance programme. The following diagram is taken from Project Ubin which was sponsored by the Monetary Authority of Singapore (MAS).

The utilization of CBDC within an issuance programme

Figure 1: Project Ubin DvP on DLT (STACS) Issuance DvP (Source: Project Ubin)



Taking the CBDC approaches above into consideration and choosing the indirect participation model, the Primary Issuance and Redemption use case scenario is:

- A bank holds a CBDC-denominated bond auction.
- An investor subscribes to the commercial bank's offering and is successful in winning a 10 million allocation of the bond.
- The investor sends an instruction to lock up the CBDC funds from their account in Ubin and deposit them in the 'escrow account'.
- The issuing bank verifies that the CBDC is in the escrow account, delivers the bond on the platform, and instructs Ubin that the funds in escrow should be delivered to the bank's wallet.
- The investor sees the bond on their account and authorizes the release of the CBDC from the escrow account to the bank's wallet.
- The purchase and sale are completed.

This is a simple example of the issuance of a bond with settlement in CBDC providing a DvP solution. A slightly more complex example is highlighted below which considers both DvP and PvP flows using a tokenised bond and a digital wallet. Additional features include different forms of hybrid technology adoption of traditional and different DLT/Blockchain implementations, as well as cross-border transactions:

- A central bank holds a CBDC-denominated bond auction.
- A commercial bank is successful in winning 100 million CBDC bond and pays for the bond in CBDC-denominated currency.
- CBDC bond is delivered to and stored in a digital vault, either at a bank or custodian (first DvP transaction completed).
- Commercial bank sells all or part of the bond to a foreign asset manager.
- The CBDC bond is delivered to the asset manager's global custodian for CBDC (second DvP transaction completed).
- On day of the coupon payment, the CBDC-denominated currency payment is calculated and paid in the CBDC bond notional currency to the local custodian.
- The asset manager wants to reduce their exposure to the CBDC issuance currency and instructs the global custodian to convert the coupon to either fiat currency in another country, or another country denominated CBDC (first PvP transaction occurs).
- FX conversion is calculated and the payment made to the asset manager.

What these experiments and use cases have shown is that there are a range of potential benefits from the adoption of digital currencies in DLT-based securities issuance and settlement; where the cash and securities legs are able to be settled, these could include:

- **24x7, faster and global settlements**
 - Potential for the payment & settlement to run 24x7x365, without the need for 'business hours' and banking holidays
 - Reducing settlement timelines from T+2/3/5 currently to T+0. It should be noted that several settlement systems globally (in their current state) can, and do, use a T+0 settlement cycle
 - Ability to process intraday settlements with more granular/ real time settlement 'runs'
 - Ability to conduct settlements atomically in multiple currencies
 - Potential to improve cross-border settlement flows
 - Reduces ability of actors to strategically renege, reducing settlement fails; i.e., atomic settlement and earmarking can make failure impossible as the trade is validated and 'locked in' if those are the rules of the marketplace
- **Automation / programmability via smart contracts of payments (i.e., coupons dividends, redemption proceeds)**
 - Automated conditional payments across digital assets and cash
 - Automating payments of interest/dividends
 - Ability to conduct atomic multi-legged settlements across assets and cash networks
 - Shared reference data that would reduce mismatches/ calculation errors
- **Reduced need for reconciliations**
 - Golden record of a single source of truth, shared by parties, providing a comprehensive audit trail
 - Greater transparency of records from issuance to settlement
 - Streamlining compliance

5.4 Risks

The current experiments also highlight a range of risks that will need to be actively managed to ensure that implementation of CBDC-enabled settlement does not make the marketplace less efficient, nor increase the risk in the post-trade life cycle. These include:

- **Liquidity / credit risks**
 - Fragmented liquidity across digital and non-digital payment networks
 - New counterparty risks when SC is involved (against issuers, reserves)
 - Netting is substantially more complex when on DLT, and impossible where networks require atomic settlement. Intellectually these issues can be addressed. The role of who performs netting may need to

change. The records are centralised on the underlying ledger and hence the activity of netting could be performed. Therefore, there could be a Tokenised Asset CCP running batches which are not atomic settlement (the instant or near-instant settlement from the point of a successful trade), but which are settled intraday. This can effectively combine some clearing functions of a CCP and settlement functions of a Central Securities Depository (CSD) in one place.

The industry will need to apply technology to the settlement model or change the settlement model from the theoretically pure gross/gross settlement. In these scenarios, a governance function will need to exist to prevent liquidity freezes similar to the JGB netting circles of the 2000s. In respect to atomic settlement (which is tied to price discovery), it is only desirable in a very liquid market where price discovery is efficient. If there is atomic settlement capability, market participants may not want instant settlement because of a lack of credit benefit in this feature; i.e., the buyer needs need to have the token supply to enable atomic settlement. A fourth potential option is a 'smart contract solution' with a novation function; i.e., a technology-driven solution using the new technology of smart contracts – this will need further exploration. Netting by CCPs presently provides a significant and very important liquidity efficiency and liquidity risks management in the market and facilitates a large degree of settlement compression on the exchange-traded volumes.

- **Outstanding considerations requiring more industry debate**

- Liquidity savings mechanisms for decentralized models of gross/gross settlement are yet to be sufficiently explored.
- Settlement on a T+0 (cash) is already possible today without CBDC and is the mandated standard in China for example. However, it is not conducive for cross-border investments where time zones differ significantly: e.g., an US investor investing into Asia markets.

- **Operational and technology risks, and liquidity costs**

- The operational, infrastructural, collateral and other costs to run a 24x7x365 cash (and securities) settlement system need to be better understood to ensure that the benefits outweigh the costs. This needs to be in reference to the whole ecosystem: i.e., the benefits must accrue to both the participants and the DLT system providers.
- Costs and risks from a lack of timely interoperability between tokenised and non-tokenised systems also needs careful consideration, especially where transactions are moving via 'on-ramp/off-ramp' models between fiat and CBDC for instance. This is especially true at the start of adoption where there will be a 'sunrise' challenge: i.e., some systems will adopt the new features first while other systems in the same ecosystem/value chain will lag, giving rise to the need for interoperability.

- New smart contract validation creates operational validation and compliance, as well as model risks (see below). The WG believes that this is particular to SC as it is unlikely that central banks would allow their CBDC smart contracts to be validated by the public.
- Liquidity costs are likely to rise as CBDC will need to be pre-positioned for the maximum intraday need in additional liquidity pools and failure to prefund could lead to contracts being revoked or penalties imposed. To be noted that 'prefund' in a highly digital environment can be in terms of minutes and a few hours, similar to today's practice of receiving cash: e.g., 30 to 180 minutes prior to market cut-off time for settlement. Therefore, 'prefunding' in this digital environment should not have similar liquidity costs than if prefunding was needed overnight onwards, but this is to be further investigated.
- **Regulatory / legal / compliance / reputational risks**
 - Legal basis of settlement finality needs to be established, particularly where transactions are across jurisdictions. This is a nuanced subject. For example:
 - If a transaction settlement occurs in the jurisdiction where the settlement venue is based, then the law should be as that jurisdiction for DvP settlement, even if a buyer is in Jurisdiction A, and the seller is in Jurisdiction B.
 - If the settlement venue is a Hash Timelocked Contract (HTLC) created by a suitably licenced financial market infrastructure, a licensed fintech venue or a licensed financial institution, then the venue law of such entities can cover the DvP finality. This is because there is always an entity that will be responsible for the HTLC.
 - In the case where the transaction is cross-border and say settling in a CHF-based token, then finality should be achieved in a similar manner as it is today. However, if the CHF CBDC is account-based there are further questions to resolve.
 - If the transaction is executed on a permissionless public blockchain, either privately agreed legal contracts that are clear on the point of DvP settlement finality, or some other explicit agreements, will be needed to avoid substantial lack of clarity. For example, an industry standard of what is the point of settlement finality in a permissionless public blockchain can be agreed to avoid disputes.
 - If executed on a permissioned blockchain, as long as it has rules similar to the present rules, finality would be confirmed.
 - New AML / KYC / CFT risks may arise if transactions occur on new non-permissioned networks, or even permissioned ones, if the permissioning body does not operate at the standard required.
 - Parties may see reputational and conduct risks with participating in non-regulated environments.

- **Technology risks**

- Smart contracts not only require model and code validation (formal proof) validation but also validation of the executing 'virtual machines' which run the smart contract models.
- Present regulations, such as those that align to IOSCO PFMI, require a level of resilience, recoverability, availability, and throughput which has not yet been tested in any of the experiments in CBDC of which the WG is aware.

It should be noted that as securities become natively issued on DLT-based ledgers as digital assets, then the need for liquidity networks that support the 24x7x365 and programmable nature of the digital world becomes essential.

Ongoing regulatory explorations (such as the EU's pilot DLT regime or the UK HMT's consultation on stabletokens) indicate a growing appetite from regulators for considering the use of digital currencies in enhancing wholesale settlement networks.

5.5 Further Implications on the Securities Market Ecosystem

As digital currency (and other digital asset) networks emerge and become adopted for securities settlement, it is likely that roles of existing financial networks and entities may undergo transformation. That transformation may be beneficial or a challenge to both the new entrants and the existing industry participants.

To explain these potential changes the WG has taken a simple equity trading example:

The investor is a US-based investment manager (US IM) with a global equity mandate. It wishes to purchase a foreign-listed equity for USD via an investment bank (IB) and hold that resulting position at their global custodian (GC) and the GC has a sub-custodian (LC) in the local market. The local market is cleared on a CCP. The main steps are:

1. US-based investment manager (US IM) issues buy order to an investment bank (IB)
2. IB routes order to exchange
3. Order is executed on the exchange
4. Exchange confirms transaction to the IB and passes the transaction to the clearing house
5. IB affirms trade to US IM
6. US IM allocates the trade to two funds and is matched by the IB
7. IB instructs their custodian to deliver the allocations to the US IM custodian(s)
8. IB receives margin call from clearing house and pays initial margin
9. US IM instructs the allocations to the global custodian (GC)
10. US IM executes foreign exchange transactions with GC for USD v traded currency
11. US IM instructs GC to deliver traded currency amounts to IB custodian

12. GC informs local custodian (LC) of the transaction and instructs the settlement of the allocations
13. LC and IB custodian match the allocations at CSD
14. Trades settle Delivery versus Payment (DvP) at CSD
15. Clearing house releases initial margin and variation margin
16. CSD informs LC that trades have settled
17. LC informs GC of settlement and new balances
18. GC updates the positions on the client holdings, including cash & CBDC holdings

In a world where CBDC are part of this flow in the foreign market but the underlying equity is still traded on an existing market, the roles and responsibilities only change slightly. In Step 10, the execution of the foreign exchange transaction would be USD v CBDC and settlement would still occur in the nostro of the GC (receive USD), but would be reflected in the CBDC wallets of the two funds. Potentially these wallets could be held at a different custodian in the foreign market and so, in fact, add another intermediary into the flow.

The cross-border post-trade industry would be radically different if the foreign equity market is also DLT-based with CBDC as the settlement currency, and direct access for the US IM who is also a direct settlement participant in the USD CBDC. This is a hypothetical scenario so does not consider the regulatory constraints.

1. US IM identifies the equity to buy and observes the market price.
2. Using that market price, the US IM executes purchase of CBDC versus USD to pre-fund the fund wallets on the DLT platform.
3. US IM informs nostro agent of USD v CBDC transaction and the nostro delivers the USD to purchase the CBDC.
4. US IM executes equity transactions on the DLT market for each of the underlying funds, they are affirmed automatically on the platform.
5. There is no clearing but atomic settlement occurs when the earmarked funds and equity match on the DLT platform.
6. The wallets are updated with the positions (CBDC and equity).

The WG is not predicting the world as it is presently seen, but rather is concurring with the BIS that the market is on a journey. Its work suggests that the following are examples of the roles and responsibilities that may change when tokenisation is present:

- Tokenisation of securities (the conversion of financial assets into digital tokens) could transform the way in which clearing and settlement of securities trades occurs, as well as the resultant roles of those involved.

- Tokenisation might reduce costs and complexity but does not eliminate the risks associated with one party failing to settle transactions.

In the WG's extreme, yet plausible, scenario, the following roles and/or the actors performing those roles could be changed: IB, clearing house, CSD, global custodian and local custodians. In addition to the BIS's prediction potential new roles are simultaneously created such as:

- CBDC liquidity provider: rather than the US IM identifying the amounts of CBDC required and pre-positioning the CBDC, can someone else do so cheaper and better?
- Wallet custodians
- Netting agents: as an IM may want to aggregate transactions throughout the day and only settle a final position
- CBDC/FX crossing providers
- Insurance of DLT platforms execution
- Order routing services between liquidity pools: as IB do today between liquidity pools
- Tokenisation of securities: the conversion of financial assets into digital tokens to enable settlement where securities are not natively issued as tokens
- Model validators
- Multiple organisations with CSD-like functionality: could coexist in one country processing instruments issued in another country
- The settlement venue may be able to handle the digital cash leg in addition to the securities leg if the settlement venue is a direct member of the CBDC clearing system: e.g., has settlement accounts with the central bank.

The success of token-based systems will depend on how well they interact with traditional account-based systems.⁴

An outcome may be that several new digital currency payment and settlement networks add further competition to the already fragmented ecosystem of FMIs (Financial Market Intermediaries). This may bring more competition but may also increase fragmentation and costs. The WG believes that establishing connectivity to emerging digital FMIs in a consistent manner will be essential both to prevent systemic risks and reduce costs; i.e., the emerging digital FMIs need to be built with interoperability in mind. This may be in direct conflict with their ambitions to become the 'hub' FMI.

⁴ https://www.bis.org/publ/qtrpdf/r_qt2003.pdf

This thinking is supported by further BIS work, where it suggests that Central Securities Depositories are, “*intermediaries [which] are important for the smooth flow of securities.*”⁵ Given the automatic nature of smart contracts, the role of a CSD could likely change in four principal areas:

- *Increased interoperability needs as there may be multiple securities settlement systems as opposed to the existing one or two CSDs in the market*
- *Less effort on operational record-keeping and a greater focus on oversight and platform controls*
- *Offering and supporting customized (shorter) settlement cycles*
- *Tokenisation requires aggregation of ‘sources of cash’ (SC/CBDC, Tokenised cash)”*

The WG would suggest in contrast that customized settlement cycles may need to be both longer as well as shorter, given the challenges of working across time zones. In summary, CBDC should offer new options, not necessarily triggering a mandatory replacement of the old ones. There also needs to be consideration given to data-sourcing for/from a smart contract so that the corporate action/event can be (risk) managed and correctly applied with the right tax treaties utilised and Withholding Tax (WHT) rate used.

As existing securities settlement systems adopt digital currencies, transitions from existing DvP processes will need to be carefully managed to ensure benefits accrue and additional risks are not created, or existing ones exacerbated. For example, one of the causes of settlement failure in today’s markets is misaligned stock: i.e., the buy is in a domestic CSD and the delivery is to be sent via an ICSD. In a world of digital currencies this could increase in complexity as both the asset and the funds may both need to be realigned instantaneously.

Several new digital asset/currency custodians have emerged globally and are gaining scale. In parallel, traditional securities custodians and settlement providers are also expanding to offer digital asset/currency custody services. Establishing consistent standards for depository safekeeping and settlement will be essential to the growth of this emerging ecosystem.

With the emergence of real time settlements, traditional segregations of roles in the trade and post-trade space can become blurred. For example, recent discussions in the EU’s pilot DLT regime have highlighted the possibility of a new integrated trade and settlement operator. This raises new questions about the management of systemic risks (e.g., from the use of data by a common operator).

⁵ https://www.bis.org/publ/qtrpdf/r_qt2003.pdf

The ability to embed conditional behaviour in digital systems offers new possibilities for the provision of traditional services like escrow services. Such services could be unbundled and provided by independent specialized operators and possibly under new legal frameworks.

Ultimately, these developments raise several new questions for industry debate:

- Would it be more beneficial to support the creation of new digital currency instruments (CDBC, SC) for settlement, or would enhancements to existing payment systems (e.g., RTGS networks) to provide 24x7 and programmable functionality be a better solution?
- How can the securities settlement ecosystem take better advantage of emerging functionality from digital currency systems? What are new programmability and digital features that are desirable and can fix today's challenges like time zone barriers to faster and safer cross-border settlement?
- How can emerging and potential systemic risks (e.g., fragmentation of liquidity, cybersecurity, loss of confidentiality, operating in a 24x7x365 environment) be managed through regulatory and legal standards?
- How would the roles of existing securities settlement parties change as a result of deploying digital assets and currencies, and how can transitions be effectively managed? These questions, although the WG has addressed the extreme scenario, will require further analysis.

In conclusion the WG is convinced that in the medium-term tokenised settlement will require interoperability with traditional securities settlement infrastructures.

5.6 Digital Money in Securities Financing and Collateral Management

Securities financing markets provide investors and firms with the ability to leverage the assets they own, including equities and debt securities, in order to secure funding by lending those assets to other parties as collateral and receiving cash in return. Securities financing involves:

- **Repo transactions**, which involve selling of debt securities with an agreement to repurchase in the future for the original sum of money plus/minus interest
- **Securities lending transactions**, involving lending of securities (typically equities) for a fee in return for a guarantee in the form of cash or other securities
- **Other securities financing transactions**, including buy-sell back, sell-buy back and margin lending transactions

Security financing transactions are often short-term and complex in nature, involving the movement of collateral and cash between the parties, their custodians, and agents. This, in some ways, explains why these transactions have been good entry points for DLT experimentation. However, if CBDC specifically were to be adopted on a wholesale basis for securities settlement, the expansion in activity would be beyond niche and/or tokenised use cases.

The digitisation of assets and transfer of assets in a distributed ledger network is helping to reduce operational complexities for market participants. It is evident that the use cases have been adopting tokenisation of assets and collateral settlement in DLT as the first step, before simultaneously settling the cash leg on the DLT platform. Delivery versus Delivery (DvD) has been relatively simpler to achieve than DvP, given that SC and CBDC are still evolving: Large scale adoption of DvP solutions which aids intraday liquidity using a SC or CBDC is likely to be dependent on the seamless integration between DLT networks and the existing payment rails. Products and marketplaces that engage a trusted third party, have a clear rulebook and which are aligned with regulatory and legal treatment are, in the view of the WG, more likely to be successful in the long run.

The emergence of digital money such as SC could potentially help achieve true DvP atomic settlement and hence accelerate the adoption of DLT solutions. The JPM intraday repo solution is a step in this direction with the use of the JPM Coin for the cash leg. Legal and regulatory treatment of SC is in its infancy and understanding the laws in various jurisdictions is imperative since collateral movements across borders represent a significant proportion of the market activity.

5.6.1 Key Trends and Challenges in the Securities Financing Markets

Regulatory requirements, reporting needs and margin pressure are driving firms to invest in improving their securities financing technology and operations.

Some of the key challenges facing the securities financing and collateral industry include:

- Lack of real-time visibility of available collateral resulting in lack of optimal allocation
- Limited transparency and information-sharing between institutions, resulting in increased collateral requirements and fees
- Rigid restrictions and inflexible settlement windows, settlement and transfers between custodians across geographies, resulting in higher operating and settlement costs
- Legacy technology, lack of a centralized view and manual workflows within firms and across firms in locating and exchanging assets, resulting in increased operational costs and dispute management

5.6.2 Distributed Ledger Technology in Securities Financing Markets

Distributed Ledger Technology (DLT) solutions are being developed to address some of the key challenges in the securities financing markets including real-time transparency, the possibility for instantaneous settlement and a single source of truth, resulting in significant reconciliation cost reduction. DLT expansion beyond the current range of securities financing products may be a direct result of CBDC expansion or, to a lesser degree, that of SC. Smart contracts that tokenise (or) digitise the collateral, offer the potential to immobilise these assets and track ownership rights on a distributed ledger.

This presents an opportunity for the market participants to demonstrate greater transparency, improve collateral mobility, liquidity, reporting capabilities and operational efficiency.

5.6.3 Benefits of DLT Solutions to Securities Financing Markets

DLT-based solutions with their inherent features of providing single source of truth, real-time transaction finality and immutability, can help address the challenges in securities financing markets and provide the following benefits:

- The current securities financing market has been tremendously successful in providing overnight and short-term funding, but operational limitations and the market structure limits its usage on intraday funding. DLT with digital representation of the asset and instantaneous real time atomic settlement provides participants the ability to exchange assets in a highly flexible manner opening new channels for intraday funding and liquidity. DLT networks can help participants improve their collateral mobility and access their collateral across multiple custodial locations, thereby reducing cross border funding needs.
- The securities finance markets are fragmented and involve significant manual operations in the execution, clearing and settlement of transactions. Multiple parties have their individual front, middle and back-office systems and have high level of interactions with their counterparties and service providers to manage the transaction lifecycle, resulting in high costs which results in margin pressure. There is also the operational cost and manual effort spent on reconciliation, margin call and dispute management. DLT and smart contracts can tokenize or digitise the asset, immobilize, and maintain ownership record at all times. This potentially helps multiple parties to view, execute and manage securities financing transactions in real-time, resulting in millions of dollars of savings in operational costs and reduced risk.
- Firms wanting to improve their liquidity tend to execute collateral upgrade transactions which allow the borrower to exchange poorer quality assets for better quality assets at a cost and by posting collateral. The current process is managed across a fragmented custody network and against a rigid settlement window. The settlement process is capital intensive for banks, consuming intraday liquidity and funding. Distributed ledger technology allows a digital representation or tokenization of a basket of collateral which can be swapped atomically. This increases regulatory transparency, tracks the collateral, reduces capital costs and allows real-time collateral upgrades.

5.6.4 Distributed Ledger Based Market Place

The 'network effect' of a DLT solution could potentially bring together various market participants including agents, custodians, buy side and sell side, into a secure network which could act as a marketplace for the execution of securities lending, repo, and potentially future digital assets including structured private placements. See Table 3 for current examples of which the WG is presently aware:

Table 3: Emerging use cases of leveraging DLT in securities finance (Source: [weforum.org](https://www.weforum.org))

	JP Morgan Onyx Intra-Day Repo	HQLAX	Broadridge Distributed Ledger Repo
Overview	JP Morgan’s Onyx division launched a DLT based intraday repo solution that enables firms to obtain a secured funding for their intraday requirements from JP Morgan. The solution settles both the cash leg and collateral leg in a DLT network with the cash leg represented by JPM Coin.	HQLAx is an innovative financial technology firm focused on frictionless ownership of assets and launched a DLT solution in partnership with Deutsche Boerse which enables firms to exchange baskets of securities across disparate collateral pools at precise moments of time.	Broadridge, working with Digital Asset, has built a DLT solution for broker/dealers to execute its intracompany and bilateral repo transactions. This enables clients to improve their collateral mobility, reduce operational risks and benefit from better liquidity and collateral management. The cash leg of the transaction settles outside the DLT.
Changes from Current State	Firms can now access an additional source of intraday funding via repo transactions on DLT which did not previously exist. Tokenization of collateral is performed by JPMC as a collateral token agent and JPM Coin (a stablecoin) is used to represent the cash.	Collateral baskets are represented as digital representations held by a trusted third party and distributed collateral registry across all participants. The immobilized collateral baskets can now be swapped between the participants at specified times of the day. The underlying asset is safely held with the custodian.	Digitised representations of the underlying collateral help immobilize the securities and the ownership is instantaneously transferred using smart contracts. The actual collateral is held at a segregated account by the custodian. Cash leg is prefunded.
Proposed Benefits	Enable intraday funding and instantaneous settlement.	Transfer of ownership at precise time of the day, reduction in intraday liquidity requirements and intraday credit exposures.	Real-time transparency, risk and cost reduction, Improved operational efficiency and better optimization of collateral allocation.
Future Roadmap	‘Go Live’ planned for 2021. On-boarding and uptick of clients for liquidity.	Expand the network, further use cases including pledge.	Expand the network and explore cash leg settlement in the DLT.
Risks and Challenges	<p>Early adoption of the DLT platforms by firms and obtaining comfort with the new technology is critical for success. The platforms must build comfort for firms with the technology, legal and regulatory treatment of the new technology and tokenised assets. It is also important that clear operational benefits are realized.</p> <p>Interoperability between various distributed ledgers does not exist today and this will lead to fragmentation of the new networks, diminishing the potential value that DLT offers.</p> <p>Atomic DvP settlement in DLT is still in its nascent stage as CBDC and SC are still not available for large-scale institutional adoption. The DLT solutions presently require prefunding by market participants.</p>		

5.6.5 Summary and Items for Consideration

Distributed Ledger technology adoption in securities financing markets has found interest and enjoyed initial success. The solutions mentioned above are either already live or will go live in 2021.

As the industry explores DLT and digital money for addressing requirements in the securities finance market, there are a few open items that require thoughtful consideration and leadership:

- How would the presence of a 24/7 settlement network change the securities finance and collateral market? Would it improve liquidity and make it more efficient to move collateral globally and enable intraday trading?
- How will the tokenised markets co-exist with traditional markets? Will there be a fragmentation of liquidity? Will this lead to arbitrage opportunities?
- Will there be a greater bundling of custody, collateral, prime brokerage and execution services in the tokenised securities market? Could this create ‘walled-garden’ models?
- How do providers deal with the legal/regulatory challenges in a distributed world, i.e., enforcing the collateral agreements in case of default or proving that the fiduciary duties have been discharged?

5.7 CBDC - Functionality

5.7.1 Essential Characteristics for Success and Test Cases

The WG has identified several key ingredients necessary for CBDC success; i.e., the core functionalities that a CBDC must possess in order to be useful. ISSA has identified three that are worthy of particular focus:

1. Availability in multiple currencies (such evidenced by BIS mCBDC and Project Dunbar)

To be most useful in the context of cross-border PVP and DvP, a harmonized rollout of interoperable CBDC denominated in several currencies is preferable. These would need to have strong governance, rule books and legal and operational underpinnings. If this feature was present, it would enable instant cross-border payments, facilitating greater access to secured funding and reducing settlement and counterparty credit risk.

2. Interoperability with other systems

To improve the efficiency of payments and enable multi-currency PVP and DvP transactions, CBDC must be designed with interoperability in mind – not just with one another, but also with other applications and legacy networks (CBDC enabled DvP with existing securities), securities settlement, collateral management, asset tokenisation and more.

Without robust efforts to ensure that a CBDC is interoperable both with other CBDC and with other existing and emerging business applications, its potential impact will be severely undermined.

The public sector needs to take the lead in the regulation, cross-border treaties and laws, to allow the CBDC interoperability to be successful. If required, the private sector’s experience in the areas of cross-border coordination, technological expertise and the development and preservation of the integrity of underlying system protocols will be available to assist any deployments, and it is likely that partnerships will benefit all involved participants.

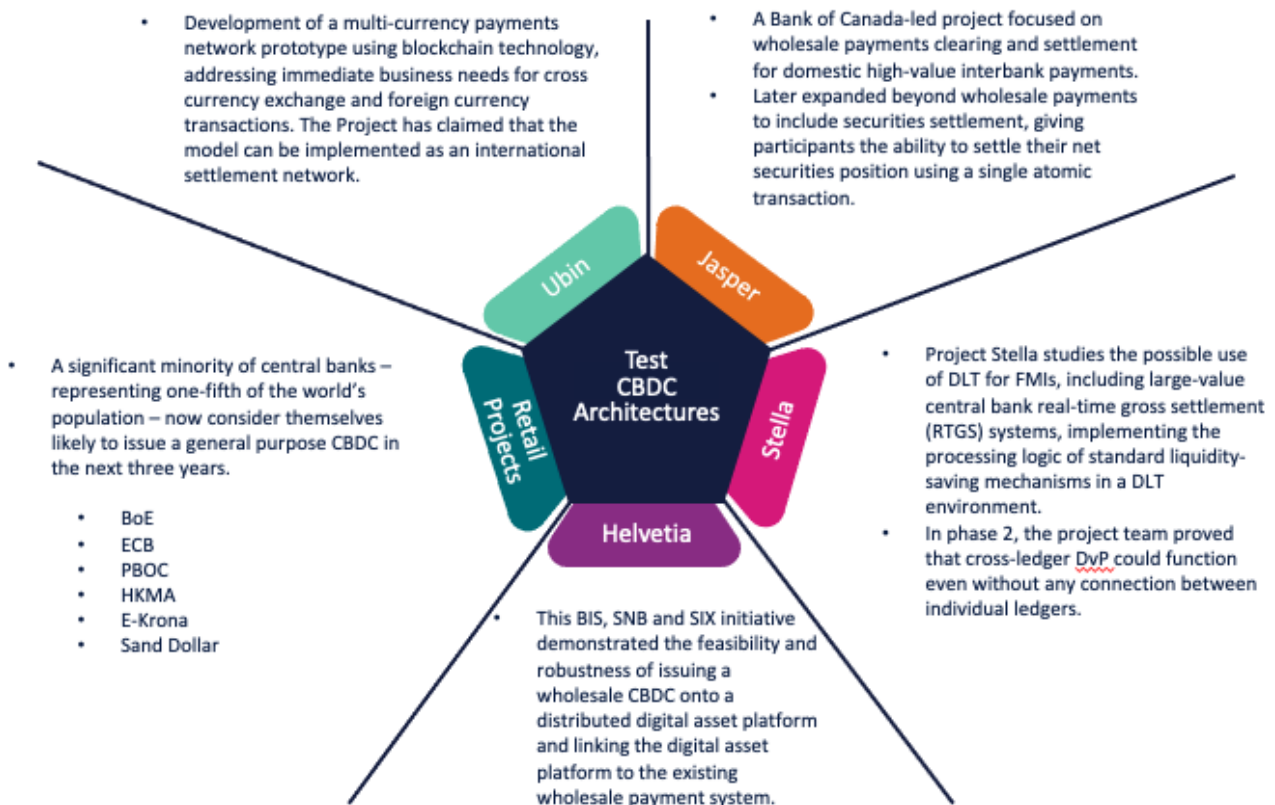
3. International accessibility

In an optimal world, CBDC would offer a secure way to expand access, allowing selected non-resident institutions to hold and transact in CBDC, while preserving regulatory and prudential boundaries.

Test CBDC projects to date

Several high-profile projects have explored and proven the potential benefits of CBDC, as detailed in the infographic below:

Figure 2: Public test CBDC projects to date



However, most of these projects are research phase engagements only – they are theoretical and are not platforms that have been proven to be commercially, legally or regulatorily viable at this point in time. Private sector firms have looked to take the many findings from the project reports into CBDC experiments and have progressed and implemented them to prove the concepts in real-world scenarios.

Despite their usefulness, many of the projects outlined above focus heavily on the technological concepts of an on-chain financial network and how different trusted banks (and other third parties) will interact with such a network. However, these projects have remained silent or vague on many of the key challenges, such as:

- **Governance:** there is little clarity on where accountability for the payments network sits. Is it the issuer onto the ledger, or is it the participants who make payment transfers?
- **Permissioned versus non-permissioned:** some experiments have used an underlying ledger which is non-permissioned but have not clarified or discussed the ensuing implications. While there have been suggestions that the protocol would be open source, the challenges of accountability, privacy, determining trust...etc, on a non-permissioned ledger are not touched upon.
- **Regulatory status:** who will supervise a global interoperable blockchain? There is a suggestion that it could be overseen and governed like SWIFT, but it is not clear how. There is also an assumption that central banks could come together to agree on a model, but this would appear to be a long-term endeavour.
- **Issuance:** both central banks and commercial banks would be able to issue onto the same blockchain to enable PvP. It is not clear how this will be done, how the interaction between currencies will work and what controls will be put in place.

5.7.2 Regulation and the Importance (and Difficulty) of Standards

The general regulatory attitude towards CBDC is, at this stage, one of it having some potential as part of the financial ecosystem, although most central banks are currently in investigatory mode. Nonetheless, CBDC are viewed as a potential way forward into the digital economy, keeping the central banks and their respective national currencies relevant and at the core of their respective economies, while increasing consumer choice, reducing transaction costs and supporting the economy's⁶ digitisation.

Central banks are cognisant of their responsibility to investigate in detail the possibility of CBDC and to make clear informed judgements, whilst carefully considering the wider potential impacts, including to monetary policy. It is also clear that international cooperation will be key in shaping the future of CBDC⁷.

⁶ [Fabio Panetta](#), "Evolution or revolution? The impact of a digital euro on the financial system", 10 February 2021

⁷ [Codruta Boar and Andreas Wehrli](#), "Ready, steady, go? – Results of the third BIS survey on central bank digital currency", BIS Papers No 114, January 2021

CBDC are being considered – and in some cases, developed – across jurisdictions at different paces, with different circumstances and motivations specific to each jurisdiction, for instance, financial inclusion [The Bahamas], enhancing payments [Cambodia – though perhaps not strictly a CBDC], or ensuring continued access to state money issued by the central bank due to a decline in the use of banknotes and coins [Sweden], in contrast with safeguarding monetary sovereignty in the face of ‘digital dollarization’ [China]. Such deviations in motivation may result in deviations of CBDC design, for instance, in determining remuneration rates, holding limits, or access.

The motivations for research into CBDC are diverse, but there are core commonalities in the public policy objectives of central banks. From these, a group of seven influential central banks, including the Bank of England, the European Central Bank, and the Federal Reserve, together with the BIS, recently derived a set of [three foundational principles](#):

- **“Do no harm”**: new forms of money supplied by the central bank should continue supporting the fulfilment of public policy objectives and should not interfere with, or impede, a central bank’s ability to carry out its mandate for monetary and financial stability.
- **Coexistence**: different types of central bank money – new (CBDC) and existing (cash, reserve, or settlement accounts) – should complement one another and coexist with robust private money (e.g., commercial bank accounts) to support public policy objectives.
- **Innovation and efficiency**: the payments ecosystem is comprised of public authorities and private agents (e.g., commercial banks and payment service providers). There is a role for the public and private sectors in the supply of payment services to create a safe, efficient, and accessible system.

Furthermore, the BIS Innovation Hub Hong Kong Centre, together with the Hong Kong Monetary Authority, the Bank of Thailand, the Digital Currency Institute of the People’s Bank of China and the Central Bank of the United Arab Emirates, have been working together to build a prototype CBDC platform, called ‘mBridge’. This project has also identified core principles that should exist for common interoperability:

- **Competition & Consumer rights**: CBDC supplied by one central bank should not disrupt other central currency sovereignty and their ability to fulfil monetary and financial stability mandates, and meanwhile should protect the legitimate rights of consumers such as data privacy and security and boost fair competition.
- **Compliance**: cross-border CBDC payment arrangements should have a sound legal system and a stable operation system, and should comply with the regulations and laws of the jurisdictions concerned; for example, capital management and foreign exchange mechanisms. Information flow and fund flow could be synchronised so as to facilitate the advancement of cross-border trade, bolster the development of real economy, and meet the regulatory requirements for anti-money laundering and countering terrorist financing.

- **Interoperability:** the development of CBDC should fully tap into the role of the existing infrastructures and leverage fintech so as to enable interoperability between CBDC systems of different jurisdictions, as well as between CBDC systems and traditional payment systems. Meanwhile, the development of the CBDC should contribute to the orderly development of the payment system and guard against market fragmentation.

The use case/motivations, operational and technical design of a CBDC will potentially inform the treatment of the CBDC in regulation and law, both domestically and internationally. For instance, the ECB, in its [report](#) on a digital euro, noted that retail access to a CBDC would entail considerable legal novelty, whereas non-retail access (i.e., where access is only granted to entities who already have access to central bank money), would be more straightforward since this would be more similar to present practices. Furthermore, regarding cross-border usage, the more currencies and jurisdictions there are, the more complex the legal and regulatory treatment: i.e., the difficulties of developing a safe and efficient international system are made more complex by divergence in the legal systems and regulatory approaches of different jurisdictions. Nonetheless, a key question to consider might be whether CBDC should be treated with the equivalent regulatory and legal standards as existing central bank money or digital money, or whether CBDC should be recognized in its own right, since it places a similar claim on central banks as existing central bank money, but with a new digital dimension.

The successful issuance of a CBDC will require a robust and unambiguous legal and regulatory framework, as well as multilateral coordination and governance of such arrangements. At the time of writing, under the FATF's guidance on virtual assets and virtual assets service providers, CBDCs are not virtual assets and are to be treated similar to any other form of fiat currency issued by a central bank. However, key regulatory proposals such as the UK's potential regulatory approach to crypto-assets and SC, and the EU's Regulation of Markets in Crypto-Assets (MiCA) are still in debate and do not set out a clear or coordinated path for the regulatory treatment of CBDC. Note that the UK's proposal introduces a new category of 'stable tokens', which includes 'tokenised forms of central bank money', whereas the EU's MiCA proposal may be read as excluding any crypto-assets that may eventually be issued by central banks acting in their monetary authority capacity and any services related to crypto-assets that central banks may eventually provide.

ISSA outlines a high-level set of legal and regulatory considerations that a CBDC might generally face:

1. Central bank authority/mandate

The legal authority of central banks to issue a CBDC remains unclear in many jurisdictions. The [BIS](#) survey of central banks identified that 26% of central banks do not have the authority to issue a CBDC and about 48% remain unsure. Similarly, the IMF noted that among the 171 central banks of the IMF membership, only 23% of central bank laws allowed directly for the issuance of currency in a digital format, with 16% of central bank laws unclear as to whether they authorize the issuance of a digital version of central bank currencies. Without a clear and explicit mandate to

issue a CBDC, questions and concerns may arise as to the legitimacy of such a currency, which could affect the claim on the central bank represented by a CBDC.

2. Governance of system

The establishment of a new CBDC and its supporting infrastructure and ecosystem raises the question of governance, and whether a cross-industry or cross-jurisdiction governance framework will be required. Roles and responsibilities within the system will need to be clearly delineated, with corresponding legal mandates and sufficient oversight.

3. Interoperability

- Technical and operational standards and expectations may need to be set out in law or regulation, to ensure minimum standards of robustness, security, resilience and interoperability (with legacy systems, other forms of CBDC, or other forms of both public and private money).
- Interoperability considerations may extend to cross-border legal and regulatory compatibility, for instance, where jurisdictions might also have to consider how domestic laws and regulations view and treat foreign CBDC. The BIS recognizes that different legal and regulatory frameworks are significant obstacles to cross-border payments and expects international policy coordination on CBDC to intensify over the coming years.

4. Other areas of law

- **AML / CFT / KYC requirements:** digital ID is a rising issue in certain jurisdictions such as the UK and will aid in meeting AML / CFT / KYC requirements. Digital ID may also be central to the design and controls of a CBDC, e.g., in providing national access or restricting foreign access to a CBDC.
- **Prudential requirements:** should a CBDC's infrastructure be considered national or systemically important infrastructure, prudential measures may be applied to participants, e.g., maintenance of capital adequacy and liquidity assets.
- **Intermediaries' distribution / access:** a level playing field will need to be created and enforced across new and existing entrants within the CBDC structure, for instance, between financial institutions and non-bank payment providers.
- **Privacy and data protection:** a balance will need to be struck between privacy and AML/CFT requirements. Furthermore, the emphasis or value placed on privacy and data protection will probably be a jurisdiction-specific choice, and variations may impact the international interoperability of national CBDC.
- **Several other potential legal areas of interest regarding CBDC, including:** currency controls, tax law, property law, contract law, payment systems and settlement finality law, insolvency law, private international law and criminal law.

However, the aforementioned diversity in motivation for the issuance of a CBDC – as well as the divergent design decisions evidenced in test implementations – may make it difficult to achieve the standardisation of terms and protocols which are the fundamental pre-requisites for successful interoperable implementations.

- **Cross-border harmonisation:** wholesale CBDC that are designed and issued independently by individual central banks might find difficulty in leveraging cross-border use cases, including multi-currency Payment v Payment (PvP) solutions. Different jurisdictions operate under different legal regimes, agreeing on a coordinated system of oversight would certainly not be simple.
- **Interoperability with other systems:** even in the domestic context (as well as cross-border), interoperability with other settlement systems for Delivery v Payment use cases will face similar challenges. In particular, emerging tokenised markets are experiencing rapid growth, driven by private sector innovation. Public institutions such as central banks may find the rapid development and iteration required to meet the needs of such markets stretching beyond their traditional areas of expertise.
- **Technical coordination / integrity of protocol:** if a wholesale CBDC or renewed RTGS system is to be DLT-based, maintaining and coordinating a community of nodes/participants and ensuring the ongoing integrity of the protocol is likely to be more readily achievable by private sector providers with prior experience of doing so with central bank and/or ‘traffic cop’ oversight. This model has successfully trialled over many years, with organizations such as CHIPS, ACH, BACS, CLS all are ‘controlled’ by the private sector but regulated by a central bank or a collective of central banks (CLS).
- **Risks associated with widening access:** widening access to central bank money is a decision that comes with risks, particularly if done so in a ‘big bang’ manner rather than gradually. Private sector organizations may be better placed to undertake the burden of assessing suitability through KYC/AML checks...etc, than public sector actors.

Private sector actors have concurrently been developing their own solutions to make wholesale financial markets safer and more efficient. Many of these solutions recognize the criticality of wholesale payments to the global economy and there are presently some SC in use for the securities markets.

Both private sector solution SC and CBDC may play a part in the future of the securities markets. As noted earlier, there are very significant differences in the risk profiles and the WG believes that CBDC will be a catalyst to speed up adoption of the potential benefits of a digital marketplace. The evolutionary path of digital money is not easy to predict, however, the WG believes that public and private sector partnerships might ultimately be the best long-term solution.

6. Conclusions & Proposed Next Steps

As far as wholesale CBDC is concerned, and given the use cases explored in this report, it is important to summarize the potential impact of CBDC on incumbents as well as new entrants according to two 'extreme' scenarios, namely:

1. **Status quo:** there are several niche securities finance, and other, use cases which become tokenised over time; however central banks do not adopt CBDC over the next decade; or
2. **CBDCs:** implemented in wholesale securities markets as a national/internationally coordinated strategy by central bank(s).

The possible outcome for broker/dealers and exchanges is potentially much narrower in the first scenario. The WG has already seen the adoption of tokenisation within the securities financing arena being applied within the securities leg of a transaction. Furthermore, the tokenisation of cash in the form of CBDC may increase the uptake of these solutions, as both sides of the exchange can happen simultaneously on a singular DLT. The WG can also see this being applicable to cross-border collateralisation, as well as foreign exchange transactions, to mitigate Herstatt risk.

The second scenario potentially has a greater impact across a wider set of use cases for broker/dealers. One often-cited improvement is that of greater transparency throughout the value chain, as each entity that operates on a DLT utilising a CBDC (or other on-chain store of value) knows the status of any transaction at any point in time. It can therefore be construed that the efforts required for reconciliation can be substantially simplified, if not eradicated. These changes could be a function of the reduced number of intermediaries involved or the ability to see where the issues are originating in a transaction.

One of the overall benefits for all parties in the value chain would be the settlement in CBDC, which effectively produces DvP1 (in central bank money) in all spheres where CBDC is issued for use to settle wholesale transactions rather than retail transactions.

For broker/dealers, other impacts are a function of utilising a DLT environment, including CBDC, as well as the use of CBDC. One of those impacts (without the use of smart contracts or other mitigating factors) may be a loss of netting benefits. Even if transactions have higher individual velocity, this may not offset the impacts (certainly for high volume transactors) of the loss of netting. Increased transaction velocity should theoretically improve liquidity, but without substantially more quantitative analysis, the interplay between these factors is hard to anticipate.

One of the features that broker/dealers may be able to benefit from is the increased options for DvD of asset classes routed via a DvP CBDC-linked transaction; i.e. if assets being crossed on different DLT platforms, but both having a CBDC leg, then the friction and uncertainty is reduced as one asset is being exchanged for another via a CBDC which will not alter in price during the transaction's life cycle.

Other implications for broker/dealers or exchanges may be the ability to operate a digital asset platform. This may include platforms trading asset liquidity pools against a wholesale CBDC, and additionally the ability to directly access a securities wallet and financing at the CSD, directly or via a custodian.

In addition to the various macro drivers for a central bank to adopt a CBDC, the use of CBDC for market surveillance in a limited rollout could be a useful model to observe the impacts, in a quantitative manner, of the adoption of additional use cases. As mentioned previously, the WG believes that interoperability will be a key feature of any cross-border use case. This interoperability could improve the ability of the CB to observe changes in the balance of investment behaviours in real time.

The adoption of a CBDC could be the harbinger of a more significant role for CBs, not only in governance but also in operational aspects. It is not inconceivable that, going forward, the CBs will have a much more significant role in the technology underpinning the Currency Supply Chain and transmission. This may not be a role that they necessarily wish to embrace. However, the governance and ‘traffic cop’ role of a wholesale CBDC interaction may be one in which the CBs see a need to be heavily involved.

Even in a solely wholesale CBDC implementation, there are decisions to be made by the CBs, e.g., will they use the capabilities of the CBDC to monitor AML, or use specialist firms to provide that function as service providers? Furthermore, as seen in the Euroclear and Banque de France case study, central banks could be wallet managers for CBDC, working with CSDs as wallet managers for securities, or potentially integrating these functions.

The custodian community is likely to be heavily impacted in either scenario. Some of these changes have already been seen with some custodians offering digital wallet services and the custody of tokens themselves. Several custodians are operating within the ecosystems, providing SC and experimenting with CBDC at the time of writing, and it is highly likely that the lines between fintech and custodians will become further blurred. This can be seen with the adoption of certain use cases by the custodians, whether in financing or elsewhere.

A more radical path is one where custodianship could fundamentally change with an even heavier focus on value-add differentiating services for customers. These could include accessing/leveraging bank balance sheets (Balance Sheet as a Service), reporting, fund accounting, and valuation services. Meanwhile, the assets and CBDC sit on a DLT that the custodians can interact with, but do not ultimately control. As with broker/dealers, this has implications for reconciliations and many other services provisions.

The impact on Central Counterparties (CCP) can offer an equally divergent future. One option is that the CCP may have little change to make, but to interact with the CBDC on a real-time basis, providing the ability to call and receive collateral postings immediately. In the more extreme scenario, one perceived limitation of CBDC, at least within a DLT framework, would be its ability to novate transactions within the recognised and regulated framework of CCPs. A CCP could potentially net transactions on a national/international blockchain network or partner in the outcome of a ‘netted’ smart contract

transaction or potentially, in extremis, evolve from its current state if netting is replaced by Real Time Gross Settlement of Securities in a T+0/instant settlement regime. Functions could be ‘bundled’ into future Digital FMIs, where the securities wallet manager performs both the traditional netting functions of a CCP, as well as the traditional CSD functionality, at the same place.

The role of Central Securities Depositories (CSDs) is evolving, although the functions that CSDs play will remain necessary as the market progresses. CSDs globally continue to consider future steps and evolution with regard to new technology. As providers of securities services and DvP transactions, CSDs are considering potential scenarios in which the payment aspect of DvP takes place with a CBDC. Given its membership, ISSA will continue the discussions regarding the potential impacts CBDC implementations may have on CSDs. Any such CBDC scenario impacting securities settlement will also need to co-exist with current settlement conventions for many years, thus interoperability strategies will also be key areas for discussion within ISSA.

The WG can see two possible paths: (i) more tokenised transactions are either processed at an omnibus level or (ii) flows move to an account-level individual gross movement, if they are the infrastructure operators for the DLT systems. It is more likely that a mix of these two scenarios occurs over time. Potential CSD models could include the redesign of core clearing and settlement (to be both applicable in the traditional model and a DLT ecosystem model for specific use cases) and the build of a parallel infrastructure such as a ‘Digital CSD’ for tokenised assets.

In the extreme scenario, CSDs will probably play more of the ‘traffic cop’ role as described in this report and, from a regulatory standpoint, CSDs are well positioned to perform this function. Furthermore, CSDs may have the potential to truly facilitate T+0/instant settlement through more direct participation at the CSD via wallet access (see the Euroclear and Banque de France CBDC case study) and to be more central in liquidity and automatic collateral management through smart contracts. These smart contracts would interoperate into CBDC and ultimately offer an enhanced risk management solution to markets, for example, allowing services such as automatic repurchase agreements, collateralization or customized settlement. CSD roles might also include serving as the wallet manager for the securities leg of a settlement (where the central bank is the wallet manager for CBDC).

For fintech providers, the first scenario sees more of a focus on creating niche products connecting to incumbents or fulfilling unmet needs that exist in the present securities ecosystems and perhaps bridging the time gap with SC solutions until CBDC are available to fulfil these needs. The solutions with lasting value are those that provide an answer to a problem which is unlikely to be the focus of a wholesale CBDC rollout. These firms will have the opportunity to keep capturing volume from inefficient (slow, lacking innovative products and/or expensive) traditional markets.

In the second scenario, the WG sees the fintech providers becoming more direct market participants with new and improved products leveraging CBDC and custodians. Traditional payment networks may settle CBDC and SC on their networks and allow their merchants to accept CBDC and SC as a form of payment. If this is the case, is there an

opportunity to pay a routine bill with CBDC, sourced from an individual's securities holdings, being used as collateral in real time?

fintechs are moving up the value chain by offering a wider array of financial products and leveraging blockchain more broadly. With the fiduciary responsibility expanding, the WG would expect to see the application of similar regulatory and prudential rules.

Impacts would be felt within the payment provider ecosystems and for market utilities such as SWIFT, but these are not the focus of this report.

- In conclusion, the WG believes that:
 - There is no 'one-size-fits-all' at this point.
 - There are both opportunities and considerations for existing business models for incumbents along the value chain of securities settlement. At a minimum, these firms should consider having a distinct DLT strategy in place given both scenarios laid out in this report.
 - Central banks have a vital, indispensable role to play in bringing trust, stability and regulation to any CBDC initiative. This is not just an area in which they have an advantage, they are quite literally the only ones who can do it. Private sector actors must seek to innovate within their regulated framework.
 - CBDC issuance is a core functionality of central banks and therefore the full control must be with them.
 - There is value in digitising the securities market. To quote from the Euroclear and Banque de France paper: *"Our experiment also highlighted that the full value of blockchain cannot be realized by simply replicating 'as is' the securities settlement operations processes. However, enabling direct access by end investors on the blockchain platform via their custodians and/or removing the current post trade processing breaks, would allow blockchain technology to significantly improve post trade operations. This could then remove reconciliation processes, reduce the overall cost and increase the efficiency of the capital markets."*
 - The industry (ultimately) has more questions than answers, including whether SC and CBDC can ultimately co-exist?
 - The WG believes that private sector innovation has helped shape the debates that are now ongoing and should be embraced by public institutions.
 - Cross-border interoperability is a key enabler to reduce the risk in cross-border transactions, including the reduction of Herstatt risk.
 - The role of incumbents is likely to change given the scenarios described earlier, furthermore:
 - Some new fintech entrants are likely to play a more prominent role going forward in partnerships, either by being leveraged or by leveraging incumbents.

- Some incumbents will need to pivot their existing business models, potentially adding further competition to the already fragmented ecosystem of FMIs or emerging Digital FMIs.
- Traditional segregations of roles in the trade and post-trade space could be blurred leading to new integrated trade and settlement operator(s).
- DLT securities settlement is a worthwhile aim and CBDC is a critical and likely enabler (catalyst) for DLT-based securities settlement and collateral management. Both securities and collateral are pushing in a similar direction – towards tokenisation. The WG conclusion is that CBDC would accelerate the tokenisation of securities but may not be a necessary condition, as properly regulated and supervised SC solutions may offer alternatives, even before a CBDC is implemented.
- Regulation should be based on risk mitigation, and activity base regulation is appropriate for all market participants who have a fiduciary duty to their clients.
- Instead of disintermediation (particularly of banks), we may see a ‘bundling’ of services as the business case is key for the ecosystem.
- Further research to be conducted:
 - Roles which could change/be created for incumbents, central banks and new market participants (i.e., ‘Traffic Cop’ at regional/international levels or the impacts on the CB, including hours of operation, new accounts...etc), as well as the resultant new policies and operational considerations. For example, what if central banks were to play the role of super-correspondent banks which can remove credit and KYC concerns of intermediary layers, and as such, possibly bridge the time zone gaps to allow faster DvP settlement, e.g., Project LionRock between HKMA and BOT.
 - A conceptual look at a digital FMI of the future.
 - Detailed analysis of the requirements for interoperability (key for adoption).
 - Cross-border usage could see wider use of a national currency (e.g., Panama’s use of the USD) – the implications of this would require deeper research.



Appendix

APPENDIX 1

Glossary of Terms

Application Programming Interface (API)	A set of sub-routines definitions, communication protocols and tools for sharing data between different systems.
Account-based CBDC systems	Distribution of the CBDC will involve the transfer of a claim recorded on one account to another account at the CB.
Asset-backed tokens	Tokens backed by holdings of underlying assets. See ‘Digital non-native (or asset-backed) tokens’.
Asset Tokens	These tokens represent assets such as participations in real physical underlyings, companies, or earnings streams, or entitlements to dividends or interest payments. In terms of their economic function, the tokens are analogous to securities.
Bitcoin	A crypto-currency issued on the first public blockchain network created in 2009 that aims to compete with fiat currencies as a means of exchange. It has no intrinsic value, asset backing or links to other projects, and is not backed by any authority such as a central bank. Bitcoins are not securities, but commodities (at least within the USA).
Blockchain	A database that places records of transactions in blocks on a DLT network. Each block is linked (or ‘chained’) to the previous block, using cryptographic signatures that make the transactions they contain immutable. This allows blockchains to operate as distributed ledgers, which can be shared with anyone without fear that the data they contain will be manipulated.
Central Bank Digital Currency (CBDC)	A fiat currency issued in digital form, backed by a central bank.
Crypto-asset	Includes payment tokens (central bank digital currency, stablecoins and crypto-currencies), securities tokens (digitally native or asset-backed) and utility tokens. A crypto-asset shares the characteristics of a digital asset (see below) and, in addition, allows for issuance, termination, ownership and transfer of ownership to be guaranteed via cryptography.
Crypto-currency	Often used as a synonym for payment or exchange tokens to distinguish them from utility or securities tokens.
Digital asset	An asset in binary form that comes with a right to use, that has clearly defined notions of issuance, termination, ownership, and transfer of ownership, a definable monetary value, which may be between specific counterparties, and which may be based on a right to use or may be based on the principle of limited supply. A digital asset is not necessarily analogous to a security.
Digital asset securities	Digital assets which are securities.
Digital token	A transferable unit generated within a distributed network that tracks ownership of the units, usually through the application of blockchain technology.
Digital currency	A currency which does not exist in physical form.

Digital financial asset	A term used to distinguish financial assets in digital form from other assets, such as images, videos and texts that are also rendered in digital form.
Digital native tokens	Digital assets that originate on a distributed ledger.
Digital non-native (or asset-backed) tokens	Assets represented digitally on a distributed ledger.
DLT asset	An asset transacted on a Distributed Ledger Technology (DLT) platform.
DLT system	A system of electronic records that enables independent entities to establish a consensus around a shared ledger without relying on a central authority to provide or authenticate the authoritative version of the records. The consensus is established by the authoritative ordering of cryptographically validated ('signed') transactions made persistent by replicating the data across multiple nodes and tamper-free by linking them via cryptographic hashes. The shared result of the consensus process serves as the authoritative version of the records.
DvP1 (Delivery versus Payment model 1)	A securities settlement mechanism that links a securities transfer and a funds transfer in such a way as to ensure that delivery occurs if and only if the corresponding payment occurs. DvP1 typically settles securities and funds on a gross and obligation-by-obligation basis, with final (irrevocable and unconditional) transfer of securities from the seller to the buyer (delivery) if and only if final transfer of funds from the buyer to the seller (payment) occurs. [Source: BIS, 16 Jun 2015]
DvP2 (Delivery versus Payment model 2)	A securities settlement mechanism that links a securities transfer and a funds transfer in such a way as to ensure that delivery occurs if and only if the corresponding payment occurs. DvP2 typically settles securities on a gross basis, with final transfer of securities from the seller to the buyer occurring throughout the processing cycle, but settles funds on a net basis, with final transfer of funds from the buyer to the seller occurring at the end of the processing cycle (BIS 16 Jun 2015)
Electronic currency	Synonymous with digital currency.
Ethereum	A public blockchain network launched in 2016, and a crypto-currency that aims to compete with fiat currencies as a means of exchange. It has no intrinsic value, asset backing or links to other projects, and is not backed by any authority such as a central bank. Ethereum is not a security but a commodity (at least within the USA).
Fiat currency	Domestic legal tender that is issued by governments rather than backed by a physical commodity such as gold.
Fork	A 'hard fork' can be defined as a software change to the DLT protocol that introduces a permanent split between the new and the old protocol, making them incompatible (backward incompatible). A 'soft fork' can be defined as a change to the DLT software that is 'backward compatible' meaning that unlike 'hard forks', there is no splitting or branching out of the blockchain.
Fungible token	A token that is interchangeable with an identical token and divisible into smaller units.
Litecoin	A crypto-currency that aims to compete with fiat currencies as a means of exchange. It has no intrinsic value, asset backing or links to other projects, and is not backed by any authority such as a central bank.

Non-fungible token	A token that has unique characteristics which make it neither interchangeable nor divisible into smaller units. CryptoKitties is an example.
Repo markets	A repurchase agreement is a short-term loan, collateralized with securities, with an agreement to buy back (or repurchase) the securities. Typically, securities are exchanged for cash and most often the collateralized securities are high grade government issued debt instruments. Repo transactions are conducted either in a bi-lateral manner between the counterparties (or) in tri-party basis where a clearing bank or agent acts as intermediary between the counterparties. The tri-party agent manages the collateral selection, substitution, valuation, margin management and life-cycle management for a fee.
Payment tokens	These are synonymous with crypto-currencies or SC and have no further functions.
PMI	Payments market infrastructure, such as the Real-Time Gross Settlement Systems (RTGSs) , operated by central banks or the Automated Clearing Houses (ACHs) , used by commercial banks to net payments prior to submission to an RTGS.
Securities Lending Markets	A securities lending transaction involves collateralized lending of specific securities by the owner to another party in exchange for a fee. Cash or other securities are generally used as collateral. The securities lending transaction allows owners to earn additional return on long term assets. Custodians play a significant role in securities lending by acting as securities-lending agents by providing services to asset owners looking to lend their securities.
Securities token	A token giving the holder an entitlement to underlying assets, companies, earnings streams, dividends, interest payments or other tokens. They are sometimes treated as securities.
Smart contract	Self-executing computer code that performs pre-defined tasks based on a pre-defined set of criteria or conditions. Smart contracts cannot be altered once deployed, since only this can guarantee faithful fulfilment of contractual obligations. A smart contract could, for example, be used to instruct a regular interest payment on a bond to be made to registered investors.
Stablecoin	A class of crypto-currency designed to eliminate the price volatility of crypto-currencies by backing them with real assets, fiat currencies or a mixture of both. A SC whose price reference is the US Dollar, for example, would be backed 1:1 by US Dollars in a custody account. Investors redeeming the SC would receive one US Dollar for each SC.
Token-based CBDC Systems	Is the digital version of cash. Users would be able to withdraw digital tokens from banks and they would be exchanged outside of the central bank's accounts.
Token versus Token (TvT)	Entirely digital transaction settlement on a DLT network in which the exchange of value is made between an asset-backed or digital native token and a payment token.
Tokenised securities	A term used to distinguish tokens regulated as securities from tokens which are not regulated as securities. However, they can encompass asset classes that are not generally securitised, such as fine art and real estate.
Utility token	Tokens which are intended to provide digital access to a current or prospective application or service.
Virtual currency	Synonymous with crypto-currency
Wholesale CBDC	CBDCs designed for use among financial intermediaries only

APPENDIX 2

References

Future of settlement: https://www.bis.org/publ/qtrpdf/r_qt2003i.pdf

IMF on key considerations: <https://www.imf.org/~media/Files/Publications/FTN063/2020/English/FTNEA2020001.ashx>

Banque de France and Societe Generale experiment: <https://www.finextra.com/newsarticle/35867/banque-de-france-and-socgen-test-digital-euro>,

Project Helvetia: <https://www.bis.org/publ/othp35.pdf>

DTCC on advance/customised settlement: <https://www.dtcc.com/news/2020/may/18/dtcc-unveils-proposals-to-explore-further-digitalization>

R3 on cross-border settlement: https://www.r3.com/wp-content/uploads/2018/05/CrossBorder_Settlement_Central_Bank_Money_R3-1.pdf

Project Inthanon – Lionrock overview:

<https://www.bot.or.th/English/FinancialMarkets/ProjectInthanon/Documents/Inthanon-LionRock.pdf>

Euroclear and Banque de France paper, *Experimenting settlement of French government bonds in Central Bank Digital Currency with blockchain technology*:

<https://www.euroclear.com/content/dam/euroclear/news%20&%20insights/Format/Whitepapers-Reports/settlement-french-government%20bonds-in-cbdc-with-blockchain.pdf>

Sources

https://ec.europa.eu/info/business-economy-euro/banking-and-finance/financial-markets/post-trade-services/securities-financing-transactions-sfts_en

<https://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/repo-and-collateral-markets/icma-ercc-publications/frequently-asked-questions-on-repo/4-how-big-is-the-repo-market/>

<https://www.sifma.org/resources/research/us-repo-market-fact-sheet/>

<https://finadium.com/datalend-7-66-billion-in-revenue-generated-in-lender-to-broker-securities-lending-market-in-2020/>

https://www.securitiesfinancetimes.com/specialistfeatures/specialistfeature.php?specialist_id=461&navigationaction=features&page=&newssection=features

<https://www.hqia-x.com/>

<https://www.jpmorgan.com/news/jpmorgan-executes-intraday-repo-transaction-using-blockchain>

<https://www.broadridge.com/financial-services/capital-markets/transform-trade-life-cycle/dlt-repo>

<https://www.weforum.org/reports/digital-assets-distributed-ledger-technology-and-the-future-of-capital-markets>

APPENDIX 3

Recent Coverage of Stablecoins by Prominent Organizations

2019: IMF: “E-money, electronically stored monetary value denominated in, and pegged to, a common unit of account such as the euro, dollar, or renminbi, or a basket thereof. Stablecoins are a type of e-money”

2021: US Office of the Controller of Currency interpretive letter: “Stablecoins are a specific form of crypto-currency typically tied to the value of a fiat currency, such as the U.S. dollar.”

2021: HM Treasury UK considering regulation around “Stable tokens”: “[tokens] which stabilise their value by referencing one or more assets, such as fiat currency or a commodity (i.e., those commonly known as stablecoins) and could for that reason more reliably be used as a means of exchange or store of value. The category would also include other forms of tokenised payment and settlement assets, as well as tokenised forms of central bank money.”

2021: Bank of Canada released its Stablecoin Assessment Framework and Bank of England’s New Forms of Money Discussion Paper, highlighting stablecoins as a new form of digital money.

APPENDIX 4

Working Group Participants

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Mr.	Colin	Parry	ISSA
Mr.	Ian	Salmon	R3 LLC
Mr.	Kishore	Seshagiri	Broadridge Financial Solutions Inc.
Mr.	Benjamin	Soh	Hashstacs Pte Ltd.
Ms.	Jeanette	Some	Hashstacs Pte Ltd.
Ms.	Nadine	Teychenne	Citigroup Inc.
Mr.	Vasant	Viswanathan	Citigroup Inc.
Mr.	Mark	Williamson	HSBC Holdings Plc
Mr.	Alejandro	Wyss	Caja de Valores S.A.