Bond Tokenisation in Hong Kong

Contents

The Hong Kong Monetary Authority's (**HKMA**) tokenisation journey started in 2021 when we collaborated with the Bank for International Settlements Innovation Hub Hong Kong Centre to concept-test tokenised green bonds. Earlier this year, we took that project forward by assisting the Government of the Hong Kong Special Administrative Region of the People's Republic of China (**Government**) in launching its inaugural tokenised green bonds (**Project Evergreen**). The issuance demonstrated the possibility of deploying distributed ledger technology (**DLT**) to a real capital markets transaction under the existing Hong Kong legal framework. It also showed the potential in DLT to enhance efficiency, liquidity and transparency in bond markets.

By laying out in detail our experience from this inaugural issuance, this report marks another milestone in our exploration and promotion of bond tokenisation. The design and policy considerations set out in this report have reflected the unique features of Hong Kong's financial market as well as latest international developments. We welcome market participants to draw reference from our experience when considering tokenised issuances in Hong Kong.

Despite the increasing number of issuances globally in recent years, bond tokenisation is still at its infancy; multiple challenges would have to be overcome for it to be widely adopted. As more financial institutions come up with their own tokenisation solutions, it will be crucial to consider how different solutions can connect and interact with each other as well as conventional systems to avoid fragmentation. Existing legal and regulatory regimes may also need to be fine-tuned to keep up with – and facilitate – technology adoption. This report explores possible future directions and actions on these fronts. The HKMA will continue to work with the Government and other stakeholders to tackle remaining issues, with a view to further enhancing our ecosystem to support tokenisation's broader adoption.

This report has been prepared with the support of and contributions from stakeholders in Project Evergreen. The HKMA would like to thank Allen & Overy, the Government's legal adviser in Project Evergreen, as well as the various participants in Project Evergreen, which include, in alphabetical order, Bank of China (Hong Kong), Crédit Agricole CIB, Digital Asset, Goldman Sachs and HSBC, for their support of and contributions to this report.

Eddie Yue
Chief Executive
Hong Kong Monetary Authority

I OVERVIEW OF PROJECT EVERGREEN

Background

1. In recent years, there has been an increasing number of tokenised bond issuances. As at the end of March 2023, the total issuance of tokenised bonds has reached US$3.9 billion globally, with nine-tenth of them issued between 2021-2023.[1] To explore the opportunities and potential of the technology, the HKMA collaborated with the Bank for International Settlements Innovation Hub Hong Kong Centre on Project Genesis in 2021, which concept-tested the issuance of tokenised green bonds in Hong Kong.

2. Building on the success of Project Genesis, the HKMA commenced Project Evergreen in 2022, which was a pilot project announced in the Policy Statement on Development of Virtual Assets in Hong Kong issued by the Government. Project Evergreen used distributed ledger technology (**DLT**) to settle, on a delivery-versus-payment (**DvP**) basis, securities tokens[2] representing beneficial interests in the green bond issued by the Government and cash tokens representing a claim for fiat Hong Kong dollars (**HKD**) against the HKMA. One of the main objectives was to test out the financial infrastructure and the legal and regulatory environment in Hong Kong for the use of DLT throughout the bond lifecycle (covering primary issuance and settlement, coupon payment, secondary trading settlement and maturity redemption) and to serve as a blueprint for similar future issuances by market participants. The tokenised green bonds were offered under the Government Green Bond Programme, and its proceeds will be allocated to finance and/or refinance projects that provide environmental benefits and support the sustainable development of Hong Kong.

3. The purpose of this report (**Report**) is to summarise the experience learnt from Project Evergreen by way of setting out details of the tokenised green bonds, and explaining the aspects that were considered in the project, including technology and platform design, deal structuring as well as legal and regulatory issues.

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[1] Sources: Bloomberg, Thomson Reuters Eikon and HKMA staff estimates.

[2] Recorded as balances in tokenised securities accounts on the digital platform.

Tokenised green bond issuance and lifecycle workflow

4. The issue and subscription of the tokenised green bonds (the **Notes**) in Project Evergreen is operationally divided into different phases, with certain phases taking place on a third-party DLT-based platform (the **digital platform**), i.e. the GS Digital Asset Platform (GS DAP™) from Goldman Sachs. The following diagram describes the primary issuance of the Notes settled on a DvP basis in Project Evergreen:

Figure 1 summarises the workflow of primary issuance in Project Evergreen settled on a DvP basis
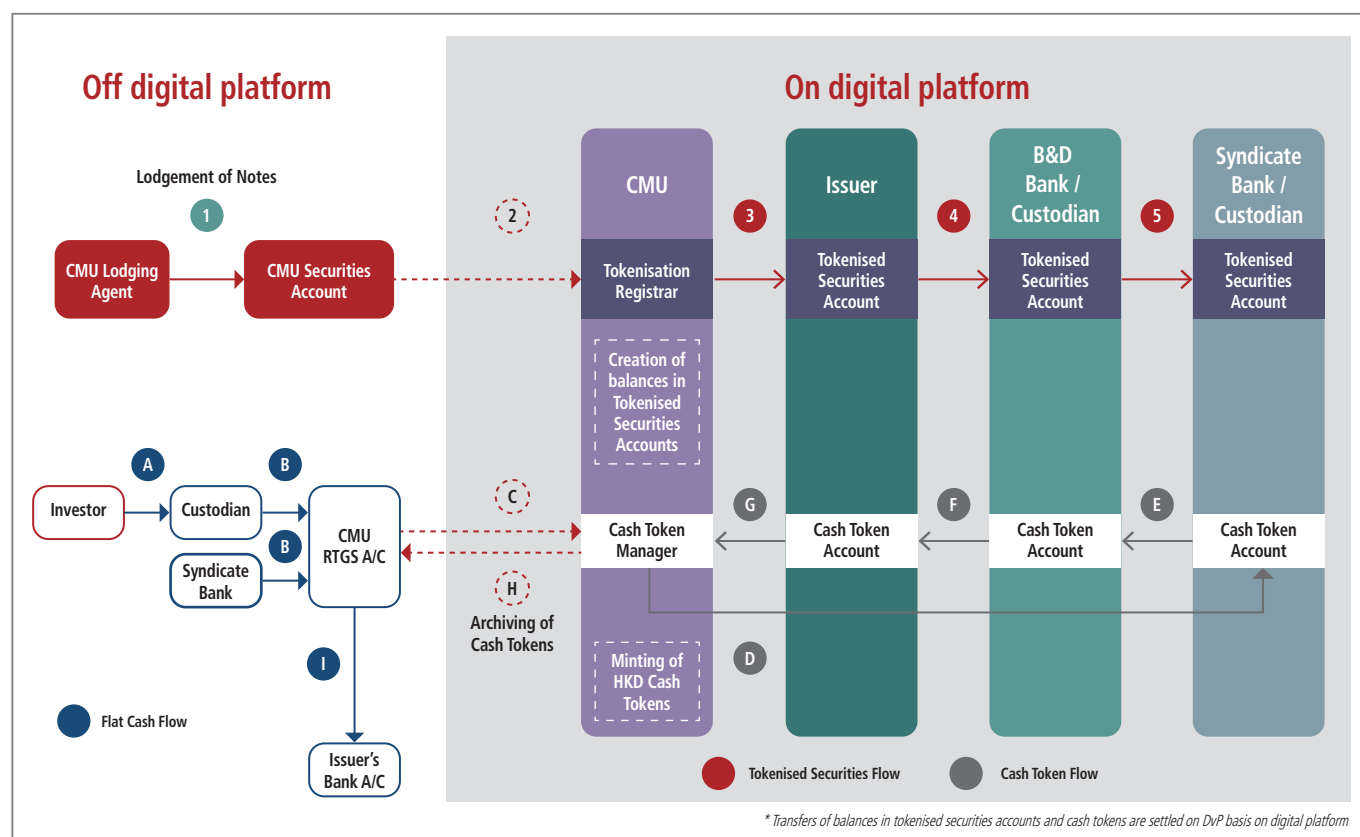
Issuance preparation: bond tokenisation and origination

5. *Participants on-boarding:* The digital platform is designed to be accessed only by platform participants, which include the Issuer (i.e. the Government), the central securities depository for debt securities in Hong Kong (i.e. the Central Moneymarkets Unit, the **CMU**), the Issuer's paying agent, Issuer Agent (as defined below), distributors, custodians and secondary traders of the Notes. Each platform participant has been assigned its role and the functionalities available to it on the digital platform. A set of commonly agreed terms and conditions applies to all the platform participants in accessing and using the digital platform. The on-boarding of the joint lead managers (as distributors and secondary traders) and the custodians, which are CMU members, was approved by the CMU. **Non-participant investors**, i.e. ultimate beneficiaries of the Notes who are not on-boarded to the digital platform as a platform participant, hold their interest via a custodian who is a participant on the digital platform.

6. *Issuance and subscription:* The issuance of the Notes is operationally divided into the off-chain and on-chain processes where some of the elements of a traditional bond issuance have been retained. Before the tokenisation process, bookbuilding was conducted off-chain and the Notes priced on the pricing date (**T**) before they were created in the CMU system's securities database upon the lodgement with the CMU system one day later on the issue date (T+1). On the bookbuilding and pricing date (T), the CMU, in its capacity as the "Tokenisation Registrar" on the digital platform, originated the smart contracts on-chain that would represent the beneficial interest of the Notes to be tokenised. The CMU as the "Cash Token Manager" also originated the smart contracts that would represent HKD cash tokens on-chain. Distributors who have been on-boarded to the digital platform were able to participate in the subscription process on the digital platform by authorising the instructions for transfer of balances in tokenised securities accounts and cash tokens.

Allocation, closing, and settlement

7. On the issue date (T+1), each syndicate bank arranged off-chain fiat cash equal to its subscription amount to be transferred to CMU's Real Time Gross Settlement (**RTGS**)[3] account. The following key workflow steps demonstrate how the use of a single digital platform can bring all different parties together and facilitate the allocation, closing and settlement activities, make possible end-to-end automation, create efficiency gains and reduce settlement delay and settlement risk:

Figure 2 summarises the workflow of allocation, closing and settlement activities

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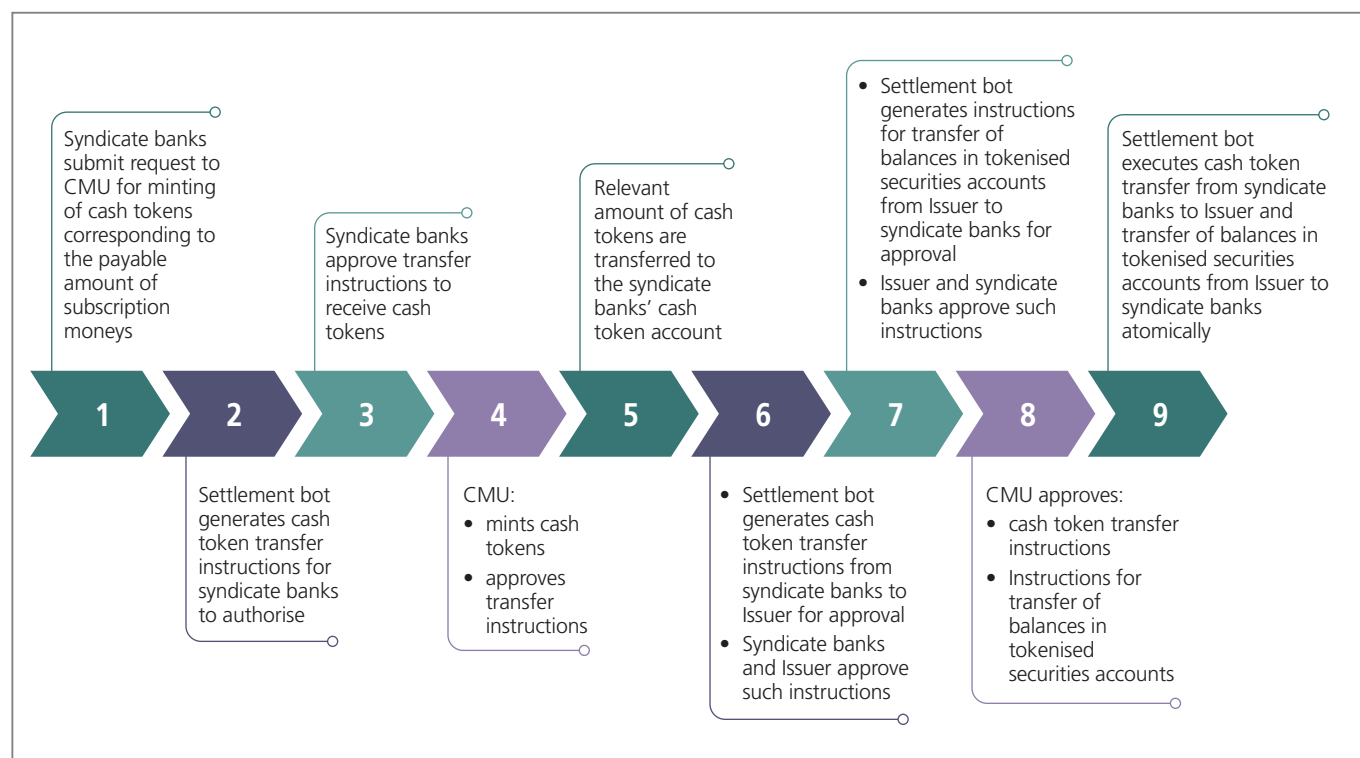
[3]   *The Hong Kong dollar RTGS system facilitates the settlement of interbank payments denominated in Hong Kong dollar, which are settled continuously on a deal-by-deal basis across the book of the HKMA without netting.*

Efficiency savings

8. Project Evergreen has shown the potential of DLT to generate various efficiencies for an institutional bond issuance as summarised in Table 1 below.

Table 1 illustrates some of the key efficiency savings demonstrated by Project Evergreen

Paperless creation	Removing the need for a physical global certificate and manual mark-ups thereon in the traditional bond creating process saves man-hours and eliminates the risk of manual processing error.
Facilitate interaction between different parties on a common DLT platform	A typical bond issuance involves multiple organisations and multiple teams within each organisation interacting via different systems to manage and run the issuance, settlement, payment and redemption processes. A common DLT platform increases processing efficiency by bringing together all the different parties onto a common platform with an immutable single source of truth, supporting multi-party workflows with participant specific authorisation, real-time verification and signatories enabled.
Atomic DvP Settlement	Bond transfer and cash payment on a common DLT platform instead of separate channels allow settlement to be done instantly and simultaneously on a DvP basis, reducing settlement delay and settlement risk.
End-to-end DLT adoption across the bond lifecycle	The use of DLT from primary issuance, secondary trading settlement, coupon payment and maturity redemption can substantially reduce multiple manual processing, lower servicing time and costs and remove the need for synchronisation between different channels, achieving significant operational improvement. The DLT ledger is the immutable single source of truth for participants on the digital platform across primary and secondary market processing and post-trade services.
Enhanced transparency	DLT enables real-time data synchronisation across different parties that creates transparency and ensures consistency, whilst enabling greater privacy from other platform participants.

9. Such efficiency gains could potentially be applicable to the wider market, depending on the features of each digital bond, the design of the on-chain and off-chain workflows and the extent to which conventional market practice, systems and infrastructure are adapted to the use of DLT. As with conventional bonds, features of digital bonds vary from one transaction to another depending on a number of factors, including technical feasibility, legal and regulatory requirements of different jurisdictions, and economic implications.

10. The discussion below lays out the details with respect to technology/platform design in Project Evergreen as well as other available options with regard to different aspects in a digital bond transaction. The purpose is to share the experience learnt from Project Evergreen and to provide guidance and reference for interested issuers.

Network type

11. In a digital bond transaction, the parties need to consider whether to leverage a public blockchain or a private blockchain. Public blockchains are generally open to anyone and thus offer more transparency. As there is no restriction on who can access public blockchains, there may be concerns on data and information privacy. On the other hand, private blockchains only allow access by authorised users and provide a higher degree of data confidentiality. Data visibility and transparency will be further discussed in a subsequent section of this Report.

12. In Project Evergreen, the digital platform consists of smart contracts implemented on the Canton blockchain and Hyperledger Besu, which provides peer-to-peer networking and ordering consensus. Both blockchains are private and permissioned, which enable greater security and privacy, as well as avoid potential issues related to public blockchains, which by nature contain many unknown actors and activities. Figure 3 below depicts the high-level architecture of the digital platform used for Project Evergreen.

Figure 3 depicts the high-level architecture of the digital platform used for Project Evergreen
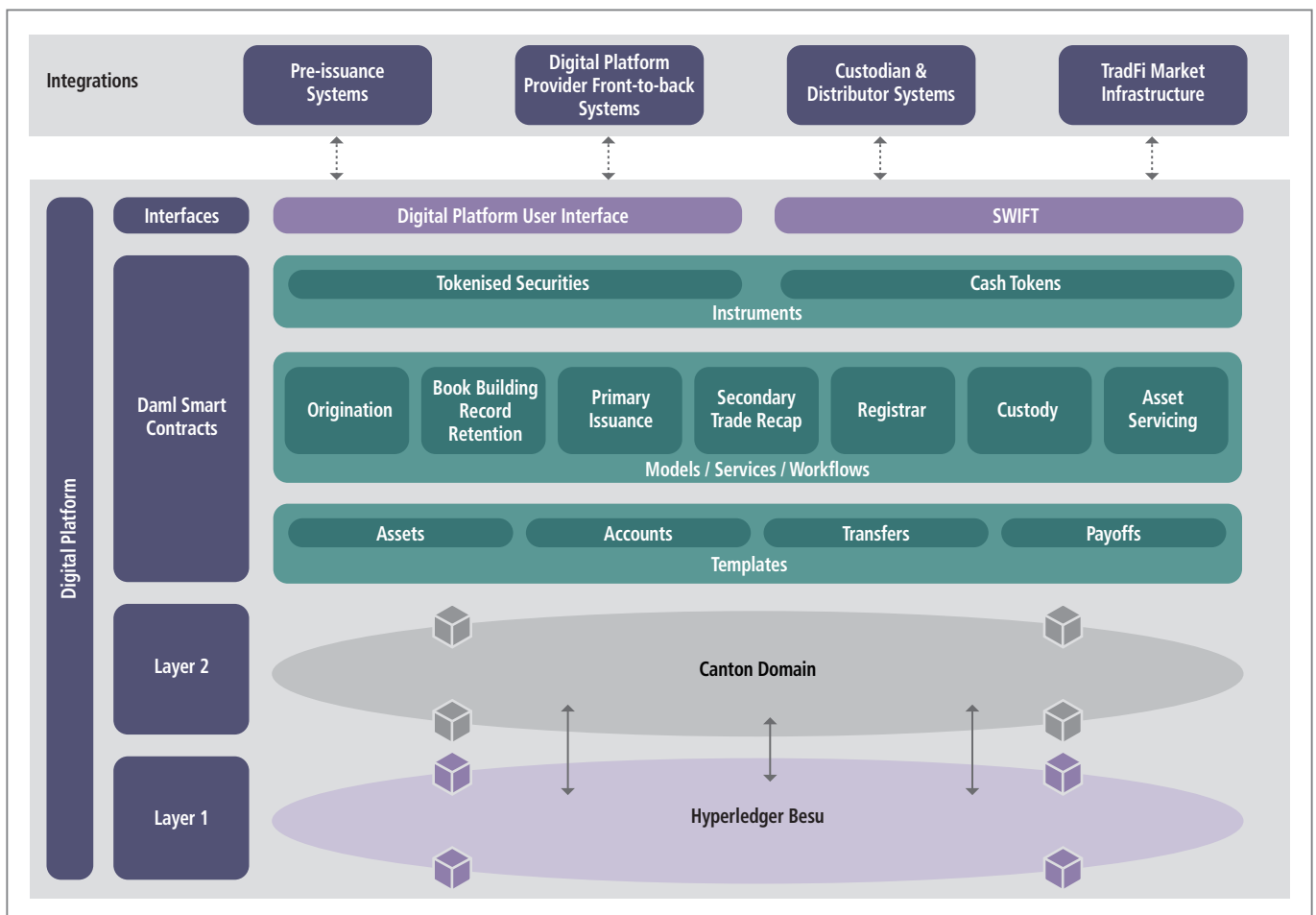
13. The digital platform uses Hyperledger Besu[4] as the Layer 1 blockchain, which is a private permissioned Ethereum blockchain acting as the inter-node communication and consensus ledger. The Layer 2 blockchain of the platform is Canton, which is a privacy-enabled and scalable DLT interpreting and executing the smart contracts and maintains consistent execution across participant nodes. Digital asset modelling language (**Daml**)[5], which is an enterprise grade, privacy-focused, open-sourced smart contract language which contains a runtime environment that defines the workflow, schema, semantics and execution of transactions across participants in the Canton DLT network, is chosen as the smart contract solution.

Participation model

14. Participation model in a digital platform ecosystem can be in the form of node-hosting or application programme interface (**API**) or user interface (**UI**).

15. Node-hosting refers to the option of running a node on the DLT platform which contains a copy of the ledger. Node-hosting allows direct access to the network and reduces reliance on intermediaries or third-party providers. However, it may entail higher upfront and ongoing costs with regard to hardware, software, bandwidth, maintenance, and security infrastructure and maybe subject to higher exposure to operational and cyber risks. An alternative solution that could potentially balance the ease of adoption and the stringent implementation of data privacy is dedicated node hosting with each syndicate bank having its own virtual instance to segregate its data being put together in a shared pool (i.e., one virtual machine for each bank). The virtual instance segregation, even though managed by the platform operator, enables subsequent de-coupling of the exclusive configuration of data jurisdiction and enhances data privacy.

16. API or UI refers to the option of using a standardised interface to communicate and interact with the DLT platform, without having to run a node or store a copy of the ledger. For Project Evergreen, participants access the digital platform via a graphical UI. This approach minimises the technical on-boarding and integration effort required for participants, enabling a faster-to-market solution and allowing participants to focus on the business and functional benefits and the potential of DLT-based solutions brought by asset tokenisation, smart contracts and lifecycle workflow digitisation.

17. Depending on the participation model and the DLT platform set-up, parties to a digital bond transaction should pay attention to relevant data privacy regulations, in particular with respect to cross-border data transfer and data localisation, which can be complex. Data protection regimes vary from one jurisdiction to another and conflicts between the different requirements may present challenges for platform providers, potential issuers and other intermediaries.

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[4] *Hyperledger Besu supports enterprise security, encryption, privacy and permissioning, is subject to regular security audits, and implements the Proof-of-Authority consensus algorithm with efficiency to support the required transaction processing volume. Hyperledger Besu is one of the widely adopted private enterprise blockchains in financial markets and is open-sourced and based on Ethereum Virtual Machine (EVM), providing a path to better inter-operate with or join the vast EVM ecosystems.*

[5] *Daml offers a financial library with useful asset and lifecycle templates, primitives and basic built-in language functions, network inter-operability and horizontal scaling across independent workflows, and built-in security and end-to-end encryption that ensures data security and integrity.*

Data visibility

18. Another important consideration for the DLT platform design in a digital bond issuance is data visibility of transactions and holdings. As discussed above, data visibility may depend on whether the DLT platform is based on a public blockchain or private blockchain. Conventional bonds are generally traded by way of traditional over-the-counter (**OTC**) trading in a bilateral manner. As a result, information with respect to trading, such as trading price, volume and frequency, are not public. Holdings of conventional bonds are recorded in the clearing system accounts of clearing system participants, while the holdings by investors through custodians are recorded in the books and records of the custodians, which are generally private information.

19. Leveraging the DLT, a public blockchain-based platform can enhance data visibility of transactions and holdings. In the £50,000,000 Sterling Overnight Index Average Floating Rate Notes issued by the European Investment Bank in February 2023, the digital bonds were first registered in a private blockchain that ensures privacy and efficiency, while a public blockchain mirror record provides increased transparency on an anonymised basis.[6]

20. In Project Evergreen, the digital platform uses the privacy model of Daml and Canton for transaction processing. Within the Daml privacy model, the visibility of different participants depends on whether they are a stakeholder (i.e. signatories or observers) to the relevant smart contracts, thereby granting certain participants visibility of certain smart contracts while ensuring privacy from others. On the transaction level, the privacy of the transactions is also enabled by Canton, with each Canton participant node possessing only part of the "virtual global ledger" state and only receiving, processing and storing the sub-transaction it is entitled to know.

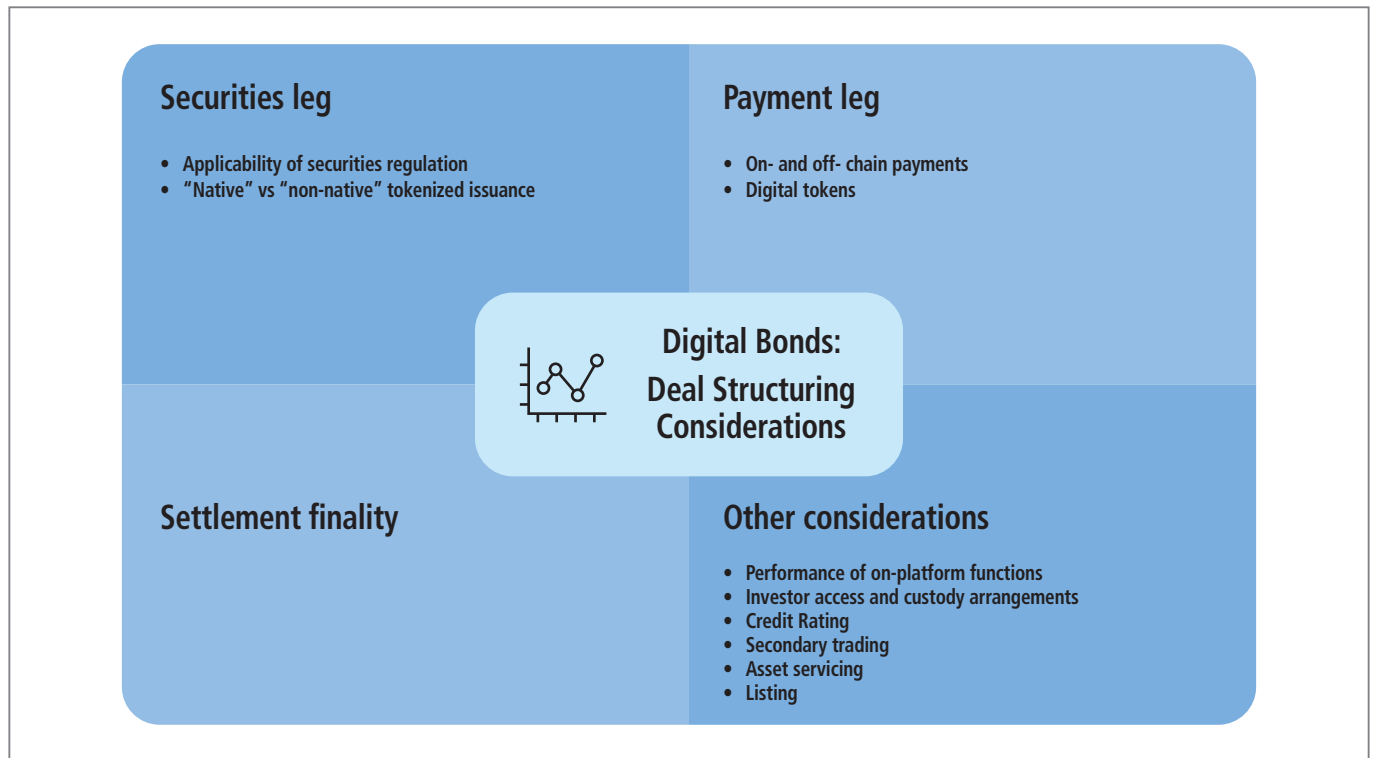## Performance and scalability of DLT network

21. In a digital bond issuance, considerations should also be given to the performance and scalability of DLT network. In Project Evergreen, the digital platform is designed with performance and scalability on both DLT layers of the Hyperledger Besu and Canton blockchain in mind.

22. To support the required processing profile and scalability, a Proof of Authority consensus protocol (IBFT 2.0) is selected for the Hyperledger Besu blockchain.[7] With regard to Canton blockchain, each of the Canton participant nodes receives and persists the data that it is entitled to access and maintains its local ledger (i.e., Canton ledger), which collectively forms the "virtual global ledger".[8] The Canton technology design also allows a Canton network to scale out horizontally via multiple ways that build on one another.[9] Part of the objectives behind the network design is such that it can eventually be scaled beyond Project Evergreen's scope.

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[6] https://www.eib.org/en/press/all/2023-030-eib-issues-its-first-ever-digital-bond-in-british-pounds

[7] Only validator nodes are allowed to validate and commit encrypted Canton transactions into blocks on the Hyperledger Besu blockchain ledger, which allows better performance and scalability than Proof of Work blockchains that require hardware-intensive computational power. Non-validator node does not affect performance.

[8] Besides this, Canton utilises the Canton protocol (which is similar to Proof of Authority) for its transaction validation consensus, whereby only the involved participant nodes are required to validate Daml transactions on a per-transaction basis.

[9] The scaling strategy is dependent on where the bottleneck lies. If the bottleneck is due to the participant node having to perform too many multilateral (participant) transactions, then performance can be improved by scaling additional participant nodes. In a large and active network where a domain (e.g., domain manager, mediator) reaches the capacity limit, additional domains can be scaled out to improve the overall network performance.

Securities leg

- Applicability of securities regulation
- "Native" vs "non-native" tokenized issuance

Payment leg

- On- and off- chain payments
- Digital tokens

Digital Bonds: Deal Structuring Considerations

Settlement finality

Other considerations

- Performance of on-platform functions
- Investor access and custody arrangements
- Credit Rating
- Secondary trading
- Asset servicing
- Listing

Securities leg

Applicability of securities regulations

23. The Securities and Futures Ordinance (Cap. 571) (the **SFO**) of Hong Kong does not expressly specify whether debt securities (including bonds or notes) need to be in paper form or dematerialised form. As such, the SFO's existing licensing regime for regulated activities (such as dealing in securities, advising on securities and providing automated trading services) and securities offering regime would also apply to the issuance or distribution of digital bonds. For corporate issuers, the prospectus requirements under the Companies (Winding Up and Miscellaneous Provisions) Ordinance (Cap. 32) (the **C(WUMP)O**) of Hong Kong, would also apply to their digital bonds.

24. In Project Evergreen, the distribution of the Notes was carried out pursuant to both the legal and regulatory requirements on securities offering and compliance with licensing requirements under the SFO, including the relevant safe harbours. Specifically, the Notes were only distributed to "professional investors", as defined under the SFO and rules made thereunder.

"Native" vs "non-native" tokenised issuance

25. In a digital bond issuance, the bonds can be issued directly on the DLT platform (i.e. a "native" issuance), or first issued off-platform and then tokenised on the DLT platform (i.e. a "non-native" issuance).

26. Project Evergreen adopts the "non-native" issuance approach. The Notes are in registered form[10] and are initially in the form of computerised book entries recorded on the issue date in the CMU system's securities database off-platform. Beneficial interests in the Notes are then recorded on the issue date in the tokenised securities accounts on the digital platform. Some issuers may prefer a "non-native", tokenised issuance with the involvement of the conventional system of a central securities depository (**CSD**) in tokenisation of the bonds following its prevailing operating rules, which may offer greater familiarity with existing market convention.

27. In a "native" issuance, the bonds are issued directly on a DLT platform without involving the conventional system of a CSD. "Native" issuances enhance the degree of integration with the DLT platform, and may reduce the need for intermediaries, such as conventional CSDs, custodians and registrars, and thus lower the transaction costs and operational risks. Coupled with smart contract technology and automation features, it may also enable faster settlement and execution of the bond processes.

28. With regard to Hong Kong legislation, neither the SFO, the Companies Ordinance (Cap. 622) (the **CO**) nor the Payment Systems and Stored Value Facilities Ordinance (Cap. 584) (the **PSSVFO**) prescribe a form which debt securities must take at issuance. However, certain considerations could apply depending on the type of issuer:

    (a) The Government is empowered to issue bonds under the Loans Ordinance (Cap. 61) (the **LO**). In respect of the form in which bonds may be issued, it is expressly stated that it may take the form of information or data which is recorded (whether by means of a computer or otherwise) in a non-legible form but is capable of being reproduced in a legible form. A distributed ledger (essentially a computerised book entry, capable of being reproduced in legible form) would fall within the scope. Therefore, bonds issued by the Government under the LO need not take a physical paper form. In Project Evergreen, the Issuer dispensed with the physical global certificate to enhance the digital element of the issuance and to streamline the off-chain processes.

    (b) Similar to the SFO, there is no express requirement as to what form a debenture (which, as defined in the CO, includes bonds) may (or must) take and thus digital bonds would be treated as "debentures" under the CO. A potential issuer which is a company incorporated in Hong Kong under the CO or the former Companies Ordinance may issue digital bonds subject to the relevant statutory requirements and its articles of association. Major requirements under the CO that may be of particular interest to digital bond issuers include:

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[10] The off-platform registrar keeps a register recording that the HKMA as operator of the CMU is the registered holder of the Notes.

(i)   under section 308 of the CO, if the company issues debentures which are not transferable by delivery, it is required to keep a register of holders of the debentures (the **Debenture Holders Register**).[11] The DLT platform that a potential Hong Kong company intends to deploy would need to be able to reproduce the register in hard copy form[12];

(ii)   under sections 318, 319, 320, 323 and 324 of the CO, debentures and instruments of transfer are required to be delivered by or to the company (as the case may be) if applicable to an issuance; and

(iii)   under section 656 of the CO, the company is required to take adequate precautions to guard against falsification if the Debenture Holders Register is kept otherwise than by making entries in a bound book and must take adequate steps to facilitate the discovery of the falsification. The potential issuer would need to ensure that the platform provider's system set-up allows the issuer (or persons designated by the issuer) to retain or obtain control over the records on the DLT platform, if necessary.

29.   Additional considerations may also apply depending on the type of the instrument. For instance, whether and how bearer bonds can be "possessed" and "delivered" in a digital sense (and hence be capable of "native" issuances as described in paragraph 27 above) may need to be further studied.[13]

Payment leg

30.   With respect to payments of principal and interest under the digital bonds, payments can be made on the DLT platform or off-platform with fiat cash. On-chain payments for the digital bond principal and interest may be made in the form of central bank digital currency, or digital tokens which are native or compatible with the DLT platform where the digital bonds are issued and/or recorded, which could offer advantages such as faster and simpler payment process. For on-chain payments, the parties to a transaction should also consider whether payments are to be made on the same DLT platform as the bond issuance, or on a different DLT platform using cross-chain mechanisms. The latter can be achieved by technologies such as cross-chain bridges, whereby the payment process can also be automated using cross-chain smart contracts. This may enhance the flexibility and liquidity of the digital bonds in terms of accessing different markets, as well as the possibility of leveraging the unique advantages of different blockchains for different functions or features. However, some challenges may include the complexity, costs, and risks of mismatch or failure in cross-chain communication and coordination, the reliability and trustworthiness of the bridging mechanisms.

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[11]   *The register must be kept in English or Chinese language with the name, address, holding, date on which the holder is entered in the register, date on which the holder ceases be a holder. Such register should be kept at the company's registered office (or a place in Hong Kong notified to the Registrar of Companies) for inspection by members of the company, debenture holders in the company's debenture register, and any other person who is entitled to inspect the Debenture Holders Register. After an allotment of debentures, a company needs to register in its Debenture Holders Register the allotment of debentures as soon as practicable and in any event within 2 months after the date of the allotment. Unless the terms and conditions of the debentures provide otherwise, the company must complete the debentures and have them ready for delivery within 2 months after an allotment. Under section 320 of the CO, a company can only register a transfer of debentures if a proper instrument of transfer has been delivered to the company.*

[12]   *Under the CO, "company records" is defined to include any register required by the CO to be kept by a company. Section 655 of the CO specifies that company records may be kept in hard copy form or in electronic form, and if the records are kept in electronic form, the company must ensure that they are capable of being reproduced in hard copy form. If any company records required by the CO to be kept by a company are kept by the company by recording the information in question in electronic form, any duty imposed on the company under the CO to allow inspection of the company records is to be regarded as a duty to allow inspection of (a) a reproduction of the recording, or the relevant part of the recording, in hard copy form; or (b) if requested by the person inspecting the recording, the recording, or the relevant part of the recording, by electronic means.*

[13]   *Under common law, bearer bonds, being a form of bearer instruments, entitle the holder of the instrument (i.e. the bearer) to ownership of the underlying asset (i.e. the underlying debt). The entitlement is derived from possession of the instrument itself, and title to the bearer instrument is passed by simple delivery and the requisite intention to pass the title.*

31. In some cases of digital bond issuances, payments of principal and interest are made with fiat monies off-platform as in conventional bond issuances. This could offer advantages such as stability and familiarity with existing processes. However, parties would need to be aware of potential reconciliation and inter-operability issues between the DLT platform and the payment system.

32. In Project Evergreen, both the balances in tokenised securities accounts and cash tokens are processed and recorded on the same DLT platform.

Digital tokens

33. On-platform payments can be made by digital tokens. In Project Evergreen, payments of principal and interest to the platform participants are in the form of HKD cash tokens (**Cash Tokens**) minted by the CMU (as a unit under the HKMA) on the digital platform. Cash Tokens represent fiat monies claim against the HKMA, and one Cash Token is equal to one fiat HKD. In the case of principal payment, the debiting of balances in tokenised securities accounts will take place atomically (i.e. a transaction would either succeed completely or fail completely, without leaving any intermediate or inconsistent state of partial execution) on the digital platform as the transfers of Cash Tokens are made. Payments by Cash Tokens discharge the Government's payment obligation under the terms and conditions of the Notes.

34. For other digital bond transactions, payments may also be made in digital tokens not minted by the HKMA (or any central bank). These tokens can be specifically designed for settlement of the digital bond issuance, providing flexibility and allowing customisation. However, such digital tokens may be subject to higher counterparty, credit, operational, volatility and liquidity risks.

Settlement finality

35. In general terms, "settlement finality" means "the discharge of an obligation by a transfer of funds and a transfer of securities that have become irrevocable and unconditional".[14] Specifically, "finality" refers to the abrogation of all rights otherwise existing at law that would allow the setting aside of a transfer order effected through, or proceedings within, a clearing and settlement system (**CSS**). In Hong Kong, settlement finality can be achieved by way of fulfilling the relevant statutory requirements under the PSSVFO (in the case of a designated CSS) or contractual agreement.

36. In Project Evergreen, the Notes are cleared and settled through the CMU, and the settlement of transactions made through the CMU benefits from the statutory settlement finality under the PSSVFO. Pursuant to section 55 of the PSSVFO, the CMU is deemed to be a designated CSS. A certificate of finality is also deemed to have been issued in respect of the CMU. Under the PSSVFO, the settlement finality regime provides statutory protection of the integrity of transfer orders settled through eligible designated CSSs from insolvency and other bankruptcy and winding up laws in Hong Kong, and where private international law applies, the equivalent laws of a place outside Hong Kong. This is to ensure that transfer orders settled through designated CSSs are irrevocable and will not be reversed by the insolvency of a participant in those systems, whereas any rights resulting from the underlying transaction of any such transfer order will be preserved.

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14 *https://www.bis.org/dcms/glossary/glossary.pdf?scope=CPMI&base=term*

37. In order for a DLT platform to benefit from statutory settlement finality under the PSSVFO, it must first be designated as a CSS by the HKMA in accordance with the statutory procedures under the PSSVFO. See also the section headed "*Clearing and settlement models*" below.

38. In a digital bond transaction where the DLT platform is not a designated CSS under PSSVFO, the relevant parties may achieve settlement finality by agreeing it contractually to give certainty to transfer orders on such DLT platform.

Other major deal structuring considerations

Performance of the issuer's on-platform functions

39. In connection with a digital bond transaction, the issuer may need to perform certain functions on the DLT platform, such as issuing, transferring, redeeming and paying interest on the digital bonds. Some of these functions may be delegated to agents on a case-by-case basis. In general, agents may help the issuer with the technical, operational, and administrative aspects of the DLT platform and its functions, which in turn mitigate potential operational risks that may arise.

40. In Project Evergreen, the Government appointed the issuer agent (**Issuer Agent**), which is a specific agent role performing functions on behalf of the Government on the digital platform, which include submitting and authorising instructions relating to debiting and crediting of balances in the tokenised securities accounts and Cash Tokens. As the Notes involve payments to and transfers of fiat monies from the CMU's accounts off-platform corresponding to the minting and redemption of the Cash Tokens, a CMU lodging and paying agent is also involved in this transaction, similar to other conventional bond issuances under the Government's global medium term note programme. The issuer agent role can thus be seen as an extension of the role of CMU lodging and paying agent in the specific context of Project Evergreen. If other issuers are contemplating a similar payment mechanism as Project Evergreen, considerations may need to be given as to whether to appoint a single institution to perform both the roles of CMU lodging and paying agent and issuer agent on the DLT platform (as is the case in Project Evergreen) to enhance efficiency and minimise operational risks.

Investor access and custody arrangement

41. Investors in a digital bond issuance can either hold their digital bonds directly on the DLT platform where the digital bond is issued or recorded, i.e. self-custody, or via a custody relationship where investors could either be on-boarded to the DLT platform for direct information access or not on-boarded.

42. Holding of the digital bonds through self-custody by the investors is where the investors hold and manage their own asset accounts (and if appropriate, the related private keys) in a secure digital wallet that grants access to digital bonds or tokens on the DLT platform. In this case, the investors would need to be on-boarded to the DLT platform. Self-custody offers investors more direct control, autonomy and privacy over their digital bonds and tokens. However, in such a case, the investors would need to have relevant technical knowledge and be responsible for keeping their on-chain accounts and/or private keys secure, as they may be subject to the risks of losing the bonds and tokens or security breaches.

43. Alternatively, investors may hold the digital bonds through custodians. Custodian services may offer investors more convenience and greater familiarity, as this is similar to other conventional bond issuances in book-entry form in clearing systems. A custody relationship may also mitigate the administrative and operational burdens on the investors. Even though investors hold their digital bonds through custodians, they could also be on-boarded to the DLT platform for direct information access.

44. In situations where the investors are on-boarded to the DLT platform, there may be regulatory and legal requirements for the DLT platform operator and transaction parties, for example, the DLT platform may need to have appropriate on-boarding screening process that can verify the identity and eligibility of the investors. The starting point would be for the DLT platform operator (and custodian(s), as appropriate) to carry out know-your-customer (**KYC**) process in relation to the investors and to take steps to enable compliance with anti-money laundering, counter-financing of terrorism, and applicable regulations with respect to each investor. Depending on the activities that can be performed on the DLT platform, the platform operator will need to consider any licensing implications under the SFO for the platform operator and/or DLT platform and the applicability of the relevant regulatory requirements in relation to the distribution of digital bonds. In the situation where the investors hold the digital bonds through custodians and are not on-boarded to the DLT platform, KYC process in relation to investors would be a matter for the custodians.

45. In Project Evergreen,

   (a) only custodians who are CMU participants and are on-boarded onto the digital platform are able to open tokenised securities accounts and Cash Token accounts on the digital platform. Beneficial interests in the Notes are recorded on the issue date in the tokenised securities accounts on the digital platform as balances in the tokenised securities accounts. Transfers of beneficial interests in the Notes between holders of tokenised securities accounts will be effected only through debiting from, and crediting to, the balances of Notes recorded against the relevant tokenised securities accounts.

   (b) non-participant investors hold their interests in the Notes through a custody relationship with the custodians who are participants on the digital platform, which requires entering into custody agreements off-platform to enable these custodians to use the digital platform as a means to hold and settle beneficial interests in the Notes on their behalf. The beneficial interests in the Notes held by non-participant investors are recorded by their custodians off-platform in the custodians' books and records in accordance with the custody arrangements.

   (c) the custody relationship between the custodians who have a tokenised securities account on the digital platform and the underlying non-participant investors is similar to that between direct and indirect participants of a clearing system, such as the CMU, Euroclear and Clearstream, in a conventional bond issuance in which the bonds are represented by a global certificate, and in which case the beneficial ownership in the bonds of underlying bondholders as indirect participants in the clearing system is held through financial institutions.

Credit rating

46. Issuers may consider obtaining credit ratings for digital bonds. In Project Evergreen, the Notes were rated on par with the Government's conventional institutional green bonds.[15]

47. An important consideration of rating digital bonds is the potential additional risks associated with issuing in digital form versus conventional form. Digital bond issuances involve DLT platforms, which leverage the rapidly changing blockchain technology and, as a result, new capabilities are not fully proven in use and remain largely untested in financial markets. To help address potential risks, it would be useful to have in place clear business continuity plans (**BCP**) which specify the steps to be taken by the platform operator and relevant parties in case of a DLT platform disruption or failure. Prior to formulating the BCP, parties may conduct a comprehensive risk assessment and analysis of, among other things, the potential threats, vulnerabilities, and impacts that could disrupt the normal operations of a DLT platform, such as cyberattacks, natural disasters, power outages, network failures, etc. The BCP may include database recovery and regular back-up procedures. To address the concern of an irremediable disruption or failure event, parties may also consider keeping a regular off-chain mirror record of the database and having in place measures for migration of the database to an alternative platform.

Secondary trading

48. As mentioned above, similar to other conventional bonds, secondary market trading of beneficial interests of the Notes in Project Evergreen takes place exclusively by way of traditional OTC trading outside the digital platform, while only the settlements and transfers are effected on the digital platform. OTC trading may offer more familiarity for the parties involved, as they can negotiate the terms and conditions of the trade directly in the same manner as conventional bonds.

49. Ideally, if trading functionality such as trading of the security tokens can be included on a DLT platform, it can enhance liquidity and transparency of secondary market, offer standardised and automated processes and protocols, and may reduce counterparty and settlement risks, as it leverages blockchain technology and smart contracts to enable more secure and efficient verification and settlement of the trade. However, including such trading functionality has complex technological and legal requirements. From the technological perspective, building such functionality into the DLT platform impacts costs and timing including but not limited to infrastructure set-up, testing and getting participants familiar with the processes. In addition, the platform provider would also need to consider the legal implications of carrying on a trading platform business, such as licensing requirements for Type 1 (dealing in securities) regulated activity and Type 7 (providing automated trading services) regulated activity[16] under the SFO for the case of Hong Kong.

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[15] *Consistent with the Government's conventional institutional green bonds (tenor longer than one year) which were rated on par with the Government's long-term credit ratings, the Notes (365-day) were rated on par with the Government's short-term credit ratings.*

[16] *A corporation that provides automated trading services shall either be authorised to do so under Part III of the SFO, or licensed or registered under Part V of the SFO. For further details, please refer to the SFC's Guidelines for the Regulation of Automated Trading Services as well as the Guidelines for Virtual Asset Trading Platform Operators (as implemented).*

Asset servicing

50. In a digital bond transaction, the parties should consider whether asset servicing is to be executed in a fully automated manner or in a partial automated manner which requires manual checking. DLT platforms may rely on smart contracts and the blockchain technology to automate the entire process of asset servicing, such as interest and principal payments. This could reduce operational costs, risks, and errors, and also enhance efficiency. In a typical conventional bond issuance the payment process usually includes intermediaries such as paying agents, while for a fully automated digital bond, it may not be necessary to appoint such an intermediary.

51. Instead of fully automating every process in asset servicing, parties may consider a partially automated process, and retain a manual verification process. For example, for a floating rate digital bond, parties may consider automating calculation of an interest payment amount, but this amount is subject to verification and approval by the relevant party before payments are made. This could balance the benefits and drawbacks of automation and related operational risks, and allow for more flexibility. In Project Evergreen, the digital platform leverages smart contract technology to automate part of the asset servicing process. For example, in the case of principal payment, the debiting of balances in tokenised securities accounts will take place atomically on the digital platform as the transfers of Cash Tokens are made. With respect to interest payments, the digital platform will automatically calculate the interest payment amounts, while such amounts are verified and approved by the paying agent before payment instructions are executed on the digital platform.

Listing

52. In Project Evergreen, the Notes are not listed on any conventional exchanges.

53. Globally, not all digital bonds are listed on conventional exchanges. One of the reasons could be the lack of connectivity between relevant conventional exchanges and DLT platforms, in particular with regard to trading and/or settlement, that may pose challenges in managing the consistency of trading data of listed digital bonds across various platforms.

54. Certain overseas exchanges have developed specific markets that cater for digital asset listing to address some of the unique features of digital transactions including the deployment of DLT platforms in settlement and asset servicing. At the moment, Hong Kong has not yet developed a designated market for digital bond listing, while secondary market trading of bonds in Hong Kong in general takes place by way of traditional OTC trading.

55. Tokenisation could potentially improve efficiency, liquidity, and transparency in bond markets. Project Evergreen has successfully demonstrated the possibility of deploying DLT to a real capital markets transaction under the existing Hong Kong legal framework. In order to fully unlock the potential of tokenisation, more could be done in terms of exploring further use cases, addressing issues of fragmentation, and enhancing the legal and regulatory framework.
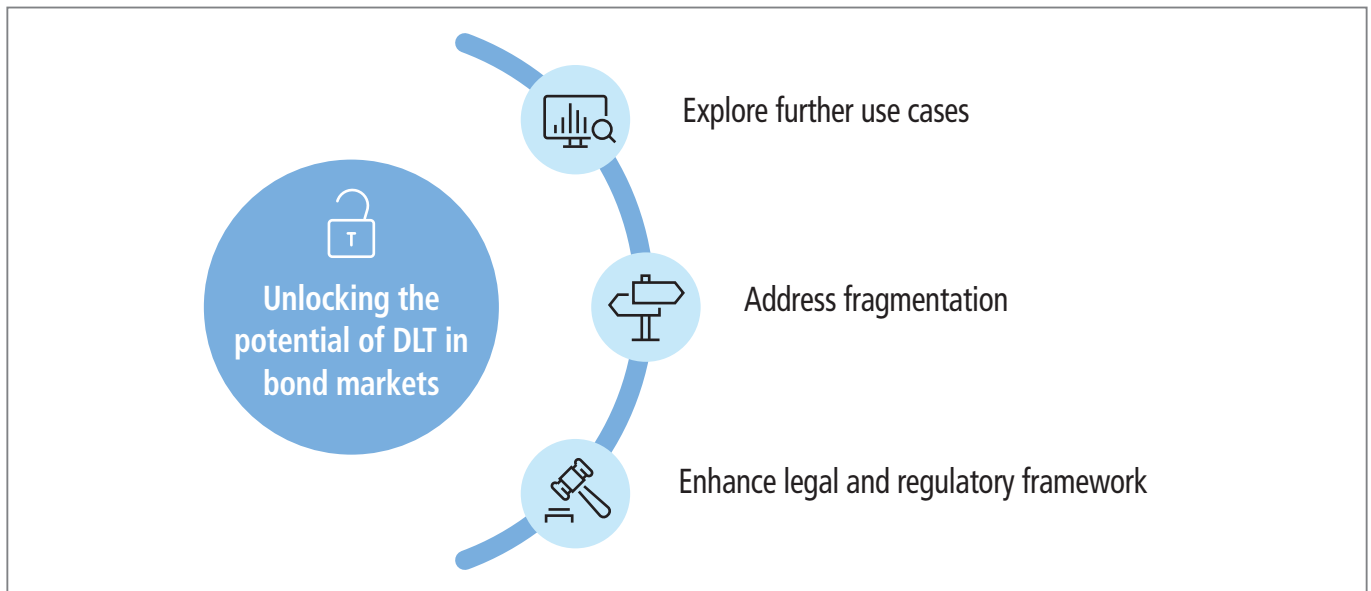
Explore further use cases

56. Building on the success of Project Evergreen, aspects and features that could be further tested include (but are not limited to) the following:

(a) *Platforms*: A number of commercial tokenisation platforms have been developed in recent years and each platform may offer different functionalities. In order to assess the benefits that could be achieved from different technological set-ups, and explore the feasibility and potential of cross-platform inter-operability (as discussed in paragraphs 58-60 below), more issuances may be conducted using different DLT platforms.

(b) *Currencies*: Issuances may also be conducted in currencies other than HKD to cater for the needs of different issuers and investors. In Project Evergreen, HKD cash tokens were minted by CMU (as a unit under the HKMA) on the digital platform. Depending on the preference and operational readiness of a bond issuer, investors and the DLT platform provider, as well as the relevant legal and regulatory framework, the cash leg could theoretically take different forms, such as cash tokens minted by commercial banks, stablecoins, or off-chain payment using fiat cash.

(c) *Standardisation of documentation*: Standardisation protocols, if widely adopted across the market, can potentially streamline certain business-as-usual processes, promote straight-through processing and pave the way for wider DLT adoption. One example is the Bond Data Taxonomy recently rolled out by the International Capital Markets Association (**ICMA**).[17]

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[17]   *Bond Data Taxonomy is a "common" language to standardise key economic terms of a vanilla bond (e.g. nominal amounts, denominations, currencies, prices, net proceeds, interest, and interest payment related information), key dates (e.g. pricing, settlement, issue dates) among other information (e.g. bearer or registered, status of the note, relevant parties, ratings) typically included within a term sheet.*

(d) _Real-time impact tracking and reporting_: The feasibility of incorporating real-time tracking and reporting features (for example in respect of environmental, social, and governance issuances) may be further explored, whereby the DLT platform collates and feeds data collected directly from underlying assets and makes such data collected accessible to end investors.

(e) _Tokenisation of repo transactions_: Project Evergreen has demonstrated a number of benefits arising from tokenisation of bonds. Given the role played by repurchase agreements (repos) in bond market liquidity, adoption of tokenisation in repo transactions may bring additional benefits to financial market participants. Leveraging the DLT, assets in repo transactions can be tokenised, and settlement can be automated on an atomic DvP basis, thus enhancing efficiency and thereby reducing settlement timeline and risks as compared to conventional repo transactions which are documentation heavy but time-sensitive in the meantime.

(f) _Retail use case_: In the longer term, subject to identifying and addressing potential legal, regulatory, technical and operational issues, tokenisation at the retail level may potentially simplify the conventional retail bond issuance/subscription process, lower denomination which permits broader investors base to participate in an issuance, and automate the primary issuance and secondary trading processes which could bring efficiency and potentially improve liquidity.

Address fragmentation

57. Similar to many other digital bonds, Project Evergreen deploys a digital platform that runs on its own DLT network where the network operates independently and does not integrate with other DLT networks. Establishing connectivity between different DLT platforms, between DLT platforms and conventional systems, between DLT platforms and a CSD, and establishing a common platform, as further explored below, may help to address potential market fragmentation concerns.

Establish cross-platform inter-operability / connectivity

58. There are multiple dimensions in realising cross-platform inter-operability/connectivity. This could include inter-operability/connectivity within the same technical stack (i.e. same smart contract language, base technical infrastructure etc.) but among different applications, or otherwise full inter-operability/connectivity between different applications and different technical stacks.

59. As discussed above, establishing cross-chain bridges among different DLT platforms may enhance the flexibility and liquidity of the digital bonds in terms of accessing different markets, as well as the possibility of leveraging the unique advantages of different blockchains for different functions or features.

60. As the market matures, it is important that DLT platform providers are flexible enough to cater for inter-operability/connectivity and commercial demands. We encourage platform providers to provide different options for future transactions with the aim to achieve cross-platform inter-operability/connectivity.

Establish connectivity between DLT platforms and conventional systems

61. Inter-operability with other conventional systems, such as existing custody systems and payment systems, is technologically complex. However, overcoming this hurdle can support the inclusion of every component of a bond transaction moves on-chain. One of the aspects of on-/off-chain integration is seamless straight-through processing (**STP**) without the need for manual double-keying into existing industry standard processes.

62. Expanding inter-operability between DLT platforms and conventional systems beyond existing messaging systems was explored in Project Evergreen and could potentially enable more seamless and streamlined STP in operational workflows within and across market participants. Take connectivity with custodians' existing systems as an example. Where the digital platform is not connected to the existing custody systems (which is the case in Project Evergreen), the custodian role will be significantly weightier when compared to the STP approach for a conventional bond issuance.

Table 2 summarises the key activities undertaken by a custodian on the digital platform in Project Evergreen as compared to a conventional bond issuance

Key Activity	Custodian in Project Evergreen	Custodian in conventional bond issuance
Safekeeping — Account Openiang	A custodian is a CMU participant who owns a tokenised securities account on the digital platform where the balances of tokenised securities are held, as well as a Cash Token account on the digital platform where the Cash Tokens are held on behalf of the custodian's clients.	Assuming the custodian is an existing CMU participant, no additional account opening is required.
Record Keeping	All holdings held in accounts on the digital platform are also recorded on the off-chain custody systems. This is because the clients of the custodian still rely on traditional messaging to instruct the custodian on trade settlements, and currently there is no connectivity between existing custody systems and the digital platform. Reconciliations between the digital platform and custody system records are done manually.	Investors and custodians have integration with existing systems, hence the process is STP.
Settlement	Custodian creates trade recaps and authorises the trades on the digital platform, on the back of client instructions. This is done manually, as there is no connectivity between existing custody systems and the digital platform.	STP.

63. If connectivity can be developed between the DLT platform and the existing custody systems, the process can be streamlined and thus enhancing operational efficiency.

64. While we are seeing DLT being applied across different areas of activity, it is still an emerging technology and traditional financial systems still play an important role in financial market transactions. There may be a need to integrate between DLT-based systems and traditional systems to address fragmentation issues.

Establish connectivity between DLT platforms and CSDs

65. When DLT platforms are operated by private institutions, CSDs may be able to play a key part in the interim before better inter-operability between DLT platforms can be achieved. For example, establishing a linkage between a CSD and different DLT platforms can enable access by a broader range of investors, as the existing member network of the CSD can be leveraged. The existing members of the CSD may not have to go through the KYC process again, and they will not have to open an account on each such DLT platform.

66. When DLT platforms are shared information technology systems where all actors co-operate directly, the role of CSDs is reduced to value-added services such as liquidity sources. In such decentralised infrastructures, the record keeping and settlement roles can be automated via smart contracts.

Establish a common platform

67. Another possibility is for established CSDs to develop DLT-based systems for digital bonds issuances, which may help reduce the risk of silo created by each issuer using different DLT platforms for each transaction. A centralised and standardised system can potentially attract higher liquidity and achieve lower transaction cost as compared to fragmented DLT platforms. However, to achieve the economies of scale that a centralised system can bring, a critical mass will have to be formed.

Enhance legal and regulatory framework

Further digitalisation of the bond issuance process

68. Currently, some paper processes are still maintained in digital bond issuances. Fully digitalising these processes could enhance efficiency gains, though it may take time for the industry to replace existing market practices and conventions which have been in place for decades. The legal and regulatory framework may also need to be fine-tuned to fully digitalise processes[18].

Listing

69. Some overseas exchanges have developed listing solutions for issuers of digital bonds. Below are two examples:

(a) The first model is for pure profile listing on the exchange with no intention of on-exchange trading (as trading is done OTC as in conventional bonds). An example of this model is the Luxembourg Stock Exchange, which offers issuers the possibility of registering their digital bonds on its Securities Official List without admission to trading.

(b) The second model is to allow both listing and trading on the exchange. Not many exchanges are currently connected to a digital trading venue, but an example of possessing such connectivity is the SIX Digital Exchange in Switzerland, which offers issuance, listing, trading, settlement and custody of digital securities. In 2022, a digital bond was issued on the DLT-based CSD of SIX Digital Exchange, and is listed and tradeable at both SIX Digital Exchange and SIX Swiss Exchange, demonstrating the possibility of connecting a digital platform and traditional financial market infrastructure.

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[18] For instance, for bearer bonds being capable of native issuances, legislative amendments to introduce the concept similar to possession of "electronic transferable record" as in the laws of other jurisdictions will be required, taking into account any potential knock-on effect to the laws on negotiable instruments more generally.

70. Developments in other exchanges provide useful examples for Hong Kong to consider when exploring developments to cater for the needs of potential issuers of digital bonds.

Clearing and settlement models

71. In Hong Kong, CSSs are, if designated as such under PSSVFO, subject to an oversight regime of the HKMA.[19] This could be relevant for a DLT platform involved in a digital bond issuance. Section 4 of the PSSVFO empowers the HKMA to designate a CSS, which is in operation in Hong Kong or which accepts clearing or settlement transfer orders denominated in HKD, to be subject to the oversight of the HKMA for financial stability or public interest considerations.[20] Upon designation, the designated CSS will need to comply with certain requirements under the PSSVFO[21], and observe the international regulatory standards on Financial Market Infrastructures, such as Principles for Financial Market Infrastructures.

72. The HKMA has published an explanatory note[22] on its website to explain the relevant policies the KMA intends to follow with respect to the designation of a CSS and the issuance of certificate of finality, and outline the major obligations of a designated CSS, the power of the HKMA in respect thereof, the appeal mechanism in respect of the designation and revocation of designation of a CSS and the issuance, suspension or revocation of a certificate of finality issued to a designated CSS.

73. Some overseas jurisdictions have adopted alternative models with a view to creating opportunities for market participants to conduct digital bond transactions. Some examples include:

   (a) _Designation and exemption of DLT platforms_: The possibility of designating[23] or exempting[24] CSSs may attract the interests of digital and financial intermediaries to facilitate digital bond issuances.

   (b) _Introducing a dedicated regime_: There are currently only a few overseas regulatory regimes dedicated to digital bonds and many of them are still in the early phase.[25] Whether it is necessary to introduce a dedicated regime, and, if so, how to craft such a regime would need to be further studied.

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[19] Under the PSSVFO, a CSS is defined to include a system established for the clearing or settlement of obligations for the transfer of book-entry securities, or the transfer of such securities.

[20] i.e. if the HKMA is of the opinion that the system is, or is likely to become, a CSS whose proper functioning is material to the monetary or financial stability of Hong Kong; or material to the functioning of Hong Kong as an international financial centre, or having regard to matters of significant public interest. Subsections 4(3) to 4(4A) of the PSSVFO set out further details on factors which the HKMA would take into account with regard to designation.

[21] These requirements include conducting the operations of the system in a safe and efficient manner calculated to minimise the likelihood of any disruption to its functioning, having in place operating rules and adequate arrangements to monitor and enforce compliance with the operating rules, having financial resources appropriate for the proper performance of the system. The HKMA may also request the system operator of a designated CSS to provide information or documents that the HKMA considers necessary to determine compliance with the PSSVFO, examine any books, accounts or transactions of the system operator at any time with or without prior notice, require the system operator of a designated CSS to submit an audit report by written notice after consulting with such system operator, give directions to a system operator for compliance with the PSSVFO and impose operating rules on such designated CSS.

[22] Explanatory Note on Designation and Issuance of Certificate of Finality of Clearing and Settlement Systems under the PSSVFO (https://www.hkma.gov.hk/media/eng/doc/key-functions/banking-stability/oversight/explanatory_note.pdf)

[23] As explained in paragraph 71 above.

[24] In Hong Kong, under the PSSVFO, where the HKMA is satisfied that the scope and nature of the supervision exercised in relation to any designated system by the authority outside Hong Kong is sufficient to achieve any or all of the objectives under the PSSVFO, the HKMA has the power to exempt the designated CSS outside Hong Kong.

[25] One example is the central account keeper regime in Luxembourg.

74. DLT holds promise for revolutionising the operation of the financial markets. Project Evergreen is an important step forward in promoting the adoption and realisation of the full potential of DLT in the bond markets. We hope that this Report can provide useful insights into issuing tokenised bonds in Hong Kong across technology and platform design, deal structuring as well as legal and regulatory considerations.

75. Building on the experience from Project Evergreen, the HKMA and the Government will work with the industry to conduct further tokenised issuance(s) to advance development on this front. We are in discussion with key market players on future tokenised issuances, which may, subject to solution readiness, include new features that can create further efficiency gains, expand investor reach and pave the way for wider adoption in capital markets.