Summary of the Workshop on Technology for Retail Central Bank Digital Currency (CBDC)

Held virtually on 25 May 2023, 13:00 – 14:30 CET, via WEBEX platform.

Introduction

On 25 May 2023, the BIS Innovation Network (BISIN) organised a workshop on technology for retail central bank digital currency (CBDC). The workshop was organised to engage with BISIN members in an open discussion on an important emerging trend in financial technology. Around 90 participants joined online with representatives from the central bank members.

The objective of the workshop was to share experience with respect to technology used in the retail CBDC experiments (e.g., centralised, and decentralised ledger technology), its benefits, and challenges. The workshop included presentations from both private and public sector representatives.

The workshop focused on exploring four main issues (security, offline capabilities, privacy, and end-user experience) in three sessions: i) insights from industry leaders in technology; ii) security standards and design of offline capabilities for retail CBDC; iii) user attraction and privacy in retail CBDC.

Session 1: Insights from industry leaders

Speakers: Mr. Richard G Brown, R3 and Mr. Raoul Herborg, G&D
Moderator: Mr. Daniel Eidan, Adviser, BISIH Swiss Centre

This session focused on strategic consideration for using technology in retail CBDC projects. Some key points discussed in this session are the following:

- DLT offers a new potential architecture for building cash-like digital payment systems, such as CBDC, which could also provide a mix of online and offline capabilities.

- The technology choice for retail CBDC should align with the desired outcomes and use cases of the CBDC, and trade-offs should be carefully considered. Eventually, the decision to support offline or online capabilities has significant implications beyond performance.

- Policymakers should make decisive decisions to create successful and innovative products like CBDCs, acknowledging that central banks face unique challenges in this area.

- Policy and architecture are important; however, its success will also ultimately depend on consumers' adaptation.

- The design criteria for retail CBDC should not come purely from a technological perspective but by understanding the needed requirements. There are five especially challenging criteria which should be considered when designing retail CBDC:

    i) re-spendable offline transactions for financial inclusion and resilience;

    ii) balancing privacy versus transparency, acknowledging the differences in different countries;

    iii) providing a platform for innovation where local companies can build products and services on top of CBDC

    iv) ensuring robust defense and resilience against attacks, even at the government level;

v) delivering production-level performance to meet user demands.

- DLT offers significant benefits, particularly in environments where there is no single trusted entity. It provides features like atomicity, immutability, decentralization, and consensus. However, two critical aspects need to be considered when applying DLT to CBDC. First, whether there is a single source of trust for validating payments, and second, whether the money itself should be programmable or if programmable payments should be provided separately. No matter whether a DLT or a non-DLT solution is applied, the design criteria described require a token-based approach.

- Some key learnings from two recent CBDC Projects are: (i) strong user adoption was observed in one project that fosters financial inclusion; (ii) integration with the private sector is crucial for smooth adoption and to encourage private sectors to build innovative products on top of the CBDC platform; (iii) it is important to tailor the technology choices to suit the specific requirements of CBDC projects and achieving the desired policy objectives.

Overall, the session emphasizes the importance of setting realistic expectations and practicing patience are crucial due to the multi-year nature of these projects. While technology is important, it is just one aspect of the overall picture. Ultimately, policy should take precedence and drive the key functional requirements, ensuring that the CBDC aligns with broader policy objectives.

Session 2: Security aspect and design of offline capabilities for retail CBDC

Speakers: Mr. Kimwood Mott, Central Bank of The Bahamas and Mr. Abdul Shadrach, Central Bank of Nigeria
Moderator: Mr. William Zhang, Adviser, BISIH Nordic Centre

This session discussed issues around related to offline capabilities and security aspects. Some highlights from the discussions are as follows:

- The first project presented was a retail CBDC system developed on a hybrid architecture that combines both decentralized and centralized technologies to provide a secure, robust, and highly scalable system that is not bound to the limitations of a DLT-specific approach. The system replicates traditional fiat monetary operations, using a multi-layered architecture with a traditional database for high throughput and a blockchain layer for transaction finality and immutable proof of spending. It operates on a permissioned DLT network controlled by the central bank, ensuring security, integrity, and performance through monitoring tools.

- One of the novelties of this project is the use of TV Whitespace (TVWS) technology for offline transactions. It deployed nodes around the islands and the system would automatically search for this white space and be able to transact to that network when all other telecommunication and internet systems would go offline. TVWS nodes were strategically placed, and when internet connectivity was unavailable, transactions within a specific radius of the nodes were recorded offline. Once the nodes reconnected to the centralized hub, the transactions would settle. The finality of settlement of the offline payments will occur only when the payment is recorded back on the ledger. It was also mentioned that the CBDC system implements different layer for offline payment and online payment. It was shared that while an offline prototype may have been novel, it has posed

some challenges for scalability in a post-pandemic world. However, there was not any cyber/fraud attempts observed so far when the offline nodes were activated, which was mainly during the pandemic.

- The second project presented was a retail CBDC system built on a DLT solution with a blend of conventional data balances. The primary aim of this approach is to establish a system of trust, essential when the government is involved in the financial system and blockchain technology. The presentation highlighted the strong business case for adopting blockchain in CBDC implementation to ensure secure and trustworthy transactions at all times. The CBDC ecosystem comprises various layers, with the core being the blockchain-powered ledger, provided by a partner as a service to the central bank. Building on top of the ledger is the Bifrost layer, which facilitate additional functionality beyond the ledger level using a traditional database. It was shared that collaboration played a pivotal role in the implementation, with various players, such as financial institutions and Fintechs, contributing to the ecosystem and providing CBDC services efficiently and cost-effectively. To ensure the security and success of the CBDC system, there are numbers of element that were used, such as robust cryptographic protocols, secure storage, strong access control mechanisms, and a risk-based approach.

Session 3: User attraction and privacy in retail CBDC

Speakers: Mr. Changchun Mu, The People's Bank of China and Ms. Aniko Szombati, Central Bank of Hungary
Moderator: Mr. Morten Bech, Head of the BISIH Switzerland Centre

This session discussed issues around user attraction and privacy concerns for retail CBDC. Some highlights from the discussions are as follows:

- The first presentation highlighted that in a situation where retail payment market is huge and has high transaction volumes. The decentralized systems cannot meet the high demands of the market. Specifically, the DLT systems face performance bottlenecks due to consensus mechanisms, limiting its scalability. To address these challenges, the CBDC system adopts a hybrid architecture. It combines a scalable centralized infrastructure to support high concurrency and low latency in retail payments with a unified distributed ledger and smart contract functionality. The centralized system achieves linear scalability and can handle current and future transaction volumes, including microtransactions.

- The CBDC project deployed smart contracts within the centralized wallet system. One example is implementing smart contracts for prepaid fund management, locking funds in wallets and releasing them to online education merchants after class completion. Each authorized operator can compose its own smart contract templates, and a centralized system manages these templates, enabling micro-apps and future trans-institutional smart contract deployments. While DLT offers additional functions, their centralized system provides a suitable environment for smart contract deployment.

- Regarding privacy protection, the CBDC system offers different categories of digital wallets with varying levels of anonymity. The least privileged category allows users to open a wallet with only their mobile number, providing a certain level of anonymity for small transactions. Upgrading to larger value transactions requires additional identification. Additionally,

measures are in place to protect personal information, comply with data protection laws, and detect suspicious transactions using big data analysis and AI monitoring.

- The second presentation shared about a pilot project in which a centralized system applied based on high-performance and scalable architecture. The system includes account management, connection to an instant payment system, and integration with commercial banks, merchants, and other service providers. The pilot project aims to test the capabilities and limitations of the system while studying real-life user behaviour and system performance in a real-life environment. It was shared that it is key to make integration with existing market infrastructure, using standardized data transmission requirements and interoperability to lower barriers to entry and ensure widespread adoption. The presentation also highlighted that serving customer needs directly is a new area for central banks, and conducting multiple pilots can help identify suitable use cases for CBDCs. The project helped raise awareness, gain experience for central bank in designing customer-centric applications, develop proper KYC processes, and collaborate with commercial banks and fintechs. Challenges faced in this pilot include integrating the new system into the existing complex central bank architecture, ensuring high-level security standards, and acquiring new skills for agile implementation.