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GFMA Considerations for Developing Central Bank Digital Currencies (CBDCs)

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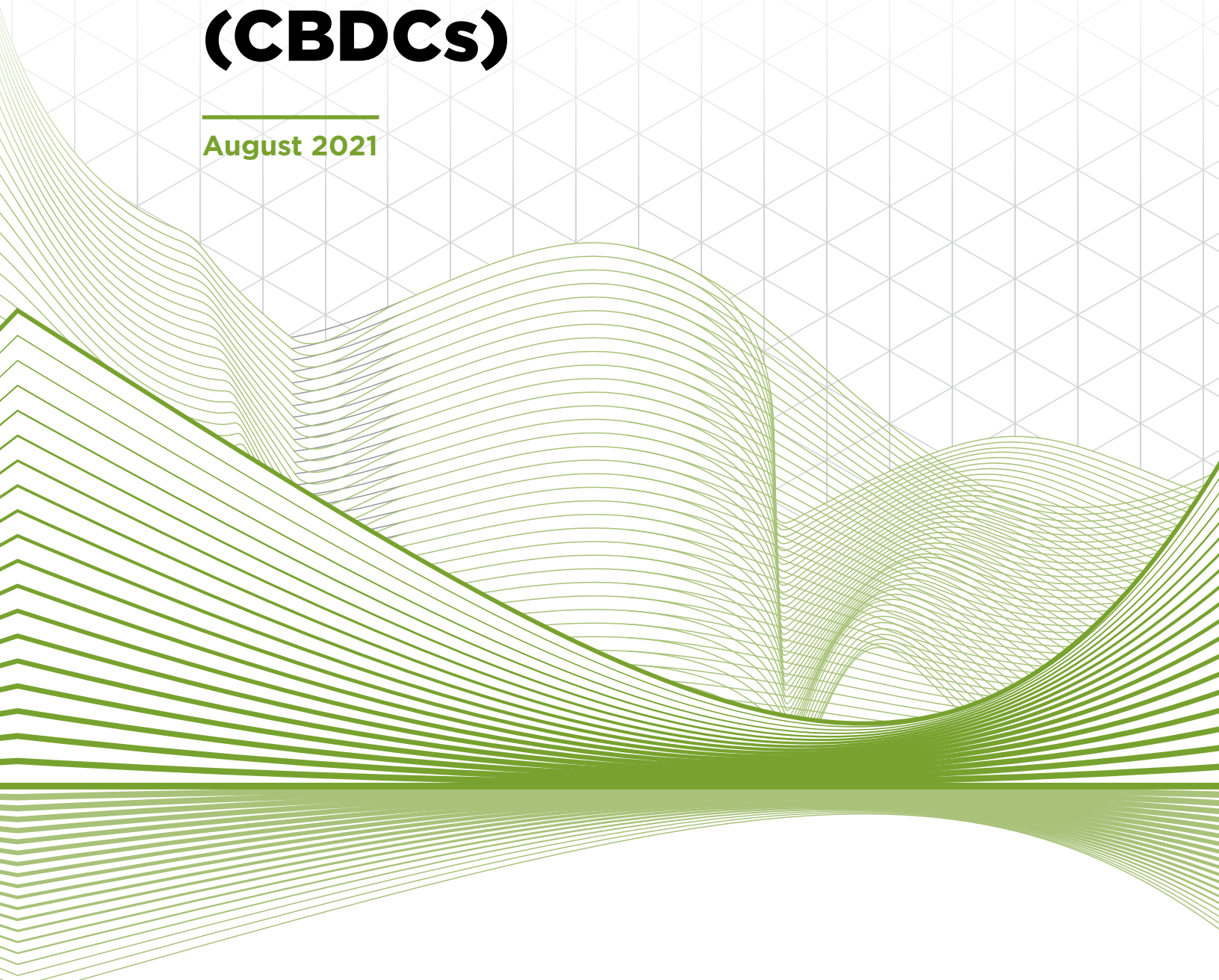

The Global Financial Markets Association (GFMA) focuses on wholesale capital markets which includes the proactive assessment of risks and opportunities from new technology. This paper is not meant to be conclusive or predictive, but simply sets the stage for open discussion and debate going forward on the potential development of CBDCs and the necessary considerations related to wholesale activities.

Introduction

Money and payments are fundamental foundations required for a well-functioning real and financial economy. They form the basis of every commercial transaction. History shows that as the real and financial economy evolve to meet the needs of their time, so too do money and payment systems. Over time, new innovations add to a broader mosaic of solutions to meet an increasingly complex set of economic needs. Money has become increasingly digital with physical cash payments reducing significantly in many jurisdictions. Distributed ledger technology (DLT), although first used by cryptocurrencies offers a range of other applications which once fully developed may allow close to instant payments, transparency, immutability, and auditability, and in the case of some ledgers, programmable functionality. Private forms of digital money in the form of either tokenized commercial bank money or stablecoins have emerged to satisfy evolving client needs. Private forms of digital money have emerged both from the regulated financial services sector and from the outside. The COVID-19 pandemic has also accelerated the migration to digital payments, prompting policymakers and central banks to facilitate a safe, inclusive, efficient, and innovative payment systems that are accessible to end users and enterprises.

In this context, central bank digital currencies (CBDCs) can be viewed as a new and additional option for policymakers. With the increased focus on CBDCs amongst central banks and market participants, there is the expectation by some that CBDCs in the near-to-medium term will continue to gain prominence in mainstream financial market discussions, and in wholesale markets more specifically, while at the same time co-existing with other forms of money, payments, and value transfer mechanisms. As the use of private digital forms of money grows as a key instrument for retail and wholesale payments, there is an expectation that central banks would provide 'digital central bank money' as an alternate to private sector solutions and drive innovation in retail and wholesale payments. So, CBDCs could be the next iteration of money, providing access to public money issued by the respective central banks, such as banknotes or coins, in a digital form.

Several central banks are currently researching or running pilot experiments on CBDCs. The reasons vary across jurisdictions and range from financial inclusion to payment diversity, payment system efficiency, payment system safety and resilience, improving payments and banking competitiveness, monetary policy implementation to continued provision of access to central bank money. Other developments that have raised central banks interest in CBDC are the emergence of private stablecoins with global ambitions as well as some other central banks launching their own, potential cross-border CBDC, which could raise concerns of currency substitution. CBDCs have the potential to fundamentally change the way the financial system operates, how the banks fund themselves and provide credit to the economy, as well as the role central banks play. However, the systemic effects of moving large amounts of money at once, particularly in times of stress, may lead to unexpected spikes in intraday liquidity and credit requirements by financial market participants. Further, a broad implementation of retail and wholesale CBDC, may also lead to a higher dependency on wholesale funding within the banking sector and will require further analysis to mitigate any unexpected financial stability outcomes.

In parallel to the introduction and growing interest in CBDCs, capital markets are starting to explore DLT for cross border multicurrency payments networks, issuance of digital tokens for traditional asset classes (e.g. equity) and tokenization of non-traditional asset classes, which are manual, non-standardized and/or do not have a liquid secondary market. DLT has the potential of transforming the entire front-to-back value chain of an asset class and not just limited to driving efficiencies in parts of the value chain. These developments have prompted the financial industry to weigh the utility of having new "on- or off-chain" wholesale payments formats (e.g. CBDC, single-fiat linked stablecoins, etc.) which can match the programmable functionality and innovation emerging on the asset-side. This convergence has potentially significant implications from both an underlying technology and interoperability perspective, as well as operational and access perspective influencing future-state roles and responsibilities split between financial market participants.

Central Banks today are considering whether CBDC can be for retail use only (gCBDC), wholesale use only (wCBDC) or general use (retail and wholesale use). Although this paper mainly focuses on Wholesale CBDC and its implications for capital markets, there are significant interdependencies between retail and wholesale CBDCs and potential impact of retail CBDC on capital markets (for e.g., impact on sources of funding for banking and capital markets and interoperability) which are discussed in the paper. See Appendix 1: 'What are CBDCs?' for more details.

To help unpack the practical operating model considerations, business impacts for financial market participants and capital market-wide impacts of CBDC, the Global Financial Markets Association (GFMA) have identified a couple of use cases to evaluate the impact of CBDCs on capital markets. The first, focuses on delivery vs. payment (DvP) and includes the exchange of digital assets for cash. The second, focuses on payment vs. payment exchanges of money (PvP) and considers money flows between jurisdictions and includes cross-border considerations.

As central banks continue to assess different use cases for CBDCs, we emphasize the importance of considering potential impacts to the existing financial ecosystem holistically, both domestically and cross border. **CBDCs issuance cannot be considered in isolation since there will be an interplay between the role of other forms of payments used for settlements, such as, fiat currency, stablecoins, traditional and tokenized commercial bank money, or synthetic or indirect forms of central bank money, which are issued by a third party or FMI but backed by central bank money, as well as potential interoperability with emergence of synthetic CBDCs and fiat-linked stablecoins.**

Ultimately, a comprehensive analysis should address 4 threshold questions:

I. What are the objectives and priorities of the central bank, i.e. what is the use case the CBDC is being designed to address, and is CBDC the right instrument?

II. What are the potential risks and benefits, for capital markets, associated with the introduction of any CBDCs?

III. What is the transitional and future structure needed to maintain confidence in the system, safety and soundness of financial market participants, and financial stability?

IV. What challenges need to be overcome to allow market infrastructure, operations, systems, legislation and regulations to resiliently and cost effectively use the new functionality offered by CBDCs?

The impacts of CBDCs in Capital Markets

It is expected that wholesale CBDC will be used in conjunction with traditional fiat payments, as well as with other new payment technologies, such as stablecoins. As such, any wholesale CBDC developments should consider established operating environments and processes to ensure the maximum benefits are achieved, without incurring increased costs or increased operational or financial stability risks. The analysis should focus on the specific problem or market inefficiencies that wholesale CBDC is aiming to solve and whether it is the right solution to solve that specific problem. For example, could innovation in payment systems address some of the inefficiencies rather than the introduction of a new form of money.

The introduction of CBDCs for capital markets has the potential to reduce the cost of transactions for corporates and financial institutions and unlock value across the market, as well as acting as a vehicle to stimulate innovation. Wholesale CBDC can be a complimentary innovation to the application of DLT in securities markets facilitating instantaneous settlement and payment of financial transactions, where applicable and appropriate. That being said, supporting innovation and potential capital market efficiencies, whilst implementing under a philosophy of 'do no harm' requires ongoing coordination and collaboration between central banks and the private sector. Such collaboration will ensure that developments consider how and why today's processes have evolved over many years to their current state, and how the use of CBDC can impact such processes, without unintentionally increasing any network risk.

Role of banking and capital markets

Banking and capital markets firms perform critical functions in the financial system today that will need to continue to be performed as CBDC becomes more prevalent. For example, banks have been and are currently responsible, alongside other payment services providers, for intermediating payments, designing various products and services to meet the best interest of clients, acting as a source of liquidity and credit to fund the economy through financial intermediation, and performing know your client (KYC) and anti-money-laundering (AML) functions, transaction monitoring, sanctions screening, filing SARs, replying to law enforcement inquiries, ensuring travel rule compliance, etc. to help mitigate the risk of money laundering and other financial crimes. Additionally, investment banks, broker dealers, and securities firms are integral intermediaries and facilitators and provide credit (a.k.a. market liquidity) in a wholesale context through their role as primary dealers and the repo market, and securities borrowing/lending, as well as ensuring that their clients meet KYC/AML requirements. Banking and capital markets is also a key provider of netting and intraday credit and liquidity solutions which are critical for smooth and timely payments and settlements. Capital markets also provide risk management solutions to the real economy and investors through derivatives and enables intermediation of savings and capital through the provision of investment management solutions to retail and institutional investors. **Introduction of wCBDCs should include a detailed analysis of the roles of various market participants in the capital markets ecosystem today, likely impact on ability or incentives to perform that role in the future and mitigating actions.**

Access

The use of CBDCs may introduce new opportunities related to faster settlement, network resilience and programmability. However, it also creates risks that need to be carefully evaluated. For example, if non-bank securities firms, payment service providers, and corporates are granted direct access to wCBDCs , regulators will need to consider the frameworks to govern their interactions with these platforms, similar to those which exist today for users of existing payment systems. For example, the new market participants should be subject to the same prudential capital, funding, liquidity, risk management and governance requirements to ensure that the financial resiliency of the overall ecosystem is not compromised. In addition, if this comes with unbundling of functions and services that today are performed by the same institution, this will also require thinking carefully about roles and responsibilities, liability frameworks and governance. The access question, while at the surface something that would seem more of a direct impact on commercial bank retail franchises, could have spillover effects to capital markets whereby the same

banks see their capacity to extend wholesale credit reduced (e.g., required by securities firms) or result in an increase in cost of credit. Many central banks over the last decade have provided direct access to banks and non-banks to their Real Time Gross Settlement (RTGS) and National Electronic Fund Transfer (NEFT) facilities. Today central banks typically only provide collateralized credit whereas on an intraday basis banks may step in to provide uncollateralized credit to investors who may not have proprietary collateral. A proper balance between self-organization and intermediation will change depending on how risk is perceived by market participants.

Operational Factors

Operational factors should also not be overlooked. Standards of connectivity, interoperability, 24/7 operations, network ecosystem, governance, and the potential of programmability alongside network capacity and throughput would need to be considered. The importance of properly managing operational resilience will also escalate[1] for all market participants in the financial system, including cybersecurity and cyber protection, particularly if there is use of smart contracts or the CBDC leverages on blockchain or distributed ledger technology. Other issues for consideration are data privacy and protection, whether and how to grant anonymity, and how to ensure robust consumer protection for general purpose CBDCs whilst ensuring compliance with KYC/AML requirements, alongside a legal and liability framework for all CBDCs. Collateral requirements by market participants is another important consideration. For example, for those banks that are already putting up collaterals to participate in 24/7 retail instant payment, how can they manage the assumed additional collateral requirements for a 24/7 CBDC used for capital markets which would have significantly higher value per transaction. A related factor is also the possibility of new market settlement patterns that can affect market liquidity.

How to frame the impacts of CBDCs on the Financial System?

While there are many possible benefits to the use of CBDCs (for instance as described in later sections of this paper), the development of CBDCs will require significant analysis to assess potential impacts on the safety and soundness and financial stability of the system, as well as on the ability to continue to provide the products and services clients' need. This analysis should focus on the potential role of CBDCs across the entire financial system, (both banking and securities settlement), including their use in retail vs. wholesale markets, and domestic vs. cross border activities. It is possible that the potential negative implications of a CBDC can be managed with a correct design. Further research in this regard is required. For example, we believe a CBDC should be designed to serve as a means of payment, not as a savings or investment instrument, so that significant outflows from commercial bank deposits into CBDC outside the banking sector is mitigated. The shift of retail bank deposits to CBDC could have unintended consequences on the role of banks in maturity transformation and the funding of the economy. In particular, the procyclicality effect of crowding-out of bank deposits would be of critical importance in the context of any financial stress of credit institutions. Further, the banking sector performs several additional functions, most importantly AML/KYC, transaction monitoring, sanctions, screening, files SARs, reply to law enforcement inquiries, ensure travel rule compliance, etc. which will have to be factored in any direct CBDC model.

1 FEDS Notes '[Preconditions for a general-purpose central bank digital currency](), Table 1 (February 2021)

GFMA propose the following recommendations for further analysis in considering the opportunities for developing CBDCs:

1) **Consider outcomes for all stakeholders and also assess the impact of levels of access to CBDC for all types of market participants.** In particular, minimum standards may be required for access to any platform in order to ensure stability and capacity is sufficient.
2) **Ensure any CBDC issued is attractive and competitive** relative to alternative payment instruments, such that it should fulfill or enhance the common functionalities offered by these instruments.
3) **Outline how the CBDCs operational model and participation rules will provide sufficient net benefits for payment services providers.** This analysis should evaluate the cost structure to ensure that it is transparent and will provide economically viable solutions for all participants. The analysis should be used to ensure prior to issuance that the CBDC infrastructure and related services are at least compatible with or enhance the central bank's ability to fulfill its key objectives in maintaining stability of the monetary, financial and payment systems. Identify the relevant regulatory tools to monitor systemic, credit, and liquidity risks, as well as the appropriate licensing requirements for an operator. Analysis will also need to determine how best to allow the CBDC to serve as an open digital infrastructure for entities to build value-added services (i.e. programmability).
4) **Evaluate how to avoid the exacerbation of bank runs during times of financial stress.** Specifically, due to the much higher transaction speed compared to cash withdrawals, evaluation of existing withdrawal or holding limits; of compliance standards with BIS to settle in Central Bank Money where possible; and of a multicurrency event.
5) **Consider how best to build and maintain public trust in the central bank as the issuer of CBDC,** including considerations for the protection of privacy of users.
6) **Consider how proposed CBDCs can co-exist and interoperate with existing and emergent public and private sector solutions.** This should recognize that there is likely not a one-size fits all on-chain cash solution that addresses all use cases. These solutions include CBDC, as well as other forms of developing on-chain payments such as synthetic CBDCs, single-fiat linked stablecoins, and tokenized commercial bank money.
7) **Consider how different CBDC design choices will be positioned in current or potential future regulatory frameworks, while also factoring any impacts to monetary policy transmission channels, loss allocation legal precedents, and prudential policy risk management objectives.** If a particular CBDC design for a use case is ultimately selected to be launched, there will also need to be significant coordination between the private and public sectors, as well as across jurisdictions, to develop standards for interoperability and timelines for implementation to mitigate risk of financial market disruption(s). The combined efforts to date by CPMI-IOSCO, BCBS, FSB, IMF, WB and BIS Innovation Hubs and the group of central banks is a welcomed coordination and collaboration on this important market innovation[2]. Increased inclusion of the private sector in these discussions will be an important next step to ensure that CBDC launches do not result in financial disruptions.
8) **Consider the potential impacts to the existing financial ecosystem holistically, both domestically and cross border.** Analysis cannot consider CBDCs issuance in isolation as there will be an important interplay between the role of other forms of payments used for settlements, such as traditional fiat currency, stablecoins, traditional and tokenized commercial bank money, or synthetic or indirect forms of central bank money, which are issued by a third party or FMI but backed by central bank money, as well as interoperability with emergence of synthetic CBDCs and fiat linked stablecoins.

Although many of the proposed Central Bank use cases on CBDC focus on the impact to retail markets, due to the interconnectedness of the markets there are material potential impacts to wholesale markets that must be considered simultaneously. This will include for example if a general purpose CBDC may be used to fund the purchase or sale of a financial instrument, or to settle any subsequent cash flows.

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2 Related publications include the joint CPMI, BIS IH, IMF, World Bank 'Report to the G20: Central bank digital currencies for cross-border payments' (July 2021), Chapter III of the BIS Annual Economic Report (June 2021), and BIS Paper No 116 'CBDCs beyond borders: results from a survey of central banks' (June 2021)

We suggest that there needs to be concurrent policy development for both gCBDC and wCBDC—for example, design decisions based on policies set for gCBDC may become the de facto design choices and policies for wCBDC due to the interconnectedness of retail and wholesale markets[3]. In fact, if analysis determines that CBDC delivers significant benefits to wholesale markets (including supporting digitization across financial markets), central banks could consider the launch of a pilot CBDC in wholesale markets first, as it may be easier to implement, the operational efficiencies may be clearer to see, and it may introduce fewer challenges in terms of bank disintermediation compared to gCBDC.

GFMA has identified a couple of use cases relevant to capital markets and cross-border payments to evaluate these key themes and critical features as a framework. An important cross cutting factor relevant to many use cases is defining and prioritizing the role of "interoperability"[4].

Overview of Selected Capital Markets Use Cases

Two use cases were identified to better explore the potential impacts of wholesale CBDC on impact on capital markets.

1. **DvP: Securities Issuance and Settlement**
   We explore the feasibility, implication, and potential benefits of wCBDC's use in DvP of securities settlement. Given that domestic DvP occurs in the context of a specific market/jurisdiction, the discussion of CBDC impact tends to center more around intra-network design and interoperability considerations:
   - Existing securities market infrastructure, products, and processes will be key factors shaping the opportunities for future innovation. Discussions of future CBDC supported settlement models need to consider these constraints, and recognize existing industry efforts underway to accelerate settlement cycles.
   - CBDC design and legal basis
   - Choice of platform, new vs. existing standards
   - Access for banks, securities firms, other non-banks, and corporates
   - Governance, liability framework and network rulebook
   - Interoperability provisions and operational processes where faster settlement models leveraging CBDCs interact with securities life-cycling infrastructure, both new (i.e. other blockchains) and existing systems.

2. **PvP: Cross Border Payments**
   We explore the feasibility and implications to link wCBDC in different currencies to allow for PvP settlement. This could involve the use of bilateral links but also the establishment of settlement platforms for multiple wholesale CBDCs. Given that cross-border PvP occurs in the context of multiple markets / jurisdictions, the discussion of CBDC impact tends to center more around inter-network design and interoperability considerations:
   - Consideration of a global settlement date to accommodate time-zone issues
   - Linkage cross network infrastructure choice and harmonized technical standards
   - Applicable rule of law and conflict of law resolution, including settlement finality and linkage mechanism
   - Governance, liability framework
   - FX and gross vs. net settlement considerations

3 For example, eg retail investors using gCBDC to invest in equities or mutual funds, which then requires the intermediary (broker, custodian, investment manager) to transform and inject that liquidity into wholesale securities market transactions (conducted in legacy cash or wCBDC).

4 The International Organization for Standardization (ISO) defines interoperability as the "capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units" (ISO (2015))

While evaluating any use case, an important variable to consider is the design of the CBDC as this will impact not only how the CBDC can be used domestically, but also how interoperable it is with other domestic CBDCs, traditional fiat and payment technologies. In many cases, it is possible that the CBDC design model selected can steer the capital markets analysis of the use case. For the purposes of this paper, the potential model choice will be included within the applicable use case. BIS has categorized three design models: Indirect, Direct, and Hybrid (Table 1)[5]. In addition to individual CBDC models, this paper also considers Multi-CBDC arrangements (m-CBDC)[6].

Table 1. Includes the key characteristics for each of the three CBDC operating models as defined by BIS.

Operating Model	Legal Claim Represented by CBDC	Onboarding and KYC Responsibility	Payment Processing Responsibility
Indirect Model	CBDC is a claim on a central bank. An intermediary CBDC (ICBDC) is also created as a claim on the intermediary.	Intermediaries are responsible for onboarding of customers and KYC functions Client deposits are held directly with the intermediary and exposure to CB is limited to current participants.	Intermediary processes retail payments. Central bank processes wholesale payments.
Direct Model	CBDC is a claim on a central bank.	Either intermediaries or the central bank can be responsible for onboarding, KYC/AML and other screening, reporting and compliance functions. Client deposits can be held via the intermediary or directly with the Central Bank.	Central bank processes both retail and wholesale payments.
Hybrid Model	CBDC is a claim on a central bank.	Intermediary is responsible for onboarding and screening, reporting and compliance functions. Client deposits are held directly with the Central Bank.	Intermediary processes retail payments. Central bank periodically records retail balances

5 CBDC operating models as defined in the March 2020 BIS Quarterly Review: "The technology of retail central bank digital currency."

6 BIS Paper No 116, 'CBDCs beyond borders: results from a survey of central banks' includes results relating to mCBDC arrangements (June 2021). Banque de France and the Monetary Authority of Singapore also announced the first use of automated market making in an m-CBDC experiment (July 2021).

I. Use Case #1 – DvP: Securities Issuance and Settlement

Overview, Operational Considerations, and Minimum Operating Model Requirements

The advancement of DLT technology in financial markets introduces the potential to re-invent post-trade operational processes. CBDCs can support a range of new approaches to settlement, ranging from the facilitation of T+1[7] settlement by allowing for the faster movement of payments (as opposed to T+2[8] settlement for most major equity and fixed income markets today) to potential future innovations including DLT enabled settlement on timeframes shorter than T+1, such as trade settlement on a same day or faster basis, through atomic[9] or near real time delivery vs. payment (DvP).

Before exploring how CBDC developments could impact potential future DvP settlement models, it is important to highlight several issues:

- **Accelerated settlement raises a number of major operational, product, and risk issues, independent of CBDCs**
- **Any near-term changes to settlement cycles (such as those being explored in the US) should be made based on current state technology and operating models**
- **Distinctions should be made between CBDC developments and broader evolution of product and settlement models**

Challenges to Accelerated Settlement

Any market-wide move to a shorter settlement cycle will entail significant disruption to the functioning of key products and processes which provide value to clients and reduce risk, yet may not be feasible under certain accelerated settlement models. While these impacts are far reaching, some of the most critical are the disruptions to securities lending, prime brokerage, margin lending, and ETF products. We explore these challenges in greater detail later in this section, and caution policymakers of the need to bear these considerations in mind as they look at any potential faster settlement models. As a result of these constraints, T-0 (the same day a trade is executed) or T-EOD (by end of day when a trade is executed) settlement is not currently achievable due to a wide range of technical factors unrelated to CBDC. In other words, the reason that T-0 settlement is not the default model in securities markets is not due to lack of access to CBDC. It is also to be noted that intraday settlement is already available as an option in most market infrastructures and is actively used by some market participants at their discretion (e.g. for same day financing). However, this selective adoption should not be implied to support changes in broader market rules. For example, even if CBDC existed in the US securities markets, it is unlikely that market wide T-0 would be achievable as a base case or whether it would even be desirable given operational risk and other concerns inherent in a T-0 or RTGS approach.

Near Term Changes to Settlement Cycles Should be Made Considering Current State Technology and Operating Models

In the US, the Securities Industry and Financial Markets Association (SIFMA), the Investment Company Institute (ICI), and The Depository Trust & Clearing Corporation (DTCC) are collaborating on efforts to accelerate the US securities settlement cycle from T+2 (two business days after a trade is executed) to T+1 (one business day after a trade is executed). The US securities industry has been discussing this effort since 2020 and are now advancing an in-depth analysis on the next steps to achieving T+1, with expected completion of this analysis by the end of Q3 2021. This analysis takes into account the range of operational, product, and process impacts of a shorter settlement cycle mentioned above, and discussed in greater depth later in this document. The industry's analysis has also determined that an industry-wide move to T+0 or atomic settlement is not feasible at this time.

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7 T+1 denotes that settlement takes place one business day after a trade is executed.

8 T+2 denotes that settlement takes place two business days after a trade is executed.

9 Atomic Settlement: Atomic does not mean instantaneous, it means it uses an 'atomic swap' code that exchanges securities for cash when both legs of the trade are present. When configurated, one factor is how long to wait for both legs. Therefore, atomic may be close to real time but it does not always mean instantaneous.

The development of CBDCs, in parallel with the creation of a broader distributed ledger-based landscape of product issuance, trading and post-trade infrastructure may allow for new future settlement models in some market segments, even if the broader industry operates on a T+1 or T+2 basis. However, it is critical that any near-term changes to settlement cycles, such as those being explored by the US securities industry, should be based on current industry technology and operating models. As a result, it is not practical to expect near term adoption of same day settlement on a large scale. Additionally, the transition from T+2 to T+1 settlement in the US will be a multi-year process, which will constrain the industry's capacity for further broad changes to settlement models and infrastructure, though market participants and infrastructure providers may continue to explore new settlement models on a voluntary basis.

The industry's analysis of what is achievable for accelerated settlement in the near term (i.e. T+1) will not change as a result of CBDC developments. We strongly caution policy makers to ground their analysis of any changes to settlement cycles in the operational, product, and process impacts surrounding today's products and post-trade landscape, not functionality of potential future CBDCs. It is critical not to conflate the future impacts of CBDCs with the immediate challenges of accelerating settlement cycles from T+2 to T+1.

Differences Between CBDC developments and Broader Product and Settlement Model Developments

While CBDCs may allow for new approaches to settlement models in some products and markets, it is important to distinguish between the direct impact of CBDCs and the broader considerations for settlement of future blockchain-based assets, as well as new approaches to settlement timeframes and processes. Market participants and utilities may explore faster settlement timelines in a range of different models, such as T+1 settlement using utility CSD functionality, optional same day settlement for some products within the CSD netting model, and blockchain-based settlement for some tokenized assets. While there are some market segments and market participants who use T-0 or T-EOD settlement today for a subset of transactions, these occur in very defined and controlled circumstances which simply cannot be applied to the entire market. Additionally, CBDCs are not a direct enabler for any of these models, which will evolve based on industry requirements. On a parallel track, as natively digital assets securities develop (i.e. those which are issued directly on blockchain infrastructure), CBDCs may be integrated in to their settlement models. However, it is essential to distinguish between these different parallel developments, and not see CBDCs as a necessary enabler for any of these changes.

CBDCs in DvP –Envisaged Benefits

While CBDCs are not a prerequisite for DvP securities issuance and settlement, they offer a number of key benefits to be considered. First, the availability and usage of CBDC could allow market infrastructures that are required to comply with the PFMI principles to effect settlement in central bank money, potentially reducing the risk in the system. Second, there is no subsequent step after settlement to convert the digital token or coin back to a centralized currency as the CBDC will be treated as legal tender in digital format. Finally, using a CBDC for DvP may potentially reduce funding requirements for risk capital, clearing funds, and settlement liquidity. However, as stated above, there will be policy tradeoffs as one considers the proper balance of self-organization and the valuable role of financial intermediation. Faster settlement could also enable intraday services and solutions and more efficient capital management, however CBDC is not always needed for that to happen.

CBDC & DvP Settlement Models – Context of Existing Products and Operations & Planning Considerations

Central banks have a key interest in the stability, safety and efficiency of financial markets and their infrastructures including the provision of adequate liquidity in central bank money, a pivotal asset for its functioning. Whilst the private sector is experimenting with these innovative new technologies, central banks will need to prepare to continue to enable settlement in central bank money – especially as international standards require FMIs to settle in central bank money wherever practical and available. So, while CBDCs may support innovation in securities issuance and settlements, it is essential for a central bank to fully understand the potential changes, challenges, and risks that DLT and tokenized assets will introduce to the operational and technical infrastructures. There are a number of key open questions and considerations which will shape if and how the industry leverages them for future innovation in this area.

The ability of the industry to implement large scale DvP settlement (or any settlement shorter than T+2) and the extent to which such settlement may be implemented will be shaped by a range of operations, product, and risk management considerations. These issues will need to be addressed in the securities markets and post trade landscape, independent of using a future CBDC for payments, and not all types of transactions may realistically be settled using this model. While the impacts of DvP settlement on the industry would be far reaching, some of the greatest challenges will lie in primary markets (as described below), as well as a range of operational and product issues, including securities lending, prime brokerage ETF creation / redemption, netting, institutional trade affirmation and allocation, buyside processes, and liquidity and funding models. As discussed above, currently US securities market participants, infrastructure providers and regulators are working to develop plans to move to T+1 settlement for secondary market transactions, and the planning for this future transition highlights the broad range of issues beyond payments and funds movement technology which are impacted as the settlement cycle is shortened. Issues include the availability of USD by cross-border market participants, in different time zones and with different public holiday schedules, to settle trades in the faster settlement cycle.

While CBDC is an enabler, it does not in and of itself resolve the many other issues associated with faster settlement in many markets. These include key industry businesses and products (such as prime brokerage, securities lending, and ETF services) and processes (such as funding, liquidity management, and post trade processes) which would need to be substantially revised to allow for settlement timeframes less than T+1. For primary markets transactions, factors that could impede settlement on shortened timeframes include the desire to align the closing of an offering with the use of proceeds from the offering, such as repaying outstanding debt or funding an acquisition, as well as the time needed to finalize definitive documentation, particularly in complex transactions.

Reviewing the opportunities for faster settlement using CBDCs should also consider the conflicts between potential benefits of faster settlement timeframes and the disruptions they will cause to the functioning of key products and industry processes which provide value to clients and reduce risk, yet may not be feasible under certain accelerated settlement models, and so constrain the potential adoption of faster settlement models Several of these challenges are not simply issues which can be resolved through the deployment of new technologies to drive faster interaction among market participants but are areas where current products and their operating models would likely be substantially disrupted and up-ended, with a range of negative consequences. For example, securities lending operating models would require major changes to how securities are borrowed or recalled. Prime brokerage at faster than T+1 settlement would require a major effort to reconcile processes within new timeframes and will require technology, regulatory and behavioral changes across the industry. ETF creation and redemption processes would need to be substantially revised to support asset transfers to and from custodians and in the new time frames, and new technology would be needed to for real-time stock ledger/ collateral movements. There would also be impacts on margin lending, with challenges for firms to calculate margin and for customers to meet margin calls in new timeframes. Buyside firms would face a range of additional product and process challenges, ranging from the need for new approaches to instructional trade confirmations and allocations to challenges with portfolio adjustment processes. It is notable that many of the pilot projects which have leveraged distributed ledger technology to allow for faster settlement have taken place in

market segments where these considerations are minimized. Ultimately, the greatest net benefits in some markets and products may come from combining the advantages in money movement provided by CBDC while retaining the broader operational, product, and market benefits of existing settlement cycles, and recognizing that on balance, faster is not always better.

Market participants and policy makers will also need to consider the net impacts of DvP settlement on funding and liquidity requirements. While DvP settlement offers the potential for firms to redeploy capital which is currently held at post-trade utilities, by operating on a gross basis it would also reduce the benefits provided by post-trade netting for batch settlement. Similarly, institutional funding models would see substantial impacts associated with the new payment timelines associated with DvP settlement. Until these issues are resolved with collaboration between private and public sector participants, the scale of adoption of DvP settlement using CBDC is likely to be limited.

Any future implementation of DvP settlement would require a range of technical, infrastructure, and process changes or upgrades beyond the CBDC itself and its supporting infrastructure, in addition to the process and product impacts described above. For example, key post trade functions such as transfer of assets, books, records and reporting requirements, and settlement processes would likely need to be supported by future DLT/digital infrastructure capable of moving at similar speed as the CBDC infrastructure. Technological advances, regardless of sector, come with transition pathways that need to be fully understood. DvP analysis focuses on the potential risk mitigation benefits of atomic or near-instantaneous settlement (24/7/365 access to the payment system and T+0 settlement). At the same time, exploration of future DvP settlement models will also need to incorporate analysis of how key risk management issues may change under this model, ranging from cybersecurity concerns to error handling.

Across both the public and private sectors, institutions have explored a variety of models for integrating DLT infrastructure to support DvP settlement within existing securities settlement systems and other market infrastructure. SWIFT Global Payments Innovation (GPI) plans to enable DLT-based payments on traditional payment systems while the Bank of England's renewed real-time gross settlement (RTGS) system would connect to a wider range of payment systems including those using. DLT-based systems, thereby facilitating interoperability. Separately, the introduction of tokenized commercial bank money or wholesale stablecoin solutions leveraging blockchain technology can also enable atomic settlement.

Interoperability, both locally and globally, between digital securities platforms and CBDCs will need to be defined with input from all stakeholders, including central banks, securities firms, exchanges, infrastructure providers, commercial banks, asset owners and asset managers, technology providers, and other market intermediaries that are involved in asset safety, handling cash and investor protection (such as transfer agents, brokers, and custodians). As a guiding principle, CBDCs should be designed to be as technologically and/or technology provider agnostic where possible, and avoid closed-loop payment systems to facilitate wider accessibility and usability. Where this is not possible or practical, greater interoperability can be encouraged through careful design (i.e. smart contract standards) and/or tooling to "bridge" asset-cash ledgers (i.e. APIs) for the purpose of cross-chain DvP for the purpose of cross-chain DvP. It is counterintuitive to count as progress if DvP using CBDC would require a number of customized solutions built by market participants to coordinate between two different transactions (securities, cash) happening on two separate platforms, instead of a more integrated / seamless DvP of securities and cash (i.e. on the same platform, on different platforms but utilizing common standards/tooling).

Importantly, these guidelines should take into account the five critical features outlined above, including 1) secure to cyber-attacks 2) instant or near instant final settlement 3) resilient to operational failure and disruptions 4) interoperable with private sector digital payments and 5) 24/7/365 payments and settlements including cross-border considerations (such as the US is an international capital market and USD is an internationally used currency). It will also be critical that these models are designed to protect the privacy of proprietary information, incorporate mechanisms to affirm and accept transactions and provide a framework for resolving errors.

As proofs of concepts continue to emerge in both digital security settlement and stablecoins, a thoughtful analysis of best practices should be undertaken and documented during the new development in the DvP space utilizing CBDCs. Experimentation should also focus on smaller market segments first, before considering potential future changes to large and complex markets such as listed equities.

Design and Operating Model implications

As wCBDC use in DvP primarily involves intra network considerations, the associated implications arising are more prominently featured around the operating model considerations related to the CBDC design and backing, market access / roles and responsibilities, and operational payment processing. Along these dimensions, we first look at the role a wholesale CBDC can play and then cite the three operating model frameworks of a retail CBDC:

I. Indirect model;
II. Direct model;
III. Hybrid model;

1. Wholesale CBDC (CBDC used in capital markets)

The concept of a wCBDC inherently represents a direct model i.e. a legal claim which a qualifying financial institution or investor holds on a central bank. Additionally, there is no impact on the relationship between that financial institution or investor and its clients.

The focus of this use case is a DvP transaction to settle digital securities/digital assets with the cash leg using wCBDC on the same DLT/digital platform. This is different to the use case of a tokenized DvP involving a RTGS cash leg[10]. Experimentation with both use cases was done within the context of the Project Helvetia[11] by the BIS Innovation Hub in Switzerland in close partnership with the Swiss National Bank and the SIX Group AG.

Settling a cash leg of a tokenized DvP via wCBDC directly on the DLT platforms eliminates the need for the interoperability between the DLT network and the RTGS system and therefore improves the efficiency of the settlement process itself. This also allows further integration of wCBDC into DLT-based capital market processes, and for new value creation potential as it further evolves. For example, it may be possible to establish programmable business logic into smart contracts, or to achieve atomic multilateral settlement of the cash leg. In selected use cases where the operating model continues to involve a CSD, a significant potential change is whether the central depository should be a direct member of the central bank's CBDC settlement system to seamlessly facilitate participant's "integrated" DvP settlement in CBDC on one platform. While this can have a high level of overall market efficiency, it will also have significant impacts to existing market structure, banks' traditional account roles, and central depositories' risk profile and responsibilities; amongst other implications.

Given its set-up, a DvP involving cash settlement via wCBDC is closest to the concept in place today for settlement in central bank money. The innovation to this concept is the new technology which does not require a central system operator as is the case today for RTGS systems. This peer-to-peer environment – i.e. direct payment between two market participants without a central bank technically required to operate in between - represents the core challenge to the central bank's operating and processing of payments in central bank money.

From a legal perspective, the existing legal frameworks for payments and securities, as well as civil laws, require a thorough review to ensure they are adequately fit for this purpose – as it is similarly required for gCBDC.

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10 i.e. the asset is delivered on the DLT platform and the cash leg is settled in central bank money in the RTGS system

11 BIS Innovation Hub, SIX Group AG, and Swiss National Bank's 'Project Helvetia, Settling tokenised assets in central bank money' (December 2020)

A starting point could be to identify and capture the transformational capital market use cases for wCBDC, and for central banks and market participants to collaborate on a blueprint and roadmap of how wCBDC can and should work. Regardless, every use case should include domestic and cross-border digital capital markets primary and secondary market flows with digital securities/digital assets.

Distribution models

2.1 Indirect Model

In the Indirect model, where CBDC is distributed indirectly through intermediaries, many of the roles and responsibilities of market participants remain the same, and the financial system closely resembles the existing two-tier financial system. In the current system, regulated banks, as well as other financial institutions like broker-dealers, provide many important benefits including required screening, reporting and compliance functions, such as KYC/AML, client access and conflict resolution.

Custodians and clearing banks will also continue to play an important role with the Indirect model for DvP, even though early proposed operating models utilizing DLT envisioned an erosion of the typical custodian architype. Custodians would continue to provide banks, asset managers, and investors both services necessary to meet regulatory risk-management requirements as well as other value-add services. We note that there are open questions as to who would provide intraday liquidity and operate the CBDC account.

2.2 Direct Model

The Direct model, where the CBDC is a direct claim on the central bank and payments and transactions are handled by the central bank, represents the largest shift to today's market structure. This model redefines traditional business models, introduces new market risk factors, and would require the development of new regulatory protocols.

The most notable market structure shift is the reduction of the roles of today's intermediaries and the vastly increased role that would need to be assumed by a central bank. In the current financial system, intermediaries, such as banks and broker-dealers, manage the responsibilities for all onboarding and KYC assurance for customers and clients wanting to issue, trade, and settle securities, in line with regulatory requirements. Under the Direct model, the central bank (or a newly created public sector institution) will be required to manage such risks. This onerous task could be somewhat reduced through the development of a digital identity infrastructure, however, it will still pose a large administrative and logistical challenge for the central bank.

The central bank will play a key role to ensure interoperability, since all transactions will be required to interface with the central bank's payment system. Digital security platform providers should be consulted during the creation of the interface requirements, recognizing accountability for operational risk management and operational resilience will necessarily fall on these platform providers.

Further to this, we note that this model is potentially more liquidity and credit intensive, on the basis that there will be limited (or no) possibility for intermediaries to net and offset liquidity movements. Therefore, the central bank will likely need to provide much more liquidity just to settle the same number of trades as under a direct model.

2.3. Hybrid Model

The Hybrid model combines aspects from both the Direct and Indirect models. CBDCs will still be a direct claim on the central bank, however, intermediaries would handle the onboarding and KYC.

A hybrid model differs from an indirect model by reducing the counterparty risk associated with non-simultaneous transactions since the central bank will retain a copy of all transactions in order to facilitate dispute resolution or restore balances in the case of an intermediary failure. Legal and regulatory disputes are not new in this area and will continue, especially in a cross-border situations, where conflicts of laws on insolvency treatment (e.g. settlement finality and CFD) have been a major issue for many years.

The Hybrid model provides the lowest barrier to entry for new financial market participants. This therefore may facilitate increased involvement of FinTechs in the ecosystem, both as Payment Services Providers and to provide onboarding services. FinTechs may choose to operate independently in this model or partner with existing banks. It is important to note, however, that if this model is adopted, it may be necessary to develop minimum requirements for connection eligibility to not oversaturate the market or the infrastructure with a proliferation of options or introduce unnecessary risks in the system.

Table 2. Potential market structure changes with the use of CBDC models for DvP with Digital Securities

The following table highlights that the launch of any CBDC (or any blockchain powered new market) introduces a new market practice that will need to be based on technology that is backed by trust and confidence, potential instantaneous execution / settlement, and technology backed immutability. Market participants will require time to assess how this new market practice would function under current safety and soundness, financial stability and operational risk and resilience requirements (e.g. How would treasury practices look like when everything is real time and irrevocable?) before investing time and resources on transition.

Entities	Current role in Securities Settlement	Market Structure Potential Changes with the use of CBDC for DvP Models with Digital Securities
Securities Settlement Systems/ Central Securities Depositories/ Transfer Agents	Central books and records for securities; Effect DvP settlement against Central or Commercial bank money (varying by geography); Also offer netting and liquidity management services.	May become partly decentralized via DLT-based registries, and support settlement of tokenized digital securities; May need to custody CBDCs and settle securities DvP against CBDCs and traditional cash networks.
Issuing, Paying and Calculation Agents	Act as agency to issuers at the settlement system to collect funds (at primary) and manage distributions (corporate events, redemptions)	May need to manage automated payment flows via smart contracts; may need to custody and manage CBDCs on behalf of issuers.
Wholesale Payment Systems/ RTGS	Utilized to process payment flows for securities settlement DvP	May need enhancements to support 24/7/365, programmability, support atomic settlements and interoperate with tokenized networks

Custodians/ Depositories	Manage titles to issued securities and maintain accounts at Securities Settlement systems to effect transfers on behalf of investors. Process corporate actions and provide liquidity for settlement and asset-servicing purposes	May need to provide cash management services for CBDCs, along with custody for digitized securities.
Lead Managers, Underwriters, Placement Agents	Negotiate terms and place issued securities with investors	Roles may remain largely unchanged; however, faster settlements where desirable may reduce usage of credit line facilities currently provided; may need to use custodians to manage CBDC flows.
Cash/ Commercial Banks	Manage cash on behalf of all participants Onboarding of clients including KYC/AML. Offer intraday and end of day credit Offers interest on deposits Provides client netting and hedging	May need to provide additional services for CBDCs, depending on model. May also need to manage liquidity fragmentation across traditional and digital cash networks.
Triparties/ Collateral agents	Provide services for securities lending/ financing and associated collateral flows	Roles may not change; CBDC use in Repo markets could enable new intraday use-cases and cross-border collateral flows

II. Use Case #2: Payment vs. Payments (PvP)

Overview and Minimum Operating Model Requirements

This refers to the simultaneous exchange of two different currencies, which we assume in this case settle in domestic currency. One thing to be aware is that the performance of existing large-value payments systems for wholesale payments, which are largely settled via real-time gross settlement systems (RTGS), is already highly efficient. It is important to think whether there are any roadblocks or inefficiencies that a wCBDC could address or any benefits that could provide within this context in mind.

We believe that real time payments and transactions are coming in the future. So, if we were to think of that end state of real time settlement, there are a number of operational issues that would need to get addressed, including the incorporation and integration of all necessary and mandatory screenings and reporting that banks need to conduct. One way to accomplish that goal of regulatory compliant instant transfers is to require for all counterparty and beneficiary reference data to be pre-registered and made available to allow for screening and validation to occur independently (and ahead) of transaction initiation. Once that is in place trading and settlement can process seamlessly at the point of execution. Another area for consideration is how to incorporate and preserve the benefits of CBDC in its interaction with the traditional payment systems, which will not offer the same functionalities. We suggest that regulatory requirements should be revisited having a real time end state in mind and how to transition to that end state from today's operations and well as how to preserve and incorporate the benefits of digital infrastructure in today's analogic world.

CBDC and the FX market

The introduction of CBDCs may also impact the FX market, both in terms of exposure and risk management requiring the development of a new exchange regime. The technical implications in terms of need for system upgrades, impact on existing conventions and standards, including ISIN codes, should be further evaluated. For wholesale markets, there are a number of considerations that will need to be assessed in order to ensure success Table 5 below presents some initial views on those considerations. Additionally, there are some existing market conventions, such as Settlement Date, which may also need to be re-assessed. The timing of when payments are made are typified by the operating hours of the central banks in which currencies are being paid; in moving to a potential 24/7/365 CBDC instant settlement model such conventions will need to be reconsidered, and the needed operational processes rethought and perhaps reimagined.

If timing of settlement is the problem to solve, a hybrid wCBDC could be a potential solution to enable[12] more efficient and close to real time payments in some cases by expanding access to a currency zone while maintaining the same risk profile. Differences between emerging and developed markets, and whether FX markets are open/liquid or not, and whether local banks refinance themselves in domestic or foreign currencies are factors that will need to be evaluated. Market structure questions quickly arise, for example, will the current RTGS systems remain in place in a hybrid model for wholesale markets? Other issues relating to credit exposure, settlement risks, DVP, and finality of payments would also need to be considered and resolved.

If cost of value transfers is the concern to address, we need to be aware that this cost may also be driven by the illiquidity of some destination currencies, the complexity of clearing networks and the FX risk involved. This may be only partially addressed with a CBDC.

In the wholesale FX market, not only are the number of users of cross-border payments very large, there are a variety of technologies in use and vast amounts of money settle on a daily basis. For example, BIS with reference to the 2019 Triennial survey[13], states in the 2019 Quarterly Review paper[14] that the daily gross payment obligations for wholesale FX in April 2019 were $18.7 trillion. After bilateral netting, the number was reduced to $15.2 trillion of which approximately $6.3 trillion was settled on a PvP basis, leaving approximately $8.9 trillion which was not, and thus having some potential exposure to Principal Risk[15]. It should also be noted that the same report notes that "growth in the size of the FX market since 2000 suggests that the absolute value settled by potentially riskier non-PVP methods may not be less than before PVP methods existed."

The introduction of CBDCs provides a solution for the latter point in the previous paragraph where the simultaneity of two currency exchanges in the form of CBDC can help mitigate such risks where existing FMIs such as CLS do not offer PVP services for non-eligible currencies. This is one good use case for Asia where regional trade can be enhanced with FX settlement mitigated by the use of PVP between two CBDCs.

There are open questions on how or whether the introduction of a wCBDC addresses the challenges mentioned above. We present below some preliminary thoughts on what requirements may be needed to make this workable and effective in practice:

12 See footnote 13 of BIS Papers No 115 (March 2021)
13 BIS Triennial Central Bank Survey (September 2019)
14 BIS Quarterly Review (December 2019)
15 BCBS 'Supervisory guidance for managing risks associated with the settlement of foreign exchange transactions' (February 2013).

General requirements:

- Establish clear policy objectives for the purpose and wide acceptance cross-border
- Decide on form of issuance[16]: account vs. token-based
- Establish who can be distributors and distribution model—direct to central bank or two-tiered system?[17]
- Consider user access, needs and user experience
- Establish CBDC as a legal tender and the provision of finality
- Allow the private sector to openly build on the network
- Establish a strong legal and liability framework and clear regulatory provisions
- Implement a robust technical solution in terms of thruput, scale, operational resilience and cyber security

Specific wholesale-oriented considerations:

- Implications of programmable money/smart contracts – ability to establish conditionality and expiration
- Cross-border access for non-residents or foreign entities
- Interoperability with other markets where CBDC may or may not be present or legacy infrastructure
- Intra-day liquidity management optimization between real-time gross settlement and different netting options and need for prefunding

Design and Operating Model implications

As CBDC use in PvP primarily involves inter network considerations, the associated implications arising are more prominently featured around the operating model considerations related to cross-border operating features and various network-to-network connectivity designs.

Operational Features to be assessed at a minimum:

- Cyber Resilience and Operational Resilience[18]
- Settlement times
- Interoperability with other CBDCs as well as private sector digital payment systems and arrangements, including fiat currencies
- 24/7/365 digital payments and settlement and its implications for EOD batch processing and accounting
- Availability/criteria for eligibility to connect and (Universal) access[19]
- Provision of On/Off ramp services – be it central bank, or other institutions granted ability to distribute or mint/burn CBDCs and interact with existing RTGS (fiat) systems
- Digital synchronized Time stamps

Additional requirements to consider or build upon include those provided in the BIS IH CBDC Foundational Principles and Core Features report. In addition to the above parameters, custody and storage; data privacy and protection, anonymity; account transaction limits; interest payments; conversions and redemption rates; programmability features; processing capability; lending activity; potential as an alternative for bank financing and overdraft; interoperability with all currencies; general purpose restrictions (e.g. accepted by CSDs for settlement).

16 A challenge in digital payments is that the form of issuance is not mutually exclusive. Question arises whether verification of the account holder/address or verifying the object. For example, some products fall into both camps where the account-based as the address and the private key is the proof of the identify, and token-based as the transaction history is the validity of the object being transferred.

17 BIS Working Paper No 948, 'Central bank digital currency: the quest for minimally invasive technology' (June 2021) addresses the question of maintaining a two-tier financial system.

18 BCBS Principles for Operational Resilience and Sound Management of Operational Risk (March 2021)

19 For wholesale CBDCs, potential participants could include central banks, non-bank corporates, investment funds, stablecoin providers, or other regulated systematically important financial institutions.

Table 3. Examples of Considerations and Observations when using CBDC for cross-border payments

	Observation
Non-PvP Transaction Matching, Confirmation and Settlement	Participants will be required to staff and skill accordingly to perform functions through a longer business day as well as train staff for operational practices related to CBDC
Intra-day controls and reconciliations	New controls and procedures will be required to accommodate CBDC activity across FX and other products
Intra-day Liquidity Management	Existing processes will require change, understanding how separate CBDC and cash liquidity pools interoperate, and any friction introduced for conversion as well as potential development of new funding pools and products
Final Checks Prior to Cut-off	Introduction of CBDC may lead to changes in operational cut-off times, enhancements to the control environment and the need to redefine end of day processing
Regulatory Reporting	Meeting pre and post trade regulatory reporting obligations will be impacted through longer business hours. Questions as to how the CBDC will be represented in reporting as well as consideration for how CBDC fits into existing central bank and BIS reporting
End of Day Batch Processes	CBDC may have the effect of extending the business day with impact to existing EOD batch processes, including when EOD is considered. Any 'offline' time may impact the ability to execute and settle trades or introduce new profiles of systemic risk during these down periods
Nostro Reconciliations and End of Day Statements	Real-time settlement is not generally factored into any current nostro services and account reconciliations; processes may be required to link back 'off-hours' settlements to CBDC activities as well as considerations for settlement finality related to when CBDC may appear on account statements
Use of Funds	Currently long or short nostro balances do not accrue time-based interest; this may be required to change if concepts of overnight and extended settlement are introduced. Scenarios which require pre-funding of CBDC will need to account for opportunity cost as well as consideration of timeliness of conversion between CBDC and Fiat and potential for fund being unavailable during conversion windows
Operating Practices	Existing processes for dealing with liquidity, capital (e.g CBDC as HQLA) and margin will need to be re-assessed to accommodate longer business hours as well as any processes associated with the creation and redemption of CBDC. This will also include any obligations that direct payment system participants may have and how these translate to CBDC use

2. Connectivity Models

Potential monetary policy transmission and market structure challenges could emerge depending on CBDC design – in so far as regulated banks/financial institutions are expected to help transmit monetary policy into the economy. BIS[20] has reflected upon cross-border payment frictions and interoperability, how enhancing compatibility of CBDC could reduce barriers increasing diversity, choice and competition, and how to make cross border payments quicker, cheaper and more transparent. Conceptually, the dimensions of payment system interoperability can be stylised in three models:

I. compatible CBDC systems (model 1);
II. interlinked CBDC systems (model 2); and
III. a single system for mCBDC (model 3).

Table 4. Includes the key characteristics for each of the three CBDC connectivity models as defined by BIS.

Operating Model	Rulebook and governance arrangement	Participant set / Transfers between CBDC networks	Infrastructure and ledger
Compatible CBDC system	Separate rulebooks and governance per CBDC network	Offered by multitude of competing private companies	Separate infra and ledger
Interlinked CBDC System	Separate rulebooks and governance per CBDC network	Clearing system established (centralized or decentralized)	Separate infra ledger
Single system	Single rulebook and governance arrangements	Single set of participants	Single infra, ledger and interface

GFMA has identify a series of pros and cons for each of the three connectivity models proposed by BIS to be considered.

2.1 Compatible systems

- **Pros:** Market driven FX solutions developed bottom-up/Competition. This model acknowledges different approaches and pace of CBDC development (scope, technology, use case etc) and offers potential for more variety in liquidity pools facilitating FX (less concentration).
- **Cons:** Can lead to fragmentation over time, but may end up consolidating in future – resulting back in a more centralized and concentrated model like today with correspondents.

2.2 Interlinked systems

- **Pros:** More standardization around FX mechanisms imposed from the start. This model acknowledges different approaches and pace of CBDC development (scope, technology, use case etc.).
- **Cons:** More difficult to implement as it requires higher degree of coordination. This may favor certain incumbents involved in shaping early designs and raises question of who (multi-national body) coordinates the clearing system.

2.3 Single system

- **Pros:** Ensures standardization and interoperability by design.
- **Cons:** Most difficult to implement as it requires huge degree of coordination. This model may favor certain incumbents involved in shaping early designs andraises the question of who (supra-national body) coordinates the entire network. Very likely to require some degree of "political alignment and integration"

Summary

This paper highlights some of the many open questions raised as capital markets firms contemplate a CBDC future. In order to support these efforts GFMA encourages that the considerations identified within are comprehensively and holistically answered before launching any CBDC.

20 BIS Papers No 115 (March 2021)

Appendix I: What are CBDCs?

Central Bank Digital Currencies (CBDC) is defined as " a "digital payment instrument, denominated in the national unit of account, that is a direct liability of the central bank."[21] In simpler terms, CBDC is a digital representation of currency in circulation, banknotes, and coins, or in economic terms, digital M0.

Central banks have become increasingly interested in the potential issuance of digital currencies. A January 2021 BIS survey of central banks found that 86% are actively researching the possible benefits and risks of CBDCs, while 60% are conducting experiments or proofs-of-concept, and 14% are deploying pilot programs[22]. Examples of the most prominent central bank initiatives include China's pilot for the digital Yuan since Q4 2020 with >55,000 corporate and >3.6 mil. individual wallets currently on trial. Also, the Bahamas launched the first phase of its national CBDC in October 2020, and the Swedish Riksbank launched an e-krona pilot in 2020. Other notable examples include the European Central Bank's public issued a public consultation on a potential digital euro[23], as well as the announcement of a joint Bank of England and HM Treasury CBDC Taskforce to coordinate the exploration of a potential UK CBDC[24]. There are many others, particularly in emerging markets, and tied to the innovation agenda. In February 2021, the U.S. Federal Reserve Board released a FEDS Notes stating, *'Preconditions for a general-purpose central bank digital currency'*[25] "are necessary, though not sufficient, and can be broadly grouped into five areas: clear policy objectives, broad stakeholder support, strong legal framework, robust technology, and market readiness."

International coordination and research on the development of CBDCs is also underway at different BIS Innovation Hubs, with four ongoing projects relating to CBDCs[26]. In support of that, the International Monetary Fund[27] assessed the legal aspects of CBDC which revealed that most central bank laws do not currently provide the legal basis to issue CBDC to the general public. In addition, it concluded that it is not legally evident that "currency" status can be attributed to a CBDC. There are other considerations as well that will have a significant impact, such as whether CBDCs should be legal tender, which implies mandatory acceptance.

What are the different types of CBDCs?

Access

One key differentiating factor between CBDC models is access. Central Banks today are considering whether CBDC can be for retail use only (gCBDC), wholesale use only (wCBDC) or general use (retail and wholesale use).

- gCBDC can be accessible to corporates, small businesses, and individuals. Intermediaries may or may not have access to it depending on whether gCBDCs are issued as strict M0 replacements. Whether that CBDC is just an MO replacement and whether it provides mandatory conversion to and from deposits will have significant implications[28].
- wCBDC is a type of CBDC where access is limited to financial intermediaries and can be used in DvP or PvP settlement. Intermediaries involved with wCBDC could be the existing ones that currently have access to central bank money, such as banks with direct central bank accounts (i.e. direct participants in the payment system), or be expanded to new providers, under certain conditions, depending on central bank objectives and risk appetite.

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21 CBDC as further defined by the BIS joint Report from 7 Central Banks (2020)
22 See BIS Paper No 114: 'Ready, steady, go? – Results on the third BIS survey on central bank digital currency' (January 2021).
23 Results of the consultation were published in the "Eurosystem report on the public consultation on a digital euro" (April 2021).
24 A joint announcement on the Central Bank Digital Currency Taskforce was published on the Bank of England website (April 2021). Following the announcement, the Bank of England published a Discussion Paper on 'New forms of digital money' (June 2021).
25 FEDS Notes 'Preconditions for a general-purpose central bank digital currency' (February 2021)
26 The BIS Innovation Hub CBDC webpage provides an overview on CBDC efforts and links to its ongoing projects relating to CBDCs.
27 IMF, 'Legal Aspects of Central Bank Digital Currency: Central Bank and Monetary Law Considerations" (November 2020)
28 AFME Position Paper, 'Considerations for a retail Digital Euro' (January 2021)

Access is an important consideration because it will determine what market participants can participate in, and benefit from the use of CBDCs. Access will also have significant implications on the role of financial intermediaries in the future state and potential systemic implications of disintermediation.

Distribution

Another key differentiating factor is the method for CBDC distribution, which includes whether the CBDCs are held directly on an account with a central bank. Three main models for distribution are considered by the BIS[29]:

- **hybrid gCBDC:** the central bank issues the CBDC but intermediaries distribute that CBDC and facilitate payments
- **indirect gCBDC:** the CBDC is issued by wholesale intermediary
- **direct gCBDC:** the central bank issues and distributes CBDC directly to retail and wholesale users

In all cases considered above, the claim for the CBDC is held against the central bank. Cases where the claim is held against an intermediary is considered a "synthetic CBDC". Synthetic CBDC, even if backed 100% by central bank money, is not free of counterparty credit risk.

A wCBDC is similar to what today is referred to as electronic central bank deposits, or also known as reserves or settlement balances, accessible to qualifying member institutions to a central bank. "Wholesale" here does not mean wholesale business users. In the case of a wCBDC, those intermediaries could be the existing financial institutions that currently have access to central bank money, such as banks with direct central bank accounts, or be expanded to new providers, under certain conditions, depending on central bank objectives and risk appetite. One could envision a direct issuance and distribution from the central bank, hybrid issuance where for example a selected group of intermediaries distribute (similar to those having central bank money access today) or even indirect issuance where a third party such as an FMI issues CBDC backed by deposits at the central bank. The BIS[30] and central banks do not consider indirect issuance, also referred to as "synthetic CDBC", to be a CBDC as the end user would not hold a claim against a central bank. This indirect or synthetic CBDC concept is out of scope for the purpose of this document.

The model used has important implications for wider financial markets. For instance, if an indirect model is used, there will be a role for intermediaries in managing the distribution of CBDCs. New intermediaries will need to be brought in scope of the regulatory perimeter, to ensure market integrity, financial stability, and a level playing field for all participants. We recommend that where possible, policymakers should leverage existing rules principles, and industry standards, such as the Committee on Payments and Market Infrastructures-International Organisation of Securities Commissions (CPMI-IOSCO) 'Principles for Financial Market Infrastructures' (a set of international standards for financial market infrastructures (payment systems, central securities depositories, securities settlement systems, central counterparties and trade repositories).

29 BIS Quarterly Review, 'The technology of retail central bank digital currency' (March 2020)

30 Central bank digital currencies: foundational principles and core features, (2020). Report by the group of central banks: Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors Federal Reserve System, and Bank for International Settlements

Appendix II

This paper highlights some of the many open questions raised as capital markets firms contemplate a CBDC future. In order to support these efforts GFMA encourages that the below questions are comprehensively and holistically answered:

1. Regarding the introduction of CBDCs for wholesale capital markets, what are the potential financial markets costs, benefits and risks, compare to traditional physical cash/electronic transfers and tokenized commercial bank money?

2. What is the nexus of the securities market and CBDCs? for example,
   a) is the development of CBDC critical for shortened securities settlement?
   b) does CBDC facilitate collateral optimization?
   c) will CBDC be held on-or-off balance sheets and what are the potential impacts this?
   d) does CBDC free up credit lines and provide additional liquidity?

3. What is the transitional and future structure needed to maintain confidence in the system, safety and soundness of financial market participants, and financial stability?
   a) who will provide the CBDC infrastructure?
   b) how will operating model/playbooks potentially change for capital market participants?
   c) who should be responsible for onboarding end users into a CBDC network?
   d) what is the short and long term CBDC roadmap (e.g. just retail, just wholesale, both retail and wholesale at the same time, a phase roll out, etc.)?
   e) does structure differ based on broader economic function (e.g. domestic vs. cross-border, closed vs. open currencies, etc.)?
   f) what regulations need to be harmonized to facilitate CBDC use?

4. What are critical CBDC features? for example,
   a) 24/7/365 payments and settlement?
   b) Secure to cyber-attacks?
   c) Privacy?
   d) Resilient to operational failure and disruptions?
   e) Compliance with all applicable regulations (AML, Sanctions, FATCS, PSD)?
   f) Interoperable between other CBDCs and/or existing infrastructure?
   g) Scalability?
   h) Ease of adoption/migration?
   i) Cold storage?
   j) Will system access be just traditional financial intermediaries, or will it be expanded?
   k) What is the appropriate balance between privacy / anonymity and KYC requirements?

5. Each capital market product segment should have different use cases for CBDC
   a) what is the current state of my product segment?
   b) what if my product segment could settle against CBDC (or what if everything became real time)? and finally,
   c) What would the transition look like?

Key Themes to Consider Regarding the Development of CBDCs:

1) Minimum Requirements for a CBDC Operating Model
2) Design Considerations
3) Regulatory/Legal Harmonization—consistent policy frameworks to decrease frictions cross-border
4) Business Model Impacts—cost/benefit analysis of market efficiencies and emerging risks to system
5) Market Considerations-who will provide critical infrastructure in a future paradigm
6) Transition pathways: consider what alternatives could be used (e.g., augmenting existing payment networks, creating new regulated liability networks) and the cost associated for individual firms and the system?

Theme 1 – Minimum Requirements for a CBDC Operating Model
Key Questions for Consideration
What will a hybrid model mean in practice and will a hybrid model be a short-term solution or the long-term end point?
Does the hybrid model work for those regulated banks not offering 'commercial bank'/retail services today?
Existing research identifies how the hybrid model works for retail, but are there other considerations with hybrid model when taking into consideration use cases for wholesale markets?
What are the minimum requirements and criteria for a viable CBDC operating model (e.g. on/off ramps[31], interoperability between CBDCs and interoperability with existing infrastructure)? Features to consider as requirements include, but are not limited to: digital time stamps, atomic real time settlement, 24/7 settlement, APIs, universal access, interoperability.
Does a CBDC operating model differ based on broader economic function (e.g. domestic vs cross-border, for closed vs open currencies, etc)?

Theme 2 – Design Considerations
Key Questions for Consideration
What are the most important considerations when designing a CBDC product (e.g. token vs account based, resilience considerations, and privacy issues)?
Should interoperability consider the use of traditional fiat, single-fiat linked stablecoins, tokenized commercial bank, and CBDC coexisting at the same time? Assuming answer is yes, how can they effectively be designed to co-exist?
Should interoperability consider the use of retail and wholesale CBDC at the same time?
Should interoperability consider anything else (e.g. domestic vs. cross border, open vs. closed currency)?
Who will have access to the system? Will it just be traditional financial intermediaries, or will it be expanded beyond to others (e.g. corporates, 'non-banks')? Are there new risks to the system for open access?

31 On/Off ramp providers will be important – be it central bank, or other institutions granted ability to mint/burn CBDCs and interact with existing RTGS (fiat) systems.

Theme 3 – Regulatory Harmonisation
Key Questions for Consideration
What regulations need to be harmonised to facilitate CBDC use? Which areas require harmonisation and why?
How can capital markets trade associations support the public sector efforts (e.g. participate in working groups, host roundtables, etc.)?

Theme 4 – Business Model Impacts
Key Questions for Consideration
Depending on if CBDC will be held on-or-off balance sheets, bank busines models will either be credit based or custodian based. What are the potential impacts of this?
How might CSD regulation evolve if CBDCs were available for wholesale use?
What will be the future roles for central banks, regulated banks, BigTechs, and Fintechs?
Who is ultimately responsible for onboarding end users into a CBDC network (performing KYC/AML)? Currently, this is generally done by commercial banks. If more centralised, CB onboards; if more decentralised (non-banks, fintechs etc.)?

Theme 5 – Market Considerations
Key Questions for Consideration
What are the potential benefits to the market (e.g. atomic settlement, risk/liquidity management, new liquidity pools/asset classes)?
Potential monetary policy transmission and market structure depending on CBDC design – in so far as banks/FIs are expected to help transmit policy into the economy.
Are there any views on which assets and which points in their trade life-cycle will be impacted the most, and what are the dependencies to achieving any positive results?

The Global Financial Markets Association (GFMA) represents the common interests of the world's leading financial and capital market participants, to provide a collective voice on matters that support global capital markets. We advocate on policies to address risks that have no borders, regional market developments that impact global capital markets, and policies that promote efficient cross-border capital flows to end-users by efficiently connecting savers and borrowers, benefiting broader global economic growth.

The GFMA brings together three of the world's leading capital markets trade associations to provide a forum for the largest globally active financial and capital market participants to develop standards to improve the coherence and interaction of cross-border financial regulation. We aim to improve the functioning of global capital markets to support global economic growth and to support lending and to serve clients in those jurisdictions they want to do business.

The Association for Financial Markets in Europe (AFME) in London, Brussels and Frankfurt, the Asia Securities Industry & Financial Markets Association (ASIFMA) in Hong Kong and the Securities Industry and Financial Markets Association (SIFMA) in New York and Washington are, respectively, the European, Asian and North American members of GFMA.