

SoK: Central Bank Digital Currency (CBDC) Requirements & Challenges

Abstract—With hindsight, the role of a currency is to facilitate trade. Every sovereign nation manages its currency through a public institution called central bank – solely responsible for supply of currency. Central banks exert their responsibilities as a response to the global and local economic conditions. There is empirical evidence of central banks failing to stop the rout of their respective currencies; thus, losing the trust of their citizens. Central banks act as a custodian of trust. Given the politico-legal framework under which the central banks exist and operate, there exists a room for policy-making that affects financial worth of an individual and in turn of a nation – thus highlighting the role of transparency in the discretionary powers of a central bank. In the recent past, the technological innovations from information technology have helped central banks to introduce digital currency; thus, cutting costs in management of currency and bringing speed in its movement. This technological evolution also brought in privacy concerns while checking the double-spend problem. Bitcoin addressed the double-spend problem in digital currency but introduced itself as a global open currency where role of central bank is done by an algorithm.

In the long and eventful evolution of currency we have come to a stage where one needs to reconsider the key decisions from the past that influenced the evolution of currency. In this paper, we discuss the key requirements in designing a CBDC and the challenges/limitations it faces.

Index Terms—Digital currency, Cryptocurrency, Blockchain, DLT

I. INTRODUCTION

The recent technological advancements in digital payments using blockchains, central banks around the world are experimenting with blockchain-based pilots for digital currency called as central bank digital currencies (CBDC) [19]. Traditionally, the central banks are responsible for managing the supply of money in their respective jurisdictions. They are the custodians of public trust. They have evolved from the gold backed collateral regime to the fiat currency regime [46]. In [14], the authors argue that the modern day central banks have not only failed to avert economic crises but may have even exacerbated problems by encouraging too much risk-taking and ethical issues through unconventional methods like quantitative easing and negative interest rates. A well-planned CBDC could offer central banks a fresh way to achieve various policy goals, enhance economic efficiency and inclusiveness, and foster economic innovation [37].

CBDCs are a digital fiat currency issued by a central bank and supported by the government's complete confidence and trust [13], [16]. The continued innovation of digital payments in several countries, exploring the potential benefits of digital currencies issued and backed by central banks [3], [39], [50].

However, there are lot on unanswered question on how this CBDC will flow through to its users.

The Bank for International Settlements (BIS) (2020) has pointed out that the adoption of CBDC brings about substantial challenges in international collaboration and cooperation, especially regarding cross-border payments between various nations. Furthermore, the absence of a universal understanding of CBDCs and a standardised regulatory framework might lead to difficulties in cross-border transactions and trade [50]. As different countries may have varied perspectives and methods concerning CBDC adoption, including payment procedures and systems, there's a crucial need to ensure that CBDCs are compatible and can be smoothly integrated with existing payment infrastructures to support international transactions.

Some cautions and considerations regarding CBDCs include striking a balance between monitoring for fraud and money laundering while preserving privacy and avoiding excessive surveillance. Additionally, there is a tension between the central bank's aim to control money circulation and the importance of safeguarding individual freedoms.

The history of central banking began the monetary authority for financial services and payment-related innovation has always been an integral part of central banking such as the establishment of real-payment system for immediate inter-bank gross settlement CBDCs represent another such potential innovation [11].

II. BACKGROUND

The financial ecosystem system has been rapidly evolved with technological advancements and changing consumer preferences. A key aspect of this transformation is the widespread adoption of digital payments, which offer convenience to its participants. The rise of digital payments fosters a cashless economy, enhancing payment convenience, reducing transaction costs, and increasing transparency to help mitigate financial crimes such as money laundering [23].

In the traditional financial system, central banks provide credit to commercial banks, it is recorded in the commercial banks' ledgers as central bank credit. This credit is not directly transferred to individual customers, but rather commercial banks use this credit to issue retail money to their customers in the form of deposits and other digital transactions. The digital money in customers' accounts represents adjustments in the balances of their accounts rather than physical currency. On the other hand, physical cash is the only form of money issued by central banks that is directly held and exchanged by customers.

A. Digital Currency

Digital payment also known as electronic payment system that transfer digital money from one account to another using digital technologies. Digital payment technologies refer to various methods of making electronic transfer of money. These are the electronic forms of dealing with fiat currency, where numbers represented in the ledger that are owned by the banks are treated as an equivalent to the physical currency. Easy access to digital devices and internet connectivity transform the way to the digital payments [7]. Technological development has enabled innovation in digital payment methods from traditional card payment to contact-less using mobile wallets and wearable to QR code [15], [38].

Digital cashless payments bring many benefits to individuals, businesses and governments [21]. Digital payments are fast, secure, and convenient, while also reducing cash handling costs for financial institutions. Governments and financial institutions actively encourage the adoption of digital cashless payment systems.

B. CBDC

A CBDC is a type of digital currency that is issued and regulated by a central bank [20], [33]. A pressing question arises: *What makes CBDC more special, given that the current money system is already digital?* According to [6], the key difference between digital currency and CBDC is that while digital currency represents a claim on an intermediary, CBDC represents a direct claim on the central bank [5]. Unlike cryptocurrencies, where open protocols control creation, transaction, and destruction, CBDCs are issued and managed by the central bank, just like fiat currency. Many central banks actively engaged in CBDC research remain focused on how it could boost financial inclusion, according to a BIS report [6]).

CBDC can be defined as a digital asset that aim to serves the basic functions of paper currency [17], with universal access and legal tender, which can be traced back to it organ. CBDC would satisfy the basic functions of money: a unit of account, a medium of exchange, and a store of value [12]. CBDCs are often discussed as digital cash with features with peer-to-peer payments and offline transactions. The aim is to replicate some of the characteristics of physical cash in a digital form, making it easy to use for everyday transactions and ensuring accessibility even when an internet connection is unavailable. However, the specific design and functionality of CBDCs can vary depending on each central bank's policies and implementation choices.

According to this study [28], countries such as Sweden, Norway, and Singapore are striving to increase domestic demand for central bank money, while others like the United States, the European Union, and China are focused on expanding the usage of their national currencies internationally. Additionally, countries like Uruguay, South Africa, and Cambodia are aiming to enhance monetary policy implementation, promote financial inclusion, or address the de-dollarization of the financial system.

C. CBDC vs Digital Currency

Digital money is a form of nations currency exists only in electronic form. Digital money offers a plethora of socio-economic advantages, including convenient payment methods, reduced transaction costs, and enhanced transparency in payments [21]. CBDC are not simply a digital version or representations of nation currency instead they are digital token that underlay the value of a nations currency. While both CBDCs and other digital money allow for electronic transactions and storage, CBDCs can be designed to offer universal accessibility, similar to physical cash, and are subject to governmental monetary policy and oversight. In contrast, other forms of digital money might be tied to specific platforms, services, or financial products and may be subject to varying levels of regulation and protection. Ultimately, the primary distinction between CBDCs and other digital money lies in the issuing authority and the nature of the claim, with CBDCs backed by the central bank and integrated into the broader monetary system, and other digital money operating within the commercial financial sector.

CBDCs tokens can offer more advanced features than traditional digital money. Digital money transactions can be categorised as either account-based or token-based [24]. In an account-based model, transactions are similar to regular deposit accounts. Users need to establish an account through which they can conduct transactions and exchange digital tokens. For each transaction, the user's information is accessed to verify the identities of both the sender and the recipient. On the other hand, token-based systems involve transferring the value of digital objects from one wallet to another. Transactions in token-based systems are authorised through public-private key pairs and digital signatures between the sender and the receiver [30].

D. CBDC vs Cryptocurrency

CBDCs and cryptocurrencies represent two distinct forms of digital money with fundamental differences. CBDCs are issued and regulated by central banks, and their value is generally stable, tied to a nation's fiat currency. They are subject to government oversight and regulation, and their design might aim for accessibility to all citizens and legal recognition as tender. Conversely, cryptocurrencies are typically created by private entities or decentralised communities, and their value can be highly volatile. They often operate outside central banking systems and provide higher levels of privacy and anonymity. While CBDCs may or may not be based on blockchain technology, cryptocurrencies are mostly built on decentralised blockchain technology. In essence, CBDCs are digital extensions of traditional currencies, aimed at modernising the existing monetary system, while cryptocurrencies seek to offer an alternative, often operating independently of government control and regulation.

As per a survey conducted almost 300 global payments leaders by Ripple [45] found that the majority of respondents believe the benefit of cryptocurrencies for payments is often considered to be faster payment resolution and lower cost.

Moreover, cryptocurrencies can significantly reduce the cost associated with payment transactions, both domestically and internationally. Traditional payment methods often involve various fees, such as transaction fees, currency conversion fees, and intermediary fees. These fees can be quite substantial, especially for cross-border payments, where the costs can add up quickly.

One of the major limitations of cryptocurrency transactions is the lack of regulatory support or oversight. Presently, cryptocurrency is subject to a diverse array of legal frameworks worldwide [44]. This absence of regulation can lead to a multitude of issues, including security concerns due to inadequate safeguards against fraud or theft, high volatility resulting in financial risk, potential legal and compliance risks, and obstacles in accessibility and usability. Without clear guidelines, users might inadvertently violate laws, such as anti-money laundering and tax regulations, leading to potential legal troubles. Additionally, this lack of regulatory backing might hinder the integration of cryptocurrencies into mainstream financial systems and create a lack of trust among potential users [41]. However, it is worth noting that some see this lack of regulation as a strength of cryptocurrencies, allowing for more freedom and innovation, but the call for regulatory clarity is growing in prominence as adoption increases.

E. Tokens (NFTs) as a Programmed Currency

The concept of tokens (NFTs - Non Fungible Tokens) refers to a digital object issued on a platform. Tokens can represent various tangible and intangible assets like ownership rights, stakes in a company, access to services, or units of value stored electronically [40]. They are commonly used in blockchain-based platforms and applications to facilitate transactions, governance, or to provide incentives within a network. The token concept has revolutionised how value and rights can be transferred, managed, and stored, allowing for new models of collaboration, ownership, and investment in the digital age.

A unique feature of a token in the context of CBDCs is that while each token's value may be fungible (interchangeable) with other tokens, each unit of the token is represented by an identifiable digital ID, similar to physical cash. Therefore, physical money such as notes or coins can be seen as a close comparison to CBDCs, but in a digital form. The designs of CBDCs aim to emulate the features of physical cash, such as handing over a banknote or coin, while also serving as a versatile tool that can be more than just a digital version of a nation's currency, satisfying numerous policy objectives [14], [43].

F. Real-time Payment System

Real-time payments refer to a payment system that swiftly transfers funds, ensuring immediate availability to the recipient. Upon authorization, the payer's account balance is promptly debited, and the recipient receives confirmation of funds in real time. Settlement times may differ among payment schemes but typically complete within seconds. Widely

acknowledged as one of the most significant financial innovations of the past decade [10], real-time payment services empower financial institutions to provide efficient, instant payment solutions either at minimal or no cost in some jurisdictions. These services play a pivotal role in driving digital adoption, fostering financial inclusion, and invigorating small business economies worldwide.

An essential aspect of retail payment systems lies in the swiftness of settlement and associated costs. Unlike traditional payment networks, where it may take a day or more for funds to reach the payee, real-time payment systems execute transactions instantly or near instantly. They operate on distinct network rails facilitated by central bank partnerships, prioritizing payment services and bypassing intermediaries, thereby reducing time and costs linked with delayed settlements.

Global efforts to develop and implement real-time payment networks vary. Typically initiated by central banks in collaboration with financial institutions, industry providers, and technology firms, these endeavors aim to deliver cost-effective and convenient real-time payment solutions. These networks offer an alternative to traditional payment network providers like Visa or MasterCard, ensuring enhanced efficiency and accessibility for users worldwide.

G. Key Difference Real-time vs Traditional Payment

In traditional card payment processes, the initiation of a transaction begins at the payee's point-of-sale (POS) terminal when a payer utilizes their card. Transaction details are then transmitted from the terminal to the acquiring bank's network, which subsequently forwards them to the card provider (e.g., Visa or Mastercard). The card provider routes the transaction to the issuer bank for approval. Once approved, the payer receives the product or service, and the acquiring bank commences the settlement procedure.

Conversely, in a real-time payment system, the payment flow follows a reversed path. The payer instigates the transaction to remunerate the payee and transmits payment details through their bank to the real-time payment network. Upon receipt, the network authenticates the payer's credentials, verifies the payee's information, and promptly executes the settlement on behalf of their respective banks. Subsequently, the payer receives notification of the transaction outcome, and funds are instantaneously transferred from the payer's account to the payee's account and their respective banks through the real-time payment network.

A critical distinction lies in the flow of payment communication: traditional card payments involve communication from the payee to the payer through intermediaries, whereas in a real-time payment system, the communication occurs directly from the payer to the payee. This direct communication enables immediate settlement and notification of transaction outcomes. The payer authorizes the payment, which is swiftly deducted from their account and made available to the beneficiary through the real-time payment network.

III. CBDC: DESIGN CONSIDERATIONS

There are a number of compelling reasons why central banks are interested in CBDCs. Monetary authorities worldwide are actively seeking guidance on the optimal approach to implementing digital forms of central bank money. In our view, modernisation of the payment system and to retention the control over the financial system, are two important reasons for central banks to explore CBDCs.

A. *Payment Categories: Retail, Wholesale, Cross-border*

Retail payments are transactions carried out between individuals and businesses. Retail payments typically cater to everyday transactions between individuals and businesses settled through commercial banking systems. Wholesale payments refer to transactions conducted between commercial banks. Whereas, cross-border payment involves two or more currencies and their respective facilitating banks.

B. *Technological Advancement*

As technological advancements continue to reshape financial services, central banks want to stay relevant and adapt to changing consumer preferences [4], [29]. The development of CBDCs is seen as a way to modernise the payment system and keep up with technological advancements [28]. This would make transactions more efficient, lower costs, and potentially increase financial inclusion by making banking services more accessible to those without traditional bank accounts [23]. The underlying concept of digital token in CBDC can solve a range of problems but they are subject to the technological development of that country's payment infrastructure which includes:

- Financial inclusion by providing access to a wider population.
- Quicker and efficient transactions settlement for payments.
- Lower transaction costs compared to traditional payment systems.
- Cross-border payment - UAE settled its first cross-border payment to China using the Digital Dirham [8].

While both real-time payments and CBDCs represent significant technological advancements, they differ in their approach and impact on the financial landscape. Real-time payment systems utilize established banking infrastructure to enhance transaction speed and convenience. In contrast, CBDCs signify a more transformative innovation, necessitating the creation of new infrastructure and potentially incorporating blockchain or distributed ledger technology to facilitate issuance of digital currency by central banks.

C. *Financial Control*

The emergence of digital currencies like Bitcoin and the increasing popularity of stablecoins have put central banks under pressure to create their own CBDCs to stay relevant and competitive in the global financial landscape. Central banks are concerned that widespread adoption of independent cryptocurrencies could weaken their control over the monetary

system and potentially lead to financial instability [2], [42]. As the use of cryptocurrencies increases, there is a risk that public trust in traditional fiat currencies issued by central banks may decline [27]. The increasing adoption and rise in popularity of cryptocurrencies and stable coins prompted central banks to explore the idea of CBDCs. There is also a competitive aspect, as central banks may feel the need to offer a digital currency option to keep up with private-sector alternatives. This is especially true if they perceive that these private digital currencies might become widely adopted and diminish the central bank's influence over the economy.

D. *Monetary Control*

The introduction of CBDC can lead to enhanced monetary control by the government for several reasons. Unlike cryptocurrencies, which operate on decentralised networks, CBDCs are more likely to be centralised, allowing the government to directly oversee and manage the monetary supply [1]. This enhanced control can enable more effective implementation of monetary policies, like controlling inflation or stimulating economic growth. Moreover, CBDCs can provide real-time data on financial transactions, aiding in the fight against money laundering and other illicit financial activities. While this increases transparency and accountability, it also raises concerns about privacy, as it could allow governments to closely monitor individual transactions. The increased control over money through CBDCs is seen by some as a potential tool for financial stability, but it also opens up a discussion about the balance between state control and individual privacy.

E. *Privacy*

Privacy is a major issue, as finding the right balance between individual privacy rights and the need for transparency and compliance with anti-money laundering (AML) regulations can be complex. Many believe that the implementation of CBDC systems may lead to privacy concerns, as central banks would have the ability to monitor transactions. However, it is important to note that financial institutions in the current digital financial system already record and monitor users' financial activities. These institutions are required to comply with data protection and privacy laws, ensuring the appropriate usage and protection of users' personal and financial data. If the CBDC system is implemented by the same financial institutions, existing privacy measures and regulations would apply, mitigating any additional privacy concerns. The same safeguards and protections that are in place for the current digital financial system could be extended to CBDC systems.

1) *Privacy and Data Protection:* The right to privacy and the protection of personal data are fundamental rights of individuals [49]. The protection of people's privacy, as well as their ability to control their personal data, should be a key priority for system developers. Ensuring an appropriate level of privacy and data protection is crucial to fostering public trust in any system, which would underpin its adoption and use.

Rigorous standards of privacy, accountability for the protection of users' data, and transparency in how information is secured and used are essential for the development of any system to command trust and confidence. However, privacy and data protection must be balanced with other public policy objectives, particularly anti-money laundering and combating the financing of terrorism (AML/CFT), and combating tax evasion. Additionally, open banking can be facilitated by the sharing of private data. It is up to co-legislators to determine where to establish the appropriate balance among these objectives.

2) *Privacy Model for a CBDC* : Users of any digital payment service currently need to identify themselves to the service provider before they can use such services. Likewise, a CBDC would also be treated similarly to other digital payment services or would have its own regime, which can be seen as regulatory compliance requirement.

Privacy may vary based on the mode of payment such as online and offline. Low-value offline payments can provide a level of privacy equivalent to cash transactions, where users may not need to share transaction data. Users can load CBDC onto their devices, similar to withdrawing cash from an ATM, although an offline limit may exist based on the terms and conditions set by the system. Online CBDC payments should take privacy, data protection, and AML/CFT rules into account to ensure conformity with other relevant legislation that is already applicable to electronic payments.

F. Centralise Control

Decentralisation is core principle of the permissionless blockchain ecosystem and it is the most crucial and first key feature of cryptocurrency. When it comes to deciding between using a permissioned or permissionless blockchain architecture for CBDC, the majority of research recommends opting for a permissioned blockchain [32], [47], [48], [51]. Corda and Quorum are permissioned distributed ledger technologies designed for intrabank and cross-border payments. Recent studies have also focused on the ability to achieve interoperability between different blockchains for cross-border transactions, a function that is considered one of the most crucial for digital money [26], [34]. In reality, CBDCs will be on a permissioned ledger governed by a central authority that governs its creation, distribution and activities. They are issued and managed by central banks of respective countries whose blockchain network interaction and accessibility are only available to particular financial institutions with necessary requirements.

G. User Control

Digital tokens transacted through a decentralised ledger makes it transparency for its participants about the ownership of token and its transaction. Users able to take custody of their tokens and store their tokens in digital wallets and transact with it in different ways which includes peer to peer and offline payments with out an authorisation of a bank.

Depending on its design, a token-based CBDC might even allow for offline peer-to-peer transactions. A traditional account-based digital money systems usually require transactions through a banking infrastructure validation by a centralised authority. However, the token concept in CBDCs can offer a digital equivalent to physical cash, with direct transferability from traditional account-based digital money. It aligns more closely with some principles of decentralised cryptocurrencies while maintaining central bank control and oversight, offering a way for central banks to innovate while retaining attributes of physical currency.

A digital asset is a non-tangible asset that is created, traded, and stored in a digital format whereas tokens are digital asset class created on a platform by a protocol or issuer. These tokens are programmable and serve a multitude of functions on the platforms they are built. Programmable is a platform-specific feature on the network, means platform run specific software protocols, which composed of rules that outline the features and functions of the token. Programmability, is also refereed as *conditional payments* [18]. The difference is that while the programmability would potentially allow the central banks to control financial transactions, conditional payments imply that such controls would be implemented by the private sector using tools provided by the central banks.

The token concept in a CBDC represents a specific embodiment of money as a digital object or token, rather than an account-based representation [36]. This distinction holds significant implications, especially when comparing CBDCs to general digital money. In a token-based system, ownership of the token equates to ownership of the value it represents, and the token can be transferred directly between parties without an intermediary, much like physical cash.

IV. CBDC: DESIGN CHALLENGES

Developing and implementing CBDCs present several challenges. First, there are technical challenges in creating a secure, scalable, and efficient technology platform. Ensuring that the underlying technology is robust enough to handle the demands of a national currency. Second, interoperability is another significant challenge. CBDCs must work seamlessly with existing financial systems and other digital currencies, requiring intricate design and well-planned integration. Lastly, the potential change in underlying network architecture, determining who will run and govern the network in accordance with regulatory compliance.

A. Platform

The current architecture of financial system is a two-tiered architecture where central banks control the governance of money, and commercial banks deal with all consumer-facing activities [6], [22]. The value of money is safeguarded by trust in central banks, who also stabilise the inflation. As commercial banks handle the customer-facing side of retail payments, the underlying question is how the functional architecture of CBDC to be a direct claims on central bank works?.

In a one-tier system, the central bank directly distributes digital money to end users. In a two-tier system, the central bank distributes digital currency to commercial banks, who then serve as intermediaries to distribute the currency to individuals and businesses. Today, the role of central bank money comprises of issuing banknotes to the general public, and digital deposits to financial institutions. Only a small fraction of central bank issued money is in circulation most money now consists of digital deposits issued to households and firms by regulated private institutions like banks.

We like to highlight the relationship between the central and commercial banks in implementing and accepting CBDC services. Currently, two forms of CBDC are being discussed: a retail CBDC and a wholesale CBDC [28], [31]. The central bank will be the sole issuer of CBDC, and they issue wholesale CBDC to the commercial bank. Wholesale CBDC is mainly used for settlement between various commercial banks or payment service providers. In other words, the central bank will update the ledger balances of commercial banks and service providers of account of CBDC. This CBDC is not directly available for consumers' retail purposes instead commercial banks issue a retail CBDC to their customers. Prior studies have investigated the potential of wholesale CBDCs to enhance liquidity and function as a payment mechanism within financial markets [25]. Early discussions suggested the central banks would handle all aspects of the CBDC, but this evolved to involve commercial banks, especially in handling customer facing role with retail CBDC.

The objective of this retail CBDC is to fulfill the payment requirements of both households and businesses. Depending on its final design, the CBDC may facilitate or restrict payments beyond the conventional financial sector [35]. Depending on the design, CBDC models might even allow for offline transactions, replicating the ability to exchange physical cash without an internet connection. Like physical cash, CBDCs would be recognized by the government as legal tender. However, they would also exist in digital form and be subject to various technological requirements, security measures, and potential regulatory controls that differ from those applying to physical cash. Thus, while CBDCs often aim to replicate some features of physical cash, they also introduce new characteristics and capabilities that reflect their digital nature and the specific policy goals of the central banks issuing them.

B. Interoperability

The assumption is that CBDCs will not entirely replace existing digital money systems. Instead, both digital money and CBDCs will exist simultaneously [9]. This is important because the integration of digital money systems into various business processes is already widespread. Introducing CBDCs into this landscape could potentially disrupt the current financial ecosystem, particularly systems that rely on intermediaries' services.

For digital money and CBDCs to coexist effectively, it is essential to ensure interoperability between the CBDC system

and the existing financial systems. This means that the CBDCs should be designed in a way that allows seamless integration with the current infrastructure, enabling smooth transactions and compatibility with the services provided by intermediaries. Achieving interoperability will be crucial in ensuring a smooth transition and coexistence of digital money and CBDCs within the financial ecosystem [?].

C. Platform & Regulatory Compliance

We assume that to keep the operational burden of the central bank low with CBDC, the private sector play an essential role in all customer-facing activities, just as in today's financial system. Private sector will provide the network services and central banks will manage the minting operations, define smart contracts, and establish policies related to settlement, privacy, and data management. Network providers provide the infrastructure for running the network servers on behalf of the central bank. Participating regulated entities, such as banks, handle account balances, account control, and the distribution of CBDCs. They are also responsible for KYC (Know Your Customer), AML (Anti-Money Laundering), and CFT (Counter the Financing of Terrorism) compliance. Account information service providers and payment information service providers are involved in the retail side of CBDCs, ensuring offline and online storage of transactions and facilitating instant and immediate payment systems.

The design of CBDC systems needs to consider a balance between preserving privacy and avoiding excessive surveillance, while simultaneously ensuring robust security measures and complying with regulatory requirements. Coexistence is an important aspect of CBDC implementation. Since CBDCs must coexist with existing systems, such as traditional banking systems, there is a need to determine the level of integration and interaction between them. Standards also play a significant role in ensuring interoperability when multiple CBDCs exist. When different countries or entities develop their own CBDCs, having common standards can facilitate seamless interactions and transactions between these digital currencies. Standardisation helps establish a framework for compatibility, efficiency, and ease of use across different CBDC systems.

D. CBDC & Real-time payment system

Both CBDCs and Real-time payment system promise to move money in real-time. By design Real-time payment system is a permissioned network where banks communicate with each other to honor credit/debit instructions from their clients present across banks. Currently, the only programmable option Real-time payment system network provides is the time-triggered transfers. Such triggers are visible only to the banks whose customers have constructed them. However, in a CBDC network, which is also a permissioned network, there could be more than one class of entities (apart from banks). It is "possible" to write and see not only the time-triggered transfers but also event-triggered transfer requests. Several of the routine, non-confidential transactions can pave way for

optimized allocation of capital in the financial system – one of the mandates of central banks.

A report from the Bank for International Settlements (BIS) outlines *high-level requirements for a CBDC architecture*, discusses whether to reuse functionality from existing real-time payment system infrastructure for CBDC or to develop it from scratch [?]. The report summarise that the decision to use a real-time payment system for running a CBDC should be made based on a careful assessment of the trade-offs between leveraging existing infrastructure and developing new functionalities to meet the specific needs and goals of the CBDC project.

V. CONCLUSION

Though CBDCs intend to replace the fiat currency, there are no successful implementations that derive all the properties of the fiat currency. By directly issuing the CBDC to retail customers, what role the commercial banks will play is yet to be ascertained. The central bank being at the helm of each CBDC transaction (to avoid double-spend), a potential surveillance infrastructure may take shape if the privacy concerns are not addressed in the design of a CBDC implementation. Design considerations like a restricted, layered-view of the transaction ledger will allow a masked view of transaction attributes/metadata to the subjects who have authorization to access the attributes at that authorization level – the default, lowermost layer shows only the presence of a transaction.

Several pilots are being experimented by major central banks across the world with a varying success. A broader question remains unanswered: what functional benefit will a CBDC provide as compared to the current digital wallet-based fiat currency interface? Despite this unanswered question at the retail side utility of the CBDC, the CBDC clearly has a compelling use case in wholesale side of the financial system, where transparency, speed, and real-time settlement are desired.

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