Central Bank Digital Currency Experiments
Progress on the Pilot Program (April 2024)

Payment and Settlement Systems Department, Bank of Japan

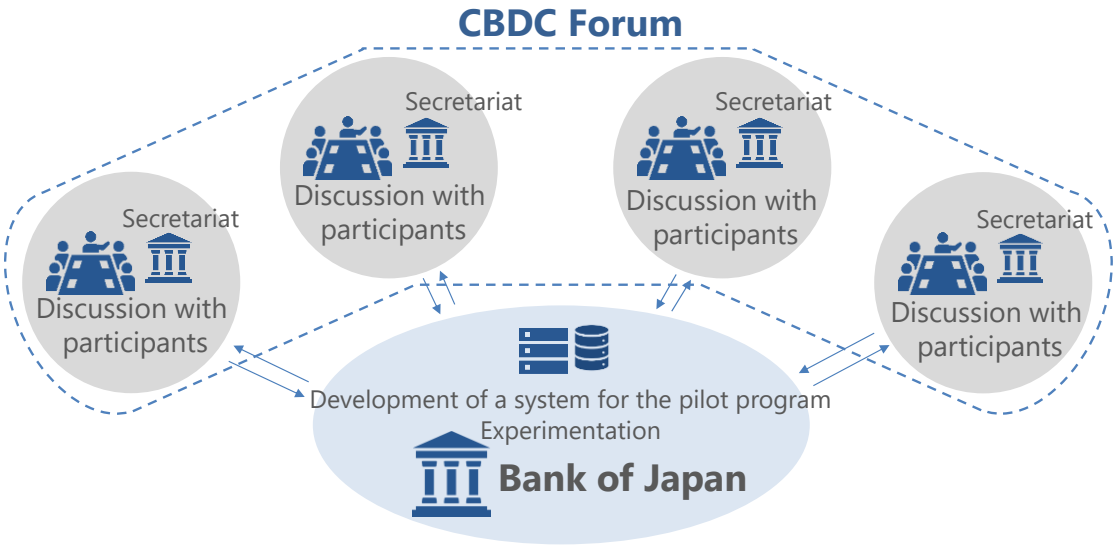
CONTENTS

1 Introduction

Based on "The Bank of Japan's Approach to Central Bank Digital Currency,"[1] which was released in October 2020, the Bank of Japan has examined whether the basic functions and features of a Central Bank Digital Currency (CBDC) are technically feasible through two phases of Proof of Concept (PoC): PoC Phase 1 (from April 2021 to March 2022) and PoC Phase 2 (from April 2022 to March 2023).[2]

Since April 2023, the Bank has been proceeding with a pilot program with the aim of conducting technical evaluation not explored in the PoCs, while leveraging the skills and insights of private businesses. The pilot program revolves around two pillars: "development of a system for the pilot program and experimentation" and the "CBDC Forum" (Figure 1). In the former, performance tests are conducted on the system developed by the Bank, and various types of desktop experimentation are carried out on functions that are not implemented in the system. In the latter, the Bank acts as the secretariat and conducts practical discussions on a wide range of themes with private businesses related to retail payments. The findings gained through the two pillars are fed into the work of each other as necessary. This report, compiled by the Payment and Settlement Systems Department of the Bank, summarizes progress made on the pilot program as of the end of March 2024.

Figure 1. Overview of the pilot program



[1] For details, see Bank of Japan, "The Bank of Japan's Approach to Central Bank Digital Currency" (October 2020).

[2] For the results of the PoCs, see the following references: Payment and Settlement Systems Department, Bank of Japan, "Central Bank Digital Currency Experiments: Results and Findings from 'Proof of Concept Phase 1'" (May 2022). Payment and Settlement Systems Department, Bank of Japan, "Central Bank Digital Currency Experiments: Results and Findings from 'Proof of Concept Phase 2'" (May 2023).

2 Development of a system for the pilot program and experimentation

One of the pillars of the pilot program involves the development of a system for the pilot program, the conduct of performance tests, and desktop experimentation focusing mainly on functions that are not implemented in the system. The following provides (1) an overview and the development status of the system and (2) an overview of and recent developments in the experimentation.

2.1 Overview and development status of the system

The pilot program is broader in scope than the PoCs. While the PoCs focused mainly on the ledger in the central system, the pilot program has an end-to-end coverage ranging from endpoint devices to the central system (Figure 2).

Against this background, the system for the pilot program goes beyond the development of the central system to include that of intermediary systems, the intermediary network system, which connects the central system with the intermediary systems, and endpoint devices (apps for smartphones and tablets). We will eventually test the end-to-end process flow while exploring potential challenges related to connections with external systems and measures to address them.

Figure 2. System for the pilot program and its scope

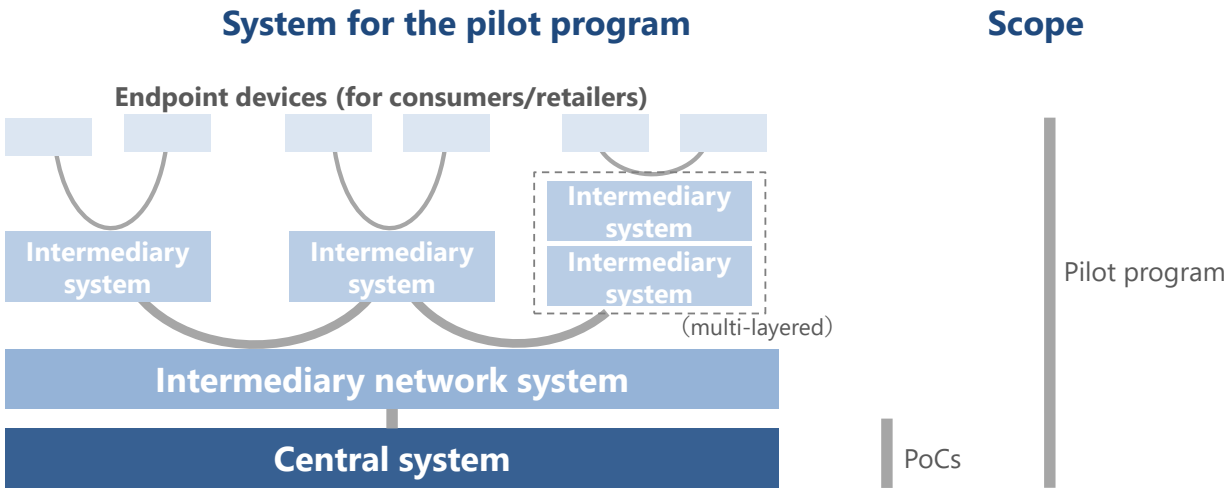


Figure 3 illustrates an overview of the structure of the system currently under development, which adopts the CBDC ledger design of an account-based data model

with shared management between the central system and the intermediary systems.[3] For clarification, this does not imply that the Bank has already decided on the ledger design suitable for potential social implementation. Rather, the idea is that this ledger design has a relatively complex system configuration and is thus expected to allow for further examination of various issues. Other ledger designs will also be explored during the desktop experimentation as we take into account the findings of the experimentation using the system.

In consideration of privacy, we plan to separate the intermediary systems handling customers' personal information (customer management component) from those processing payment (CBDC ledger component).[4]

With regard to performance, we aim to build a system that can handle higher load processes than the PoCs.[5] In doing so, we will identify and evaluate technical issues and solutions, so as to satisfy performance requirements in the possible event of social implementation.

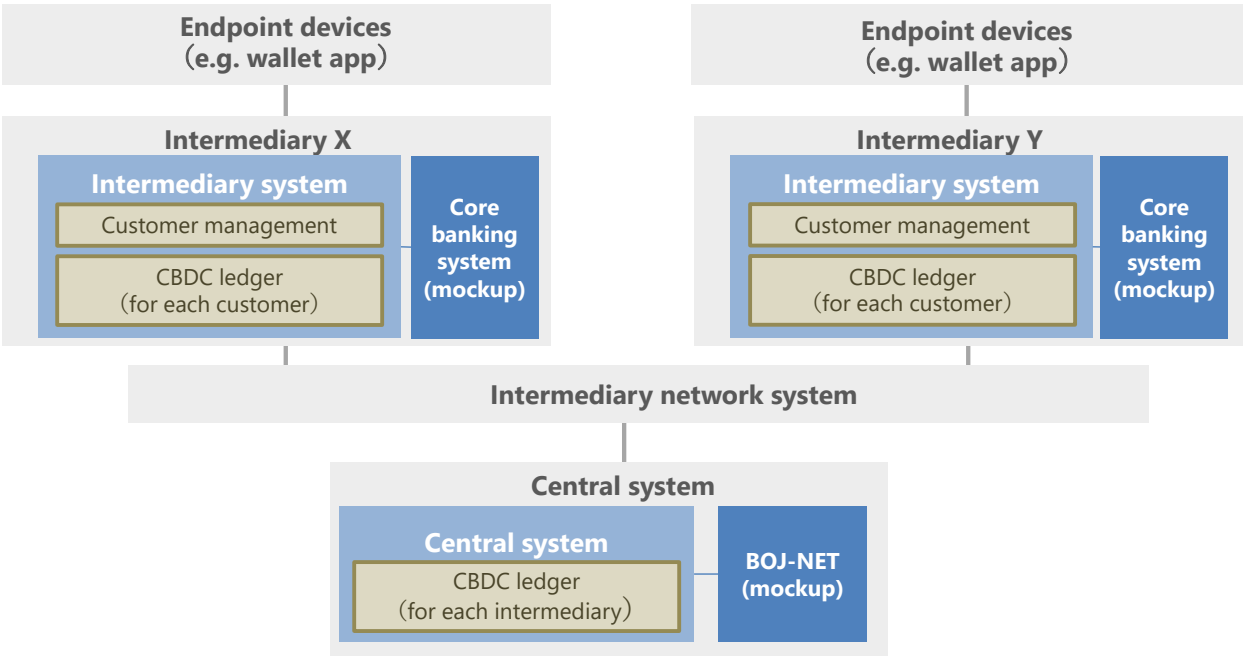
Furthermore, during the system design phase we plan to incorporate features that support functional and performance scalability, which may lead to identifying and evaluating technical issues and solutions.

[3] This ledger design corresponds to Design 2 in the PoCs.

[4] Other central banks in developed countries have similar considerations for privacy. For example, the European Central Bank (ECB) has presented in "Digital euro market research" (January 2023) a preliminary requirement that "[t]he Eurosystem will not itself be able to monitor the holdings of any individual or track the transaction history or infer payment patterns of any user." Similarly, the Bank of England (BOE) proposed at the time of joint consultation with HM Treasury in February 2023 that "[a]ny information accessed by the Bank would have to be effectively anonymised off-ledger."

[5] In the PoCs, we assumed a typical load of tens of thousands of transactions per second and a peak load of 100,000 or more transactions per second as the processing performance required for potential social implementation.

Figure 3. System overview



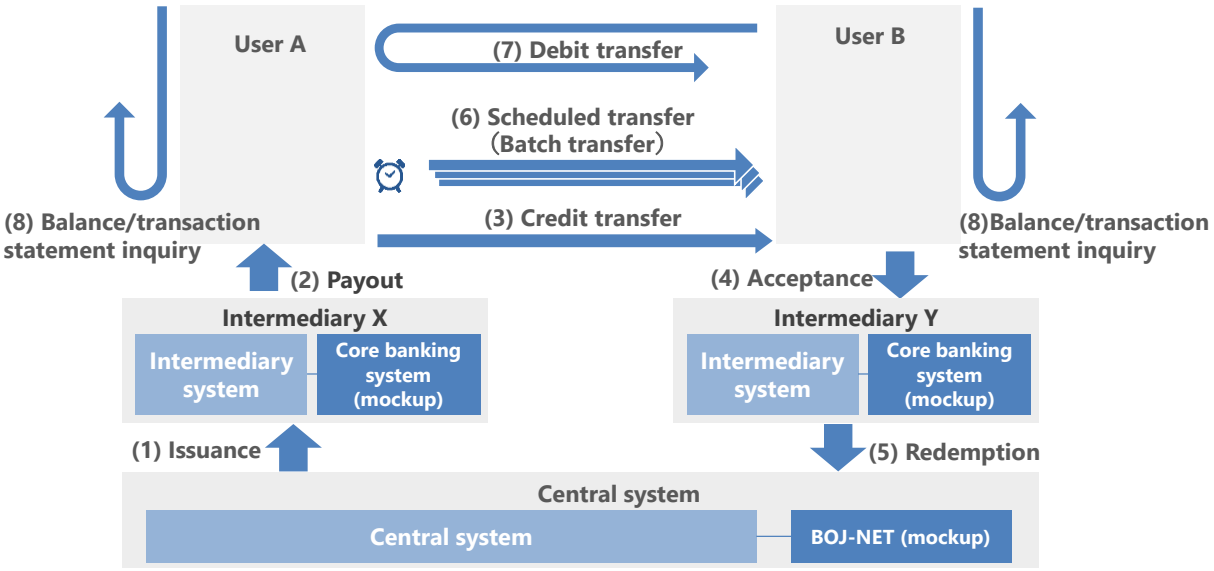
The system will be equipped with a series of basic functions that were also built into the system for the PoCs, namely, issuance, payout, credit transfer, acceptance, and redemption (Figure 4). In addition, the system will be equipped with auto-swing[6] and auto-charge[7] functions, which can be triggered at the time of transfer, and limit check functions against, for example, a holding limit. In the pilot program, we aim to cover a wider range of technical considerations and solutions than the PoCs, by expanding the scope of the system to include not only the central system but also the intermediary systems and endpoint devices.

Further, additional functions, such as scheduled transfer including batch transfer, debit transfer, and balance/transaction statement inquiry, which were built into the system for PoC Phase 2, are also planned to be incorporated.

[6] An auto-swing function is the automated acceptance of CBDC for the amount in excess of a holding limit into, for example, a bank deposit account linked to a CBDC account.

[7] An auto-charge function is the automated payout of CBDC for the amount that enables a transfer from, for example, a bank deposit linked to a CBDC account, when the balance of a CBDC account is insufficient for the transfer.

Figure 4. Basic functions and additional functions



Function	Outline
Basic functions	
(1) Issuance	The current account deposit of intermediary X at BOJ is debited while its CBDC account is credited.
(2) Payout	User A's deposits, for example, are debited and CBDC is transferred from intermediary X to user A.
(3) Credit transfer	CBDC is transferred between users. ・Auto-swing, auto-charge ・Various limit checks (such as holding limits)
(4) Acceptance	CBDC is transferred from user B to intermediary Y and user B's deposits, for example, are credited.
(5) Redemption	Intermediary Y's CBDC account is debited while its current account deposit at BOJ is credited.
Additional functions	
(6) Scheduled transfer (Batch transfer)	Transfer instructions to be executed in the future are registered and executed automatically at a specified time. (Batch transfer is the batch execution of multiple transfers)
(7) Debit transfer	Based on the prior consent of the payer, the payee sends a debit transfer instruction to the payer's account and initiates the debit transfer.
(8) Balance/transaction statement inquiry	Inquiries are made on a statement of the user's current balance and its transaction history of CBDC managed in an intermediary system.

2.2 Overview of and recent developments in the experimentation

After developing the system, relevant experimentation including performance tests will be carried out using the system.

In parallel with the system development and relevant experimentation, we will perform desktop experimentation on functional and non-functional aspects of a CBDC system, such as system configuration and security measures.

Themes for desktop experimentation on functionality include (i) various functions that are not implemented in the system, (ii) interoperability with external systems, (iii) external connection interfaces, (iv) adoptability of potential offline payments, and (v) privacy enhancing technologies (Figure 5). Examples of non-functional themes cover system configuration aspects, such as measures to minimize system downtime as well as functional and performance scalability, and facets of security measures.

These themes for desktop experimentation may be modified accordingly, taking into account the results of the system development and experimentation as well as future discussions at the CBDC Forum.

Figure 5. Examples of themes for desktop experimentation

Theme		Outline
Functional aspects		
	Various functions not implemented in the system	- Explore functions that are not implemented in the system. These include opening/closing of accounts, requests to pay, recurring direct debit, and limits on number of account holdings
	Interoperability with external systems	- Explore possible features of a CBDC system to ensure interoperability with other systems
	External connection interfaces	- Look into considerations regarding a CBDC system's interface for external connections with intermediaries and overlay service providers (such as API gateways)
	Adoptability of potential offline payments	- Explore functions and scalability required for an online CBDC system in realizing offline payments
	Privacy enhancing technologies	- Explore privacy enhancing technologies (PETs) taking into account related legal and regulatory requirements
Non-functional aspects		
	High availability	- Explore measures to minimize system downtime
	Functional and performance scalability	- Explore scalability measures to allow for enhancement of functions and performance
	Security measures	- Explore security measures necessary for a CBDC system

3 The CBDC Forum[8]

The CBDC Forum consists of members from a wide range of industries. They are financial firms and non-financial firms including start-ups, which have insights in technologies and business practices of retail payments (64 participating firms as of March 2024). The Payment and Settlement Systems Department of the Bank acts as the secretariat, forming and organizing thematic working groups (WGs). The status of the discussions held in each of the five WGs (Figure 6), which are currently ongoing, is as follows.

Figure 6. Discussion themes for each WG

WG		Theme
[WG1] since Sept. 2023	Connection between CBDC system and fundamental external systems	- Connection with core banking systems - Connection with private payment and settlement infrastructure - Coordination with internet banking apps
[WG2] since Sept. 2023	Overlay services and CBDC ecosystem	- Business utilization of CBDC (overlay services) - External coordination of a CBDC system regarding overlay services - Design of CBDC ecosystem
[WG3] since Oct. 2023	KYC and user authentication/authorization	- Current practices of KYC and AML/CFT checks - Authentication/authorization
[WG4] since Jan. 2024	New technologies and CBDC	- Back-end layer (e.g. alternative data models) - Front-end layer (e.g. "wallets") - Coexistence with other types of payment methods and assets (stablecoins, asset tokenization, interoperability with DLT platforms, etc.)
[WG5] since Mar. 2024	User devices and UI/UX	- UI/UX and accessibility - Endpoint devices - Offline payments
TBD	Horizontal coexistence of CBDC and other payment instruments	- Smooth conversion to and from electronic money and other forms of money
TBD	Operational flow of basic functions	- Operational flow of basic functions - Conversion between cash and CBDC

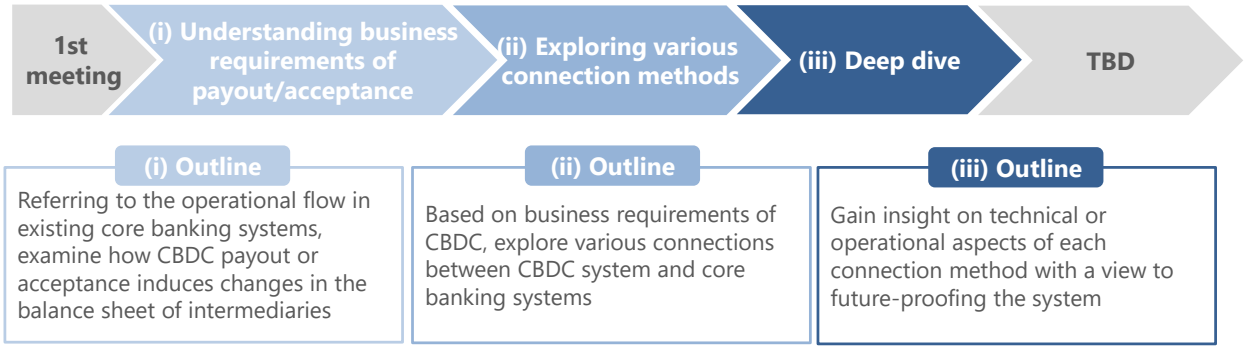
[8] Materials and minutes for each WG are available in Japanese (https://www.boj.or.jp/paym/digital/d_forum/index.htm).

3.1 [WG1] "Connection between CBDC system and fundamental external systems"

3.1.1 Overview (Figure 7)

Since its first meeting in September 2023, WG1 has held eight meetings (as of March 2024) to discuss connection methods for a CBDC system. The purpose of WG1 is to gain insight into technical and operational aspects of connection methods particularly with core banking systems, after exploring connections between existing external systems and core banking systems as well as their operational flow. At the first and fourth meetings, the Bank provided an overview and assumptions of WG1, and from the second meeting onward, members gave presentations on each given theme, which were followed by discussions. Specifically, members first explored the business requirements for payout and acceptance of CBDC, and then discussed connection methods for a CBDC system, taking into account the given business requirements and in view of the connection methods for core banking systems and existing external systems.

Figure 7. Overview of WG1



3.1.2 Summary of discussions (Figure 9)

Assumptions for discussions (1st and 4th meetings)[9]

The Bank presented the following assumptions[10] for discussion.

(1) Functions

The functions to be explored are payout and acceptance (including auto-swing and auto-charge) as well as transfer. Payout and acceptance are given a higher priority for discussion among these, as their functioning requires core banking systems to be connected with a CBDC system. Additional assumptions related to the functions are as follows:

- Instant conversion between CBDC and other forms of money, such as bank deposits, is available.
- CBDC system operates 24/7/365.
- The number of intermediaries' end-user accounts equals the current number of their deposit accounts.
- Required settings for processing performance in introducing a CBDC are maintained from the PoCs: typical throughput[11] of tens of thousands of transactions per second, peaking beyond 100,000 transactions per second, and a latency[12] of within a few seconds.
- Non-functional aspects are to be discussed subsequently in the WG.

(2) System configuration and ledger design

A CBDC system consists of two parts: a customer management component[13] and a ledger component.[14] The data model of the ledger given in WG1 is account based, and both central and shared management ledger architectures are explored under this model.[15]

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[9] The meetings specified in parentheses indicate those during which discussions were held on the respective topics.

[10] The assumptions are for discussion purposes only. The Bank has not yet specified components suitable for social implementation, such as ledger design and system configuration.

[11] Throughput refers to the number of transaction requests that a CBDC system can process per unit time.

[12] Latency refers to the processing time from the time the end-user terminal sends a request to the time it receives a notification of, for example, process completion.

[13] Customer management of a CBDC system is a system for managing information about CBDC users. Specifically, upon receiving a request from an endpoint device, it sends messages such as a payment instruction to a CBDC ledger. It could also handle the opening and closing of accounts as well as AML/CFT.

[14] A CBDC ledger is a system for recording CBDC balances.

[15] The central management architecture assumes that the ledger is managed solely by the central bank. The shared management architecture assumes that the ledger is managed by both the central bank and

(3) Scope of discussion in terms of system connections

We assume connections with two types of systems: core banking systems and a CBDC system. Given that WG1 prioritizes payout and acceptance as its discussion topic, the connection between core banking systems and a CBDC system (customer management portion) is specified as the scope of the discussion.

Business requirements in payout/acceptance (2nd and 3rd meetings)

WG members gave presentations on the business requirements for payout and acceptance and on the assumptions for connection methods between a CBDC system and core banking systems.

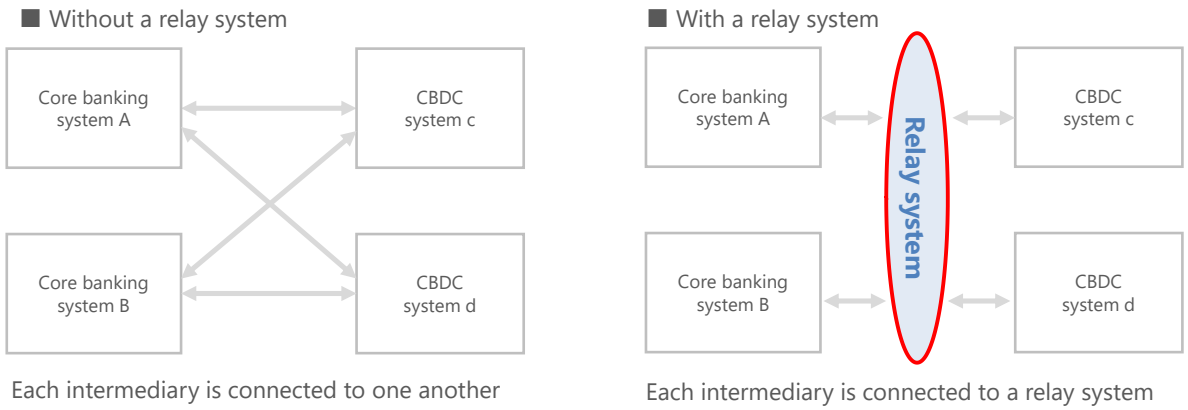
The following views were expressed during the discussions.

- Movements on intermediaries' balance sheets (CBDC issued by the central bank is paid out to a user, and an equivalent amount is deducted from the user's bank deposits), as shown in the "Liaison and Coordination Committee on Central Bank Digital Currency 'Interim Report,'" [16] could be realized by adding to and subtracting from the account balances of core banking systems.
- The following items should be considered in particular when exploring system connections: connection interfaces (communication line, protocol, etc.), online/batch processing, and 24-hour operation.
- Measures to be taken in the event of a supension of deposit account-related processes, during non-operating hours of the core banking system, for example, are also issues for discussion.
- When considering efficient connection methods between intermediaries, there is a need for some kind of relay system connecting a CBDC system and core banking systems of intermediaries (Figure 8).

intermediaries, with intermediaries managing the ledger for each user. Other data models, such as the token-based model, are explored in WG4 of the CBDC Forum.

[16] For details, see Bank of Japan, "Liaison and Coordination Committee on Central Bank Digital Currency 'Interim Report'" (May 2022).

Figure 8. Stylized representation of relay system



Connection methods between CBDC system and the core banking system (3rd through 6th meetings)

Members gave presentations on connection methods between core banking systems and existing external systems as a potential source of reference for examining connection methods between a CBDC system and core banking systems.

The following points were raised during the discussions.

- The Zengin System, CAFIS, CARDNET, COTRA system, API infrastructure, J-Debit, and integrated ATMs are examples of existing external systems that connect to core banking systems. Existing connection methods include connection interfaces (communication lines, protocols, etc.), online/batch processing, and 24-hour operation.
- The instant processing of core banking systems through the external systems includes (1) money transfer within a bank, (2) interbank money transfer, and (3) cash deposit and withdrawal.
- When considering the conversion between CBDC and bank deposits in view of these processes, the following issues need to be borne in mind. In the event that the conversion between CBDC and bank deposits is not completed within the same intermediary -- for example, payout is processed by using the bank deposits of one intermediary and CBDC of another intermediary -- fund settlements between intermediaries are expected to occur. There will also be a need to send out a response message to notify the parties involved of the settlement.

Issues regarding various connection methods (6th and 7th meetings)

Members summarized the features of and the points of discussion for each method presented at previous meetings.

The following issues were raised as additional points for discussion: (1) the optimal intermediary network for achieving a simple process flow; (2) points to be considered in the case of a shared intermediary system as well as the pros and cons of possible options for CBDC system configuration; and (3) functions to be included in the relay system.

Figure 9. WG1 agenda and presenters

	Date	Agenda	Presenter
1st	Sept. 20, 2023	- Overview of the WG	Bank of Japan
2nd	Oct. 13	- Business requirements of payout/acceptance	Mizuho Bank Ltd.
			Fukuoka Financial Group, Inc.
3rd	Nov. 2	- Various types of connections between CBDC system and core banking systems	Sumitomo Mitsui Banking Corporation
			Chiba Bank
4th	Nov. 22		Bank of Japan
			Seven Bank, Ltd.
5th	Dec. 12		JAPAN POST BANK Co., Ltd.
			BIPROGY Inc.
6th	Jan. 17, 2024		Aeon Bank, Limited
			NEC Corporation
7th	Feb. 7	- Deep dive on connection methods	NTT DATA Financial Technology Corporation
			The Shinkin Banks Cooperative Center The Shinkin Banks Information System Center Co.,Ltd.
8th	Mar. 15		MUFG Bank, Ltd.

3.1.3 Next steps

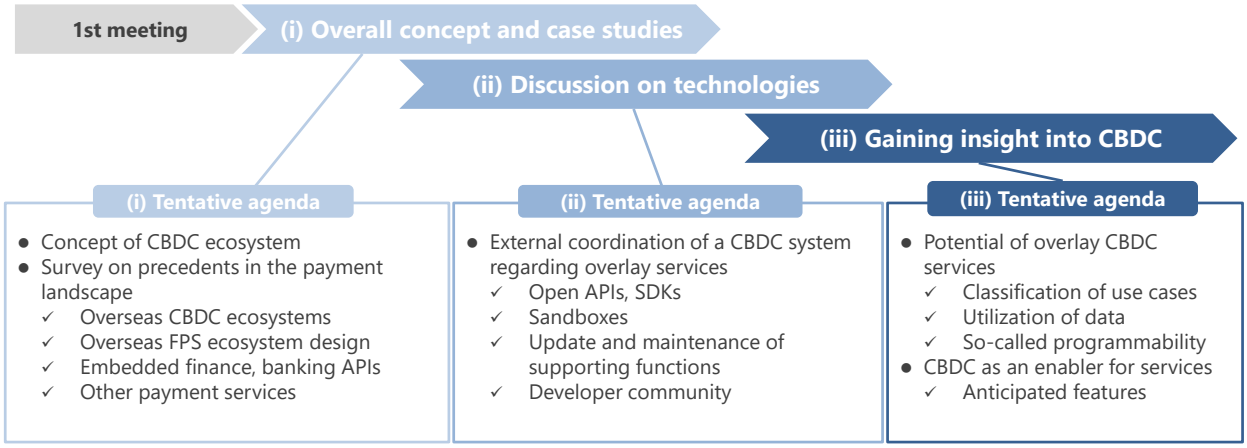
As next steps, discussion points raised by members will be utilized for experimentation using the system, another pillar of the pilot program. The Forum will continue to consider various possibilities such as discussing issues that need to be delved into more deeply by treating them as additional themes in this WG or exploring them in a new WG.

3.2 [WG2] "Overlay services and CBDC ecosystem"

3.2.1 Overview (Figure 10)

Since its first meeting in September 2023, WG2 has held a total of seven meetings (as of March 2024) to discuss the concept of a CBDC ecosystem and survey precedents in the payment landscape.

Figure 10. Overview of WG2



Specifically, the WG has discussed the overall concept of a CBDC ecosystem in order for members to share a common understanding of its implications. As examples of existing payment ecosystems, members have presented overseas cases and efforts by member firms of the WG. Alongside this, the WG has discussed specific technologies that support the development of the ecosystem, such as application programming interfaces (APIs).

3.2.2 Summary of discussions (Figure 11)

Scope and assumptions for discussions (1st meeting)

The Bank introduced the following scope and assumptions for WG2. The WG focuses on overlay services (i.e., services provided by various players of the private sector by adding functions to basic functions such as the simple transfer of money) starting with discussions focusing on services related to domestic P2P and B2C fund transfers. While discussions here would assume online payments, offline payments will be handled by a different WG.

The following views were expressed during the discussion.

- The importance of being attentive to future changes in technological trends and user needs should be addressed.

- There is a need to consider what the uniqueness of CBDC is in providing overlay services in the payment system.

Overall concept, case studies, and technology of ecosystems (2nd through 6th meetings)

The Bank introduced overseas case studies from ongoing discussions on CBDC-related services and of Fast Payment Systems (FPSs), mainly in Europe and in the United States and Australia, respectively. Members also gave presentations on each of their firms' initiatives and technological trends.

A summary of the views expressed by WG members on each topic is as follows.

[API standardization and UI/UX]

- Standardization of technology, especially that of API, is important. From this perspective, both interoperability and overall user experience (UX) should be considered.
- Regarding API standardization, the following areas should be differentiated from each other: (1) common areas where the specification of APIs should be standardized and (2) areas where overlay services should be considered while providing leeway for discretion by each player.
- The shared thinking process between the API provider and the user allowed them to develop a deeper mutual understanding of their respective positions, resulting in a concrete discussion.
- APIs need to undergo maintenance and updates regularly and as necessary; accordingly, it is also important to update software development kits (SDKs), which contain libraries and documents.
- Regarding UX, because it is targeted for the wider general public, it is essential to perceive matters strictly from the users' perspective. Developing a kind of user interface (UI)/UX that stimulates demand is crucial for CBDC adoption.

[Programmability]

- Regarding so-called programmability, it is better to distinguish between (1) programmable payments, which program the procedures of fund transfer that occur in conjunction with a certain event or transaction, and (2) programmable money, which focuses on embedding specific attributes and/or programs in an "object" called monetary data so as to control their behavior individually.
- Rather than embedding programs into CBDC itself (programmable money), it would be appropriate to achieve advanced functions through external mechanisms such as apps.

[Competitive environment in a CBDC ecosystem]

- When designing a CBDC ecosystem, importance should be placed on the lowering of barriers for participation, allowing for a healthy competitive environment, and on the appropriate sharing of roles between private and public entities.

[Instant payment capability]

- With regard to instant payment capabilities of CBDC, attempting the strict achievement of instant payments might hamper the creation of user-friendly services.
- Whether to achieve instant payment finality is also worth considering with flexibility.

[Ensuring stability and standardization of authentication/authorization]

- Authentication/authorization are particularly important, and given that past security incidents related to retail payments have resulted from vulnerabilities in authentication/authorization mechanisms, it may not even be an exaggeration to say that authentication/authorization are the essence of payment.
- Unless we adopt a standardized technology for authentication/authorization and KYC, in the event that vulnerabilities manifest themselves, we would have no choice but to deal with these individually, which would prove costly in terms of both time and labor. We ought to adopt the standard of the time; if today, Fast IDentity Online 2.0 (FIDO 2.0).[17]
- There is a trade-off in authentication/authorization, specifically, between convenience and safety.

[Utilization of data in overlay services]

- Data utilization in overlay services might be more useful if data on items purchased could be used for analysis coupled with the transaction value.
- If said data is shared appropriately with other firms, this could have the potential to support the creation of various applications.
- In relation to this, for privacy purposes, the data distribution function for overlay services -- even if introduced -- should not be built on the foundational platform of the central bank and intermediaries and should be left for the areas outside of it.
- Because obtaining user consent is a prerequisite for such data utilization, it is important to establish a solid framework that ensures effective consent.

[17] FIDO is a registered trademark of FIDO Alliance, Inc.

[Ensuring interoperability]

- While the importance of standardization and interoperability has previously been shared and stressed among the parties involved, these have not resulted in success in many cases.
- The idea of a clean slate advanatage ought to be leveraged in designing a CBDC from scratch.

[API sandbox]

At the fifth meeting, the Secretariat provided an overview of Project Rosalind by the Bank for International Settlements (BIS) and the Bank of England (BOE). The Secretariat's proposal to launch an API sandbox project (see BOX) as part of WG2's efforts, using Project Rosalind as a source of reference, has attracted interest from members.

Figure 11. WG2 agenda and presenters

	Date	Agenda	Presenter
1st	Sep. 26, 2023	- Overview of the WG	Bank of Japan
2nd	Oct. 17	- Overseas discussion on CBDC ecosystems (with a focus on Europe)	Bank of Japan
		- Concept of CBDC ecosystem	NEC Corporation
3rd	Nov. 7	- Overseas FPS ecosystems	Bank of Japan
		- Embedded finance and the potential of CBDC	Infcurion, Inc.
		- Toward a CBDC ecosystem	Money Forward, Inc.
4th	Dec. 8	- API policy	Fukuoka Financial Group, Inc.
5th	Jan. 18, 2024	- BIS-led Project Rosalind	Bank of Japan
		- Presentation	Merpay, Inc.
6th	Feb. 27	- API sandbox project	Bank of Japan
		- Potential use of CBDC	MUFG Bank, Ltd.
7th	Mar. 27	- Architecture and process requirements for development of CBDC	Sony Corporation
		- Challenges of CBDC social implementation from the viewpoint of regional currencies in the Aizu region	TIS Inc.

3.2.3 Next steps

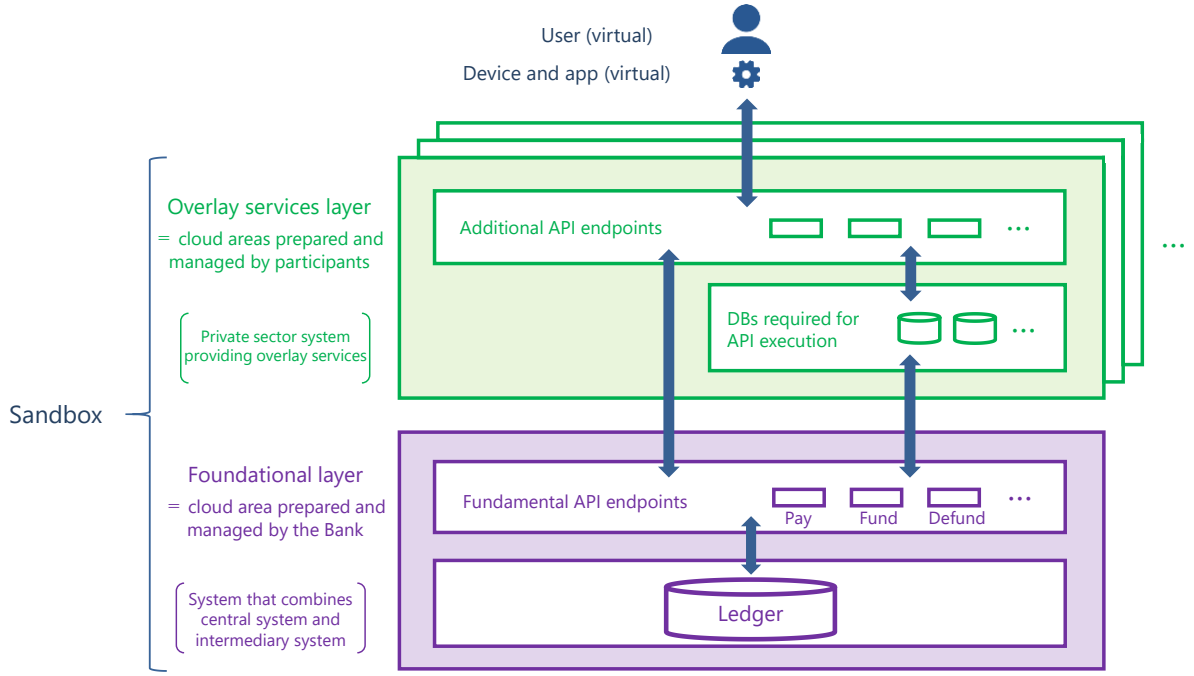
Going forward, WG2 will continue to consider and discuss the potential of overlay services and the features of CBDC as "an enabler for services" while being increasingly conscious of the implications of insights gained from case studies. In this process,

members will pursue the right balance of stability, safety, convenience, and scalability of a CBDC ecosystem. They will also discuss whether opportunities of leveraging new technologies and building new systems can bring greater convenience and scalability while continuing to ensure stability and safety. Furthermore, leveraging the expertise of members, the Bank and volunteer members of the WG have built a sandbox (experimental environment) related to APIs with reference to overseas cases. The WG will discuss in greater detail how to provide overlay services for CBDC (see BOX).

(BOX) Approaches to developing an API sandbox (experimental environment)

Since April 2024, the Bank and volunteer members of WG2 have prepared an experimental environment in the cloud with overlay CBDC services in mind and have been developing various API functions. This project is separate from that involving a system for the pilot program described above (2. Development of a system for the pilot program and experimentation) and is an attempt to focus on the external coordination of a CBDC system through APIs and to discuss the functional scalability of CBDC while gaining hands-on experience (BOX Figure). Specific examples and use cases of overlay services are also expected to be discussed, taking into account the functionality of the built APIs.

(BOX Figure) Conceptual model of API sandbox



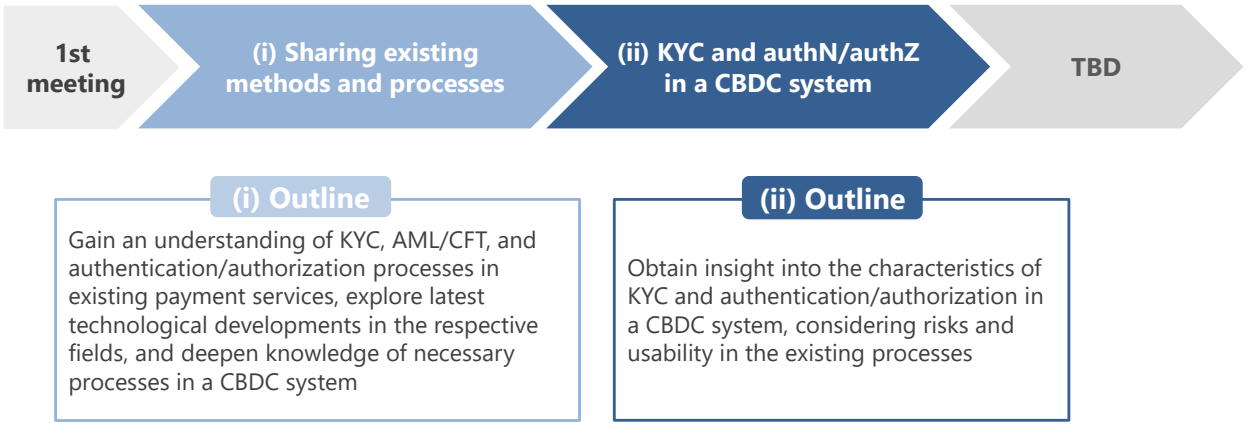
Looking at developments overseas, the BIS Innovation Hub and the BOE have also been working on a project to build API prototypes with private sectors (Project Rosalind), building functions such as account management, balance inquiries, funding and defunding, aliases, and programmability, and considering use cases with participants on this basis. The findings suggest that a set of simple core API features are capable of supporting a variety of use cases. This has significant implications for system design, for example, how simple API features should be designed to bring about high functional scalability for the CBDC ecosystem as a whole.

3.3 [WG3] "KYC and user authentication/authorization"

3.3.1 Overview (Figure 12)

Know Your Customer (KYC) and authentication/authorization are fundamental to the safe and secure use of payment services. Since its first meeting in October 2023, WG3 has held six meetings (as of March 2024). Through their discussions, members have aimed to grasp an understanding of KYC, anti-money laundering and combating the financing of terrorism (AML/CFT), and user authentication/authorization processes in existing payment services as well as the operational challenges they face in this regard, and to gain technical and procedural insight into KYC and authentication/authorization for a potential CBDC system while introducing the latest technical developments and trends.

Figure 12. Overview of WG3



3.3.2 Summary of discussions (Figure 13)

Scope and assumptions for discussions (1st meeting)

The Bank provided an overview, the scope, and the assumptions for the group's discussion.

The following views were expressed by WG members in response.

- With regard to KYC, the underlying risks vary depending on the aims of payment services using CBDC; it is therefore necessary to respond accordingly.
- Additional measures might be required in some cases, for example, where required documents for the identification process differ depending on such factors as whether the scope of users is limited to residents or includes foreign travelers.

  In order to ensure efficient discussions within a limited time frame, the Bank responded that it would be preferable for certain cases to be discussed ahead

of others, namely, situations where CBDC is used for domestic payments by residents in Japan and where various procedures are not conducted in person.

KYC and AML/CFT in existing payment services (2nd through 5th meetings)

WG members gave presentations on user actions and operational processes regarding identity proofing and authentication in KYC in existing payment services as well as on current AML/CFT processes and their latest developments. The Bank also gave a presentation on overseas discussions concerning topics related to the WG.[18]

A summary of the views expressed by WG members on each topic is as follows.

[Identity proofing and authentication]

- As for the effectiveness of identity proofing and authentication, it is important to determine the required level based on potential risks and to adopt a method tailored to meet that level.
- At the same time, assessing the fitness of the methods and technologies to be used might prove challenging, as is the case with striking the right balance between usability and security given their trade-off.
- Regarding the specification of identity proofing and authentication, there would be room for considering efficient systems through standardizing non-competitive components of the system, which would be separated from competitive components.

[Necessity of security measures and guidelines]

- Considering that a security hole in even a portion of the service providers is prone to affect payment services as a whole, it is necessary to incorporate cross-cutting guidelines with reference to case studies abroad in order to maintain a certain level of security.
- With regard to preventative measures for illicit use, it would be preferable to enable information sharing among service providers on threats and countermeasures as well as to contribute to the sound operation of service providers as a whole.
- It is necessary to establish a structure that allows security measures to be implemented swiftly in response to changes in malicious attacks.
- As security measures become obsolete over time, it is necessary to not only take additional measures based on the reality of illicit use but also take into account risks that are not limited to online fraud, which include forged identification documents and defrauded PIN numbers.

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[18] European Central Bank, "A stocktake on the digital euro" (October 2023).

- It is necessary to conceive of possible scenarios of illicit use when discussing the demarcation of responsibilities among relevant parties in the event that illicit use is detected.

[Universal access]

- While completely online transactions and procedures via web browsers and apps are proliferating every year, from the viewpoint of universal access, assistance in person or by phone continues to be in demand to serve elderly users.

[AML/CFT and KYC processes]

- Given the highly public nature of CBDC, the sharing and collaboration of data collected by each intermediary, and utilizing this to support AML/CFT measures, might be an option.
- When comparing situations where KYC processes are managed by individual intermediaries with ones where they are managed by a joint central unit, the latter seems more reasonable in terms of work efficiency. Nevertheless, it should be noted that there is a need to obtain consent from customers when collecting their personal information and to take careful consideration regarding the protection of customer privacy.

Figure 13. WG3 agenda and presenters

	Date	Agenda	Presenter
1st	Oct. 25, 2023	- Overview of the WG	Bank of Japan
2nd	Nov. 21	- User action and operational process relating to KYC and authentication in existing payment services	NTT DOCOMO, INC. et al.
3rd	Dec. 11		Aeon Bank, Limited MUFG Bank, Ltd.
		- Overseas discussion relating to this WG ("A stocktake on the digital euro")	Bank of Japan
4th	Jan. 24, 2024	- Existing AML/CFT processes and latest developments	Microsoft Japan Co., Ltd. Mizuho Bank Ltd.
5th	Feb. 15	- Existing KYC processes and latest developments	NEC Corporation Sumitomo Mitsui Banking Corporation
6th	Mar. 25	- Existing authentication processes and latest developments	SECOM Co., Ltd. JAPAN POST BANK Co., Ltd.

3.3.3 Next steps

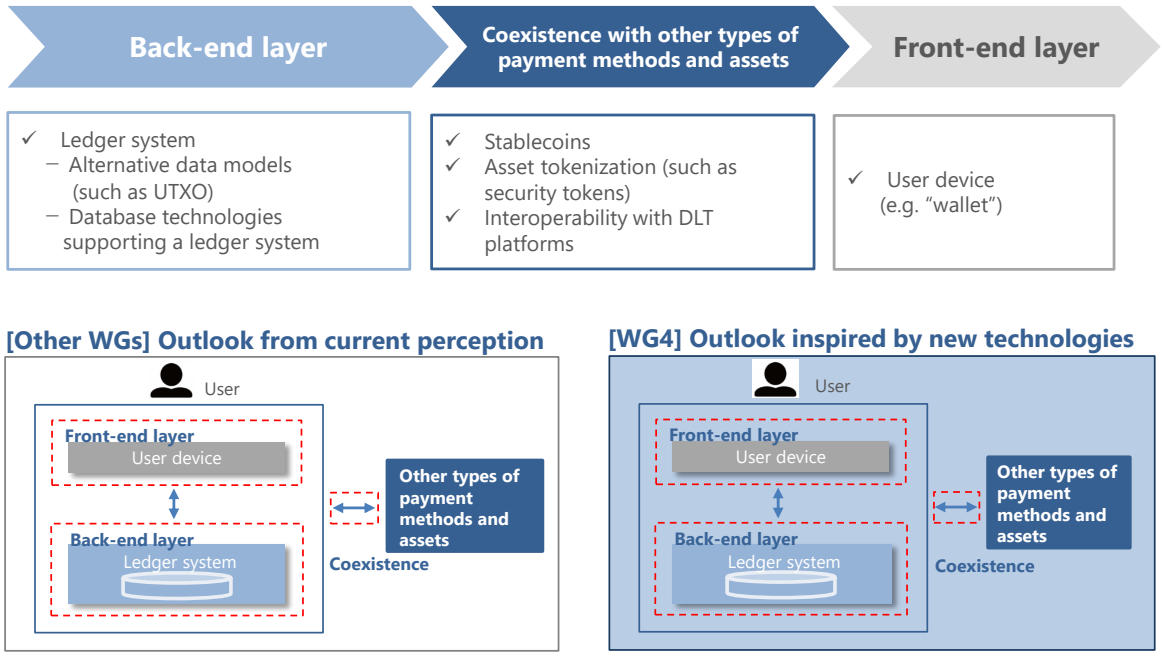
As next steps, WG3 will delve into each theme, such as authentication/authorization use cases, to gain insight into the methods and features of KYC and authentication/authorization with regard to CBDC.

3.4 [WG4] "New technologies and CBDC"

Since its first meeting in January 2024, WG4 has held a total of two meetings (as of March 2024), focusing on new technologies possibly relating to CBDC and considering a CBDC system inspired by them.

As is the case with other WGs, the scope of the discussions covers the CBDC system itself (back-end and front-end layers) as well as the coexistence of CBDC with other types of payment methods and assets. At the same time, the discussions are expected to focus on technologies that could be utilized in the future and are not necessarily based on existing technical assumptions and constraints. Having begun its discussions with a focus on the back-end layer, the WG will proceed with its exploration of other topics, including the front-end layer and the coexistence of the CBDC system with other types of payment methods and assets (Figure 14).

Figure 14. Overview of WG4



In discussing the back-end layer, the WG introduces examples of various technical approaches related to the data model, such as adopting an Unspent Transaction Output (UTXO) model, which is different from the linking of balances to accounts with respect to the data model, devising ways of locking and updating data at the time of data update, and exploring alternative database designs (Figure 15).

The following views have been expressed during the discussions to date.

- The parallelism of the UTXO model -- one of its strengths -- could be secured to a certain extent by devising a method for updating data even if the model were account based.

- The characteristics of the data model could change depending on the assumed system configuration.

Figure 15. WG4 agenda and presenters

	Date	Agenda		Presenter
1st	Jan. 30, 2024	Back-end layer	- Overview and scope of the WG	Bank of Japan
			- Characteristics of a UTXO model	SBI R3 Japan Co., Ltd
2nd	Mar. 13	Back-end layer	- The future of a UTXO model	SBI R3 Japan Co., Ltd
			- Recent trends in data models and potential usage of DLT for CBDC	Coincheck, Inc.

3.5 [WG5] "User devices and UI/UX"

WG5 held its first meeting in March 2024. After deepening its understanding of the flow of messages from user devices to intermediary systems, WG5 will explore universal access and UI/UX in the context of CBDC and discuss how to make it available for anyone to use, wherever necessary and under various circumstances.

Figure 16. How to proceed with discussions in WG5

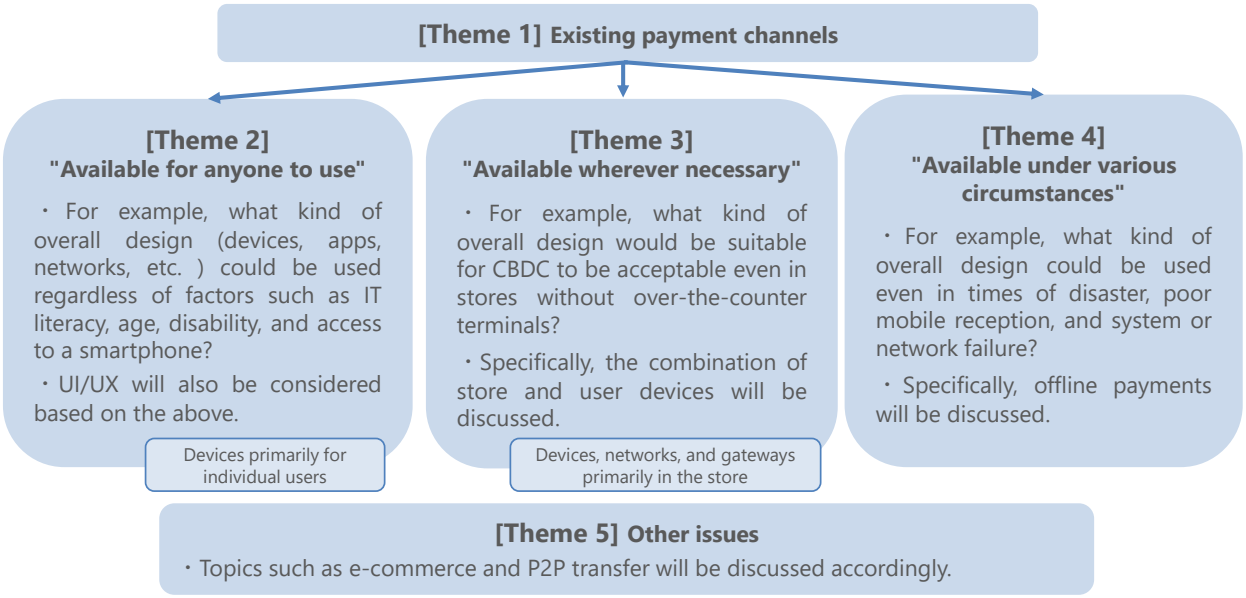


Figure 17. WG5 agenda and presenters

	Date	Agenda	Presenter
1st	Mar. 21, 2024	- Overview and scope of the WG	Bank of Japan
		- Existing payment channels and issues	Lawson, Inc.

4 Conclusion

In the pilot program, the Bank has been conducting experiments and discussions from a broad perspective based on the two pillars of "development of a system for the pilot program and experimentation" and the "CBDC Forum."

Taking into account the discussions at the CBDC Forum, the Bank will proceed further with efforts to develop the system. The CBDC Forum also assumes the establishment of additional WGs, namely, a WG for considering the conversion between CBDC and other payment instruments such as electronic money (provisional name: horizontal coexistence of CBDC and other payment instruments) and a WG for considering the operational flow of basic functions and the conversion between cash and CBDC (provisional name: operational flow of basic functions) (Figure 6). The latter is expected to be formed and managed while considering the continuity of discussions in WG1.

Whether to issue a CBDC in Japan should be decided by discussions among the public. The Bank will continue to thoroughly explore CBDC with a view to providing a basis for such discussions.

(Appendix) CBDC Forum member list

Aeon Bank, Limited
Infcurion, Inc.
Canal Payment Service, Ltd.
Coincheck, Inc.
Cotra Ltd.
JCB Co., Ltd.
THE SHIZUOKA BANK, LTD.
Joyo Bank, Ltd.
The Shinkin Banks Cooperative Center
The Shinkin Banks Information System Center Co.,Ltd.
SECOM Co., Ltd.
Seven Bank, Ltd.
Japanese Banks' Payment Clearing Network
Sony Corporation
SoftBank Corp.
Soramitsu Co., Ltd.
Dai Nippon Printing Co., Ltd.
Daiwa Securities Co. Ltd.
Daiwa Institute of Research Ltd.
Chiba Bank
Tokio Marine & Nichido Fire Insurance Co., Ltd.
Toyota Financial Services Corporation
TradeWaltz Inc.
Nudge Inc.
NEC Corporation
IBM Japan, Ltd.
Japan Securities Clearing Corporation
Microsoft Japan Co., Ltd.
Nomura Securities Co., Ltd.
Nomura Research Institute, Ltd.
Panasonic Connect Co., Ltd.
EAST JAPAN RAILWAY COMPANY
Hitachi Solutions, Ltd.
Hitachi Channel Solutions, Corp.
FeliCa Networks, Inc.
Fukuoka Financial Group, Inc.
Money Forward, Inc.
Mizuho Bank Ltd.
Mitsui Sumitomo Insurance Co.,Ltd.
Sumitomo Mitsui Banking Corporation
Sumitomo Mitsui Trust Bank, Limited
MUFG Bank, Ltd.
Merpay, Inc.
JAPAN POST BANK Co., Ltd.
The Bank of Yokohama,Ltd.
Rakuten Payment, Inc.
Resona Holdings, Inc.
Lawson, Inc.
Lawson Bank, Inc.
au Payment Corporation
BIPROGY Inc.
BOOSTRY Co., Ltd.
Datachain, Inc.
JPX Market Innovation & Research, Inc.
NRI SecureTechnologies, Ltd.
NTT DATA Japan Corporation
NTT DATA Financial Technology Corporation
NTT DOCOMO, INC.
PayPay Corporation
Ridgelinez Limited
SBI R3 Japan Co., Ltd
Startale Labs Japan KK
TIS Inc.
TOPPAN Edge Inc.

（as of March 2024）