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CLIFFORD CHANCE

# Scaling DLT-Based SSA and Government Bond Markets

## A Roadmap Strategy for European Issuers

June 2024

Association for Financial Markets in Europe
www.afme.eu

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AFME works to promote a robust, connected and competitive financial system in the EU, UK and globally. providing expertise across a broad range of regulatory and capital markets issues. We represent the leading global and European banks and other significant capital market players. AFME's members are the lead underwriters of 89% of European corporate and sovereign debt.

AFME advocates for deep and liquid secondary market, pursues changes that enable the European green and digital transformations, supports the completion of the Banking Union and Capital Markets Union and connectivity of EU and UK financial markets with the rest of the world.

Clifford Chance's cross-border Digital Assets and DLT team has advised fintechs and financial institutions on a variety of innovative projects, including work on digital assets, cryptocurrencies, NFTs, tokenised securities and derivatives, as well as the development and implementation of blockchain-based platforms and DLT infrastructures.

The team's expertise and experience spans Corporate, Global Financial Markets, and Litigation & Dispute Resolution practices.

With a dedicated tech public policy team, Clifford Chance also advices and engaging with governments, international bodies, and regulators on technology-related policies, including blockchain and digital assets.

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# Foreword

Distributed Ledger Technology (DLT) holds great promise for enhancing the efficiency of, enabling innovation in, and expanding access to capital markets. Implemented at scale, DLT can make a significant beneficial contribution to increasing the efficiency and accessibility of capital markets, and in so doing to the real economy.

In recent years, various proofs-of-concept initiatives in DLT-based issuance of bonds, and tokenisation of bonds, funds and other financial assets have been completed successfully and shown the potential of DLT in capital markets. Increasingly, investors, issuers and other market participants are becoming a part of the DLT-based markets ecosystem.

The development of DLT-based capital markets has therefore reached a critical point: the prerequisites are now largely in place to significantly grow DLT-based capital markets over the next couple of years. Public-sector issuers of debt instruments in Europe - sovereign, supranational and agency issuers – can play a key role in this process of scaling DLT-based capital markets through increasingly deploying DLT solutions in their issues.

Such DLT-based issues would not only provide benefits to public-sector issuers themselves; they can also serve as a catalyst for further DLT-based innovation, efficiency, and resilience across capital markets. Moreover, by entering DLT-based markets at the present time, European governments and public-sector actors can ensure that Europe is in the lead in shaping the future of capital markets.

This Roadmap document was created in collaboration with a variety of stakeholders across the capital markets. The objective of the Roadmap is to support European sovereign, supranational and public-sector agency issuers in developing a strategy for issuance of debt instruments on DLT-based infrastructure. It sets out the benefits and workings of DLT-based issuance and details a phased approach for public issuers to entering and scaling DLT-based issuance; from early-stage issues through benchmark issues to integration of DLT-based issuance in their regular issuance programmes.

**Adam Farkas**
**CEO**
Association for Financial Markets in Europe

# Executive Summary

**The last years have seen significant acceleration in the development of capital markets based on Distributed Ledger Technology (DLT)**, with uptake in issuance of and interest in DLT-based financial instruments including bonds and funds. International and European sovereign, supranational and public agency (SSA) and government bond issuers have led the way towards scaling of DLT-based capital markets.

This increase is a recognition of the significant efficiency and product innovation benefits offered by the use of DLT, and of the potential DLT holds to transform capital markets over the medium and longer term. It is therefore not only imperative that SSA issuers in Europe not fall behind in DLT adoption, but that they **seize the opportunities of leading and shaping the capital market transformation towards DLT.**

**This roadmap document lays out a phased strategy for issuers to initiate and scale DLT-based SSA and government bond issues.** It sets out how DLT can help SSA and government-bond issuers achieve their mandates and objectives and makes recommendations on concrete steps for issuers to take. These recommendations are structured as a roadmap for issuers. The recommendations distinguish between different levels of adoption maturity (see Figure 1 below), from those issuers who have not yet undertaken any DLT-related issuances to those which have explored using different platforms and structuring options.

Figure 1: **Phased strategy for DLT-based SSA or government bond issuance**

| | Phase 1 Experimentation | Phase 2 Scaling | Phase 3 Maturity |
|---|---|---|---|
| **Issuance Size & Frequency** | Issue series of 3 issues<br>Aim for benchmark issue | Increase issuance frequency<br>Conduct benchmark issue | Issue significant and growing percentage of issues on DLT |
| **Bond Features** | Issue (short-date) fixed-rate bonds<br>Consider DLT-specific options | Issue floating- and fixed-rate<br>Remove DLT-specific options | Issue DLT-based bonds across full range of maturities |
| **Bond Structuring & Infrastructure** | Use different structuring options, DLT platforms and ledgers | Issue only DLT-native bonds<br>Consider operating bridge | Issue only DLT-native bonds on platforms with scale |
| **Cash Leg** | As available and appropriate, consider taking part in DLT-based central bank money trials | Settle in DLT-based central bank money, as available | Settle DLT-based bonds only in DLT-based central bank money |
| **Bond Innovation** | Use smart contracts for issuance and redemption<br>Issue a DLT-based green bond | Use smart contracts for coupon payments and in green bonds | Make full use of smart contracts, including in green and KPI bonds |
| **Issuance Management** | Use small number of book runners with DLT expertise<br>Use regular selling restrictions in issuance documentation | Expand number of book runners<br>Use whitelisting to control access to DLT-based bonds | Use regular issuance management structures (syndication, auctions)<br>Use whitelisting to control access to DLT-based bonds |
| | **0-2 years** | **2-4 years** | **4+ years** |

**"It is imperative that SSA issuers in Europe seize the opportunities of leading and shaping the capital market transformation towards DLT"**

## Full Roadmap Preview

While DLT is being adopted in different parts of capital markets, **this roadmap focuses on adoption of DLT in markets for bonds issued by European sovereigns, supranational institutions and public-sector agencies**.

For further details, please see the following parts of the roadmap document:

- **Part 1 – Benefits and Challenges of using DLT in Bond Markets** setting out how DLT can help issuers achieve their issuance and policy objectives.
- **Part 2 – State of the DLT-based bond markets** showing the growth in DLT-based bond markets.
- **Part 3 – DLT vs Traditional Bond Trade Lifecycle** comparing the bond lifecycle in a DLT architecture to that using traditional infrastructures.
- **Part 4 – Prerequisites and Enablers for Scaling** setting out the key enablers for scaling of DLT-based SSA and government bond markets and the degree to which these are in place.
- **Part 5 – Issuer Roadmap** setting out a strategy for issuers to enter the DLT-based bond market, following 3 phases: Phase 1 - Experimentation with early-stage DLT-based issuances; Phase 2 - Scaling of DLT-based SSA and government bonds; and Phase 3 - Regular issuances in mature DLT-based markets.

The Issuer Roadmap is to be read jointly with AFME's separate recommendations for policymakers and regulators ('Policymaker Roadmap') to complement and enable DLT-based capital market developments, which will be published in July 2024.

This roadmap uses the following definitions throughout the report:

**Distributed ledger technology (DLT)** is a database construct that enables the recording of state updates and transactions of assets between participants in a network. The record of transactions exists on a networked, distributed peer-to-peer system, ensuring simultaneous access, validation, and record updating. The networked database is linked by a collection of nodes operated that verify transactions through a consensus mechanism or protocol.

**DLT Platform:** DLT-based infrastructure with capabilities to facilitate issuance or representation of assets including financial instruments like bonds on distributed ledger.

**Tokenisation**: the representation of assets including financial instruments and cash on a distributed ledger, reflecting an ownership right of the underlying asset.

**Tokenised bond:** a tokenised bond is a bond issued using traditional infrastructures, subsequently immobilised and then represented on a distributed ledger in token form.

**Bond token:** in contrast to "tokenised bond", "bond tokens" refers to bonds that have been issued solely ('DLT-native') on a DLT platform without any underlying bond in existence on traditional infrastructure.

**DLT-based bond:** Refers to the use of DLT as the underlying technology for a bond and encompasses both tokenised bonds and bond tokens.

**Smart contracts**: computer code that, following an "if-then" logic, automatically executes all or parts of an agreement when certain preconditions are met.

# 1. Benefits of DLT-Based SSA and Government Bond Issuance

For issuers of SSA and government bonds, a key objective and mandate is the efficient and cost-effective management of debt (issuance). This centres around financing debt at minimum costs, over the short- or medium-term. A broad investor base and efficient secondary markets for SSA and government bonds contribute to achieving this objective.

In addition, both national governments and (public-sector) supranational organisations have policy objectives in which SSA and government bonds play a key role, including ensuring robustness and efficiency of capital markets. DLT offers benefits pertaining to all these objectives. They are set out in the Figure 2 below; see Annex 1 for a more extensive discussion of the different benefits.

Figure 2: **Benefits of DLT by issuer objective**

| Objective | Benefit provided by DLT | Benefit materialises |
|---|---|---|
| **1.Efficient and cost-effective management of debt** | Reduction in primary-market settlement time and risk, e.g. from T+5 to T+1 or T+0 | Immediately |
| | Automation of issuance work flow | Over time |
| | Automation of corporate actions | Immediately |
| | Possibility of enhanced transparency on bond holdings, as appropriate | Immediately |
| | Reduction in secondary-market settlement time and risk reducing transaction costs. | Immediately |
| | Enhanced liquidity in secondary-markets by freeing up bank balance sheets | Over time |
| **2. Broad(en) investor base for issues** | Enable innovative features with added value for investors (e.g. customised coupon payments) | Immediately |
| | Fractionalisation of tokens enables access to issuance for a broader investor base and customised allocation for funds | Immediately |
| | Attract new investors with DLT-specific strategy | Immediately |
| **3. Resilience of capital markets** | Reduction of single-point-of-failure risk in financial market infrastructures | Immediately |
| | Reduction in settlement failure due to automated, programmable and atomic settlement | Immediately |
| **4. Innovation in capital markets** | Kick-start innovation ecosystem | Immediately |
| | Simplifies issuance process enabling more (and smaller) corporates to finance through markets | Over time |
| | Enables shortening of settlement cycles (to T+1, T+0) | Over time |
| **5. International competitiveness of capital markets** | Early issuance and engagement enables issuer/jurisdiction to shape the parameters of DLT-based capital markets | Immediately |

**"A key objective for SSA and government bonds issuers is the efficient and cost-effective management of debt"**

# 2. State of DLT-Based SSA and Government Bond Markets

DLT-based bond markets are moving beyond experimentation to commercialisation. The past 3 years have seen a growing number of issues of DLT-based SSA and government bonds. This part sets out the state of DLT-based markets for such bonds and discusses the investor base issuers can expect.

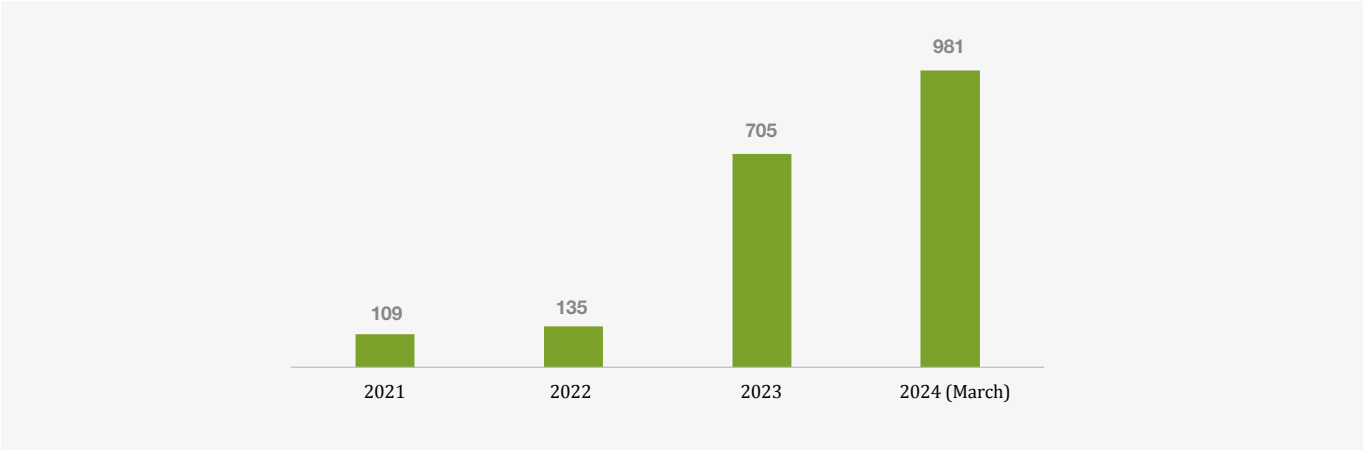
## Issuance volumes

DLT-based SSA and government bond issues are growing rapidly, even exponentially (see Figure 3): global issuance up to March 2024 (USD $980mn) already exceeded the total for the whole of 2023.

The bulk of DLT-based bond issuance has taken place in Asia (particularly Hong Kong) and Switzerland, **with notable bond issues in Europe** including from the World Bank, European Investment Bank, and KfW Development Bank.

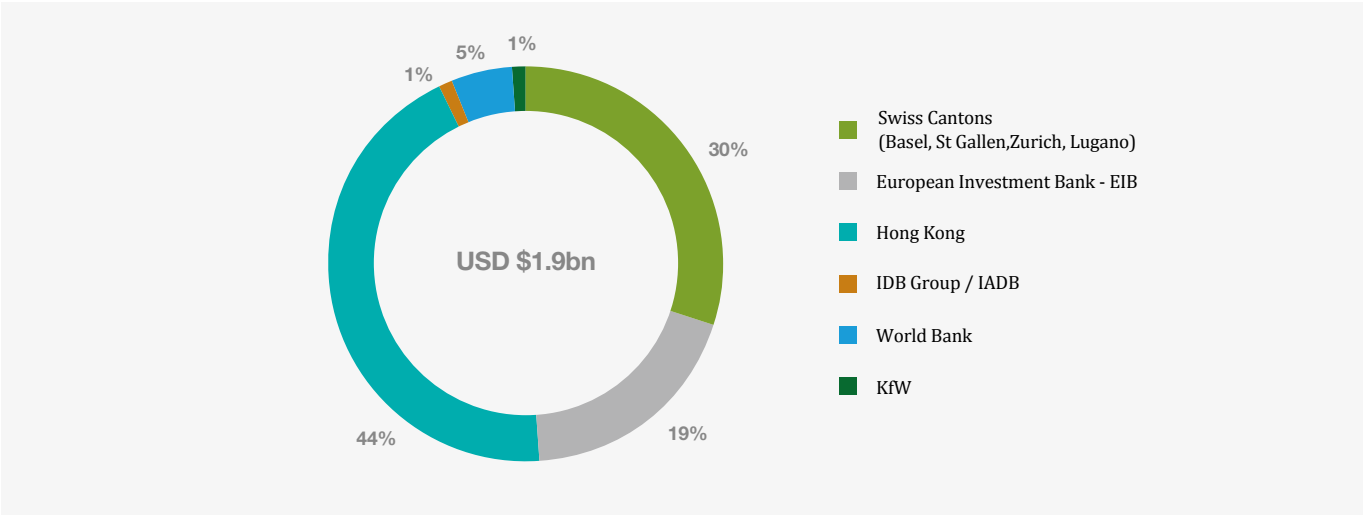
**The observed momentum is likely to persist, with greater participation by issuers, and onboarding of buy-side entities**. The resulting impact would be acceleration to a scaled ecosystem of DLT-based bonds.

Figure 3: **Global issuance of DLT-based SSA and government bonds since 2021 (USD mn)**




Source: AFME Research

Figure 4: **Global Issuance of DLT-Based SSA and government bonds by issuer since 2021 (% of the total)**




Source: AFME Research

## Investor base

Surveys have found a significant degree of interest among investors to invest in DLT-based securities.

**The expectation is that the investor base for DLT-based SSA and government bonds will not differ significantly from that for traditional bonds**. Unchanged operational processes and bond features that are similar to those in traditional issues – especially in early in the DLT-based issuance journey - can help ensure an unchanged investor base.

In addition, **product innovation features offered by DLT – for instance in green bonds – may contribute to the widening and deepening of investor appetite**. Moreover, DLT-based bonds may attract new investors with mandate focused on DLT or innovation; although the impact on the overall investor base is likely to be limited.[1]

### CASE STUDIES – Notable recent DLT-based SSA and government bond issuances

Notable recent DLT-based SSA bond issuances include:

- HK SAR Government's offering of a HKD $6bn two-year bond token in February 2024.
- Canton of Zurich issuing its first bond token on the SIX Digital Exchange (SDX) in November 2023,
- EIB issuing its first green bond token of 1bn Swedish kronor in June 2023. These SSA bond issuances have also triggered limited DLT-based issuance in European corporate-bond markets.

**"Product innovation features offered by DLT may contribute to the widening and deepening of investor appetite"**

1 This assessment is in part based on views and input received from investor associations including The Investment Association (IA) and EFAMA.

# 3. DLT vs Traditional Bond Trade Lifecycle

While DLT holds the potential for transformative benefits for issuers, DLT-based issues need not lead to significant operational changes. This part provides an overview of the differences and similarities between DLT-based and traditional bond trade lifecycles.

As set out in Figure 5 below, the main operational changes in the bond trade lifecycle related to the use of DLT are found in the settlement, custody and asset servicing stages of the lifecycle. These changes are related to the fact that, since DLT-based bonds reside on a distributed ledger, processes such as transfers of ownership and asset servicing are executed 'on-chain' and in an automated way using smart contracts. This represents a significant change from traditional market architecture infrastructures.

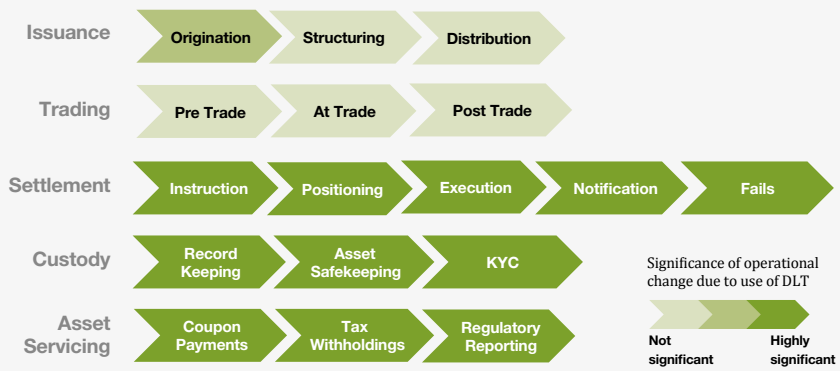
The operational changes in the DLT trade lifecycle with greatest direct relevance for SSA- and government-bond issuers focus on enhanced efficiency of back-office operational processes:

- **Issuance – Origination:** use of DLT could enable more automated origination workflows, removing inefficiencies and manual processes. Moreover, DLT-based bond issues to date have shown the ability to reduce issuance settlement time, from T+5 to T+2, T+1 or T+0.

- **Asset Servicing - Coupon Payments:** the distributed ledger serves as the single source of truth and can through smart contracts automatically establish and communicate the amounts due to market participants, reducing the need for reconciliation between issuer and e.g. paying agent and CSD.

Annex 2 provides further background on the operational lifecycles for SSA and government bonds for both DLT and traditional architectures.

Figure 5: **Operational change due to use of DLT across bond trade lifecycle**



## Documentation

DLT-based bonds should qualify as transferable securities under MiFID and thus **continue to be considered as financial instruments for all regulatory purposes**[2]. This also means **there are no material differences between traditional and DLT-based SSA and government bonds in terms of the offering documentation to be provided by issuers**. As with traditional bonds, offering DLT-based bonds to the public in the EU and UK may trigger the obligation to publish a prospectus in accordance with the Prospectus Regulation. To date, however, most DLT-based bond issues have been issued using wholesale denominations and have not been listed on a regulated market, thus falling out of the scope of prospectus regulations in the EU and UK.

## Origination & Distribution

**The origination and distribution processes for DLT-based issues do not differ in any significant way from that for traditional issues, as underlying economic risks of issues are the same**. For initial, early-stage DLT-based issues issuers may wish to rely on syndication through book runners with expertise in DLT, so as to facilitate a higher-touch and more informative distribution process. In the medium and longer term, we think it is highly likely and strongly advisable that current issuance structures and process flows, whether they be auction-based, syndication-based or a combination of these, be maintained owing to the highly specialised and critical roles played by the various third parties involved in the origination and distribution process currently. For government bonds, this includes the continued use of the primary-dealer model to enable smooth distribution of issues and mitigate market risk.

**"The origination and distribution processes for DLT-based issues do not differ in any significant way from that for traditional issues, as underlying economic risks of issues are the same"**

2 Ibid., para. 27 et seq.

# 4. Prerequisites for and Enablers of Successful DLT-Based Issuances

Several key enablers are prerequisites for innovative technologies such as DLT to be able to develop and scale. Below, these key enablers are set out and an update is provided on the degree to which they are in place in current DLT-based capital markets.

Figure 6 below outlines the degree to which various enablers and prerequisites for (at-scale) DLT-based SSA and government bond issuance are already in place and/or are to be developed further over the medium-term:

Figure 6: **Overview of status of enablers and prerequisites for scaling**

| | In place | To Be Developed Further |
|---|---|---|
| **Technology Maturity** | Sufficient maturity and market expertise for successful DLT-based bond issuances. | Further evolution of smart-contract design as new smart-contract functionality is included in bonds |
| **Investor & Custodian Onboarding** | Limited onboarding of custodians and investors to DLT-based issuance and repo platforms. | Widespread investor access through custodians to key DLT platforms |
| **Secondary Market Trading** | Mainly buy-to-hold with some OTC trading and listings on regulated venues. | Standardised connectivity between distributed ledgers and off-chain venues |
| **Repo** | Number of DLT-based Repo platforms are operational offering programmable, intraday repo | Further onboarding of market participants<br><br>Access to DLT-based central-bank money |
| **Interoperability** | Early-stage adoption of interoperability protocols (e.g. Daml, ERC) and cross-chain smart contracts (e.g. HTLC) | Expanded interoperability (including through bridges), consolidation of market around limited number of DLT platforms |
| **Partnerships** | Initiatives enabling linkage and cooperation between different parts of the ecosystem | Fully-developed ecosystem linkages |
| **Cash** | Initiatives that enable use of DLT-based central and commercial bank money and stablecoins. | Permanently available public DLT-based central-bank money solutions |
| **Regulation** | Sandbox regimes that temporarily enable different DLT-based issuance models | Permanent regulatory frameworks that enable different DLT-based issuance models. |

Key enablers for issuers to monitor as they develop their DLT-based issuance strategy include:

- Investor and custodian onboarding
- Development of repo facilities
- Policy clarity: cash and regulation

## Investor and custodian onboarding

The ability of investors to invest in DLT-based securities including bonds is dependent on their having access – directly or indirectly – to the distributed ledgers on which DLT-based securities and assets reside. It is expected that investors will (continue to) access DLT-based bonds through their custodians.

**Custodians, including the world's largest depositaries, have begun to onboard to various DLT platforms**, enabling investors' access. While custodians carefully consider the cost and benefits of participating in individual platforms, it is expected that this development towards onboarding will continue and accelerate over the short and medium term. **It is recommended that issuers monitor these developments and engage with custodians as part of their DLT-based bond issuance strategy.**

## Repo

A key part of secondary-market liquidity for SSA and government bonds is repo markets.[3] DLT has proven to provide significant advantages in repo markets as it makes possible programmable, precise and intraday repo possible. Given this value-add of DLT, **a number of availability of DLT-based repo platforms have been developed.** These platforms operate by immobilising bonds in custody accounts and representing them in token form on the repo platform. Smart-contract capability is deployed to achieve programmable repo transactions. Depending on the platform and counterparties, the cash leg is settled using either off-chain fiat money or on-chain tokenised commercial or central-bank money.

**OVERVIEW – DLT-based Repo platforms**

In recent years, different DLT-based repo platforms have become available:

- **HQLA$^X$:** platform built on R3 Corda platform that offers different collateral mobility solutions, including Delivery-versus-Delivery swaps, securities lending as well as Delivery-versus-Payment Repo. HQLA$^X$ has enabled the settling of cash legs in off-chain fiat money or central-bank money by linking to the Fnality payment system.
- **Onyx:** the Onyx platform (JP Morgan) is built on a private-permissioned DLT network. It enables true DvP settlement for repos as it enables atomic (simultaneous) and programmable exchange of tokenised deposits and tokenised collateral (including bonds).
- **Distributed Ledger Repo (DLR):** DLR is built on a permissionless ledger on top of Broadridge's existing infrastructure and offers DLT-based repo functionality.

## Policy clarity

### Regulation

Steps have been and are being taken in Europe to make the regulatory framework more accommodative of DLT, for instance through sandbox regimes in the EU and the UK. The sandboxes would temporarily remove regulatory obstacles to certain forms of DLT-based issuance for sandbox participants, potentially increasing issuance optionality for issuers.

Policy debates are ongoing on the definitive treatment. **It is advisable for issuers of to be actively involved in these policy discussions, to enable them to shape the development of the DLT-based capital markets ecosystem in line with their requirements**.

### Cash

The ability to settle DLT-based transactions in central- and commercial-bank money is a key prerequisite for the scaling of DLT-based capital markets. Solutions are emerging that enable on-chain settlement of the cash leg of transactions. These include DLT-based central bank money solutions such as solutions available through the ECB's wCBDC trials and experiments, and the Sterling Fnality Payment System in the UK.

3 https://www.ecb.europa.eu/press/economic-bulletin/focus/2020/html/ecb.ebbox202001_05~37e169eb0f.en.html

# 5. Issuance Roadmap Strategy

Given the benefits that DLT offers and given the early-mover advantages of shaping new market infrastructure, **it is advisable for SSA and government bond issuers to engage early on through a DLT-based issue**.

At the same time, **such issues should be part of a medium-term issuance strategy** that allows the issuer to move towards more regular, larger issues with full DLT functionality.

In this section, such a phased approach to adoption of DLT-based issuance is set out, moving from the experimentation phase, leading to increasingly sizeable and mature DLT-based issues, as set out in Figure 7 below:

Figure 7: **Phased strategy for DLT-based issuance**

| | Phase 1 Experimentation | Phase 2 Scaling | Phase 3 Maturity |
|---|---|---|---|
| **Issuance Size & Frequency** | Issue series of 3 issues<br>Aim for benchmark issue | Increase issuance frequency<br>Conduct benchmark issue | Issue significant and growing percentage of issues on DLT |
| **Bond Features** | Issue (short-date) fixed-rate bonds<br>Consider DLT-specific options | Issue floating- and fixed-rate<br>Remove DLT-specific options | Issue DLT-based bonds across full range of maturities |
| **Bond Structuring & Infrastructure** | Use different structuring options, DLT platforms and ledgers | Issue only DLT-native bonds<br>Consider operating bridge | Issue only DLT-native bonds on platforms with scale |
| **Cash Leg** | As available and appropriate, consider taking part in DLT-based central bank money trials | Settle in DLT-based central bank money, as available | Settle DLT-based bonds only in DLT-based central bank money |
| **Bond Innovation** | Use smart contracts for issuance and redemption<br>Issue a DLT-based green bond | Use smart contracts for coupon payments and in green bonds | Make full use of smart contracts, including in green and KPI bonds |
| **Issuance Management** | Use small number of book runners with DLT expertise<br>Use regular selling restrictions in issuance documentation | Expand number of book runners<br>Use whitelisting to control access to DLT-based bonds | Use regular issuance management structures (syndication, auctions)<br>Use whitelisting to control access to DLT-based bonds |
| | **0-2 years** | **2-4 years** | **4+ years** |

**"Given the benefits that DLT offers and given the early-mover advantages of shaping new market infrastructure, it is advisable for SSA and government bond issuers to engage early on through a DLT-based issue."**

# Phase 1 – Experimentation

*For issuers without prior experience with DLT-based issuances, it is advisable to start the DLT issuance journey with a series of initial, experimental DLT-based issuances to be carried out over a period of circa 1 to 2 years.*

*The aim of these early-stage issues should be to gain experience with different options that exist in DLT-based issuance. The issuer can utilise different types of platforms and ledgers, as well as different options available for settlement of the cash leg. A step-by-step outline of recommended approaches in the experimentation phase is set out below:*

## 1. Issuance size & frequency

**Key Recommendation to Issuers:** conduct an early-stage issuance series of ca 3 issues to gain experience with DLT-based bond issues. Issuers should aim to achieve sizes similar to regular benchmark issue sizes, but the size should be driven by investor interest and may be below benchmark sizes.

In order for issuers to acquire the required experience and expertise with DLT-based issuances it is advisable for SSA issuers to start their journey with a series of early-stage issues. **Such a series can consist of circa 3 issues over a period of between 1 and 2 years.** During this period, new developments in regulatory frameworks or the possibility of central bank money settlement can also be taken into account.

**CASE STUDIES – Issuance Sizes to date**

Most of the SSA and government bond issues have been around the **EUR 100m** mark to date, for example:

- **EUR 100m** - World Bank (October 2023) and
- **EUR 100 m, GBP 50m, SEK 1bn** (around EUR 90m or GBP 75m). – European Investment Bank (2022, 2023)

However, as momentum around and familiarity with DLT-based bonds is growing, larger issues are increasingly feasible, and indeed the recent Hong Kong Government issuance was significantly larger:

- **HKD 6bn** (around EUR 720 m or GBP 620 m) - HKSAR (February 2024)

For early-stage issues, **issuers should aim to achieve issuance sizes that approach those of regular benchmark issues, while bearing in mind that feasible sizes may be below those of their regular issuance programme.** During the early-stage issues, issuance size is to be driven by investor demand, which is likely to grow over the period as investor become more familiar with DLT, custodian onboarding on DLT platforms progresses and investors' internal processes for investing in DLT-based instruments mature. In recent months, momentum and issuance sizes have grown (see Case Studies box below), and this trend is expected to continue.

## 2. Bond Features

**Key Recommendation to Issuers:** in the early-stage issuance series, issue plain-vanilla bonds with fixed-rate coupons. Consider including DLT-specific options if this enhances investor comfort.

As with traditional issues, SSA issuers will need to consider various features and elements of a DLT-based bond, including maturity, coupon, governing law and options to include in the issuance. **These features are likely to be similar for those in traditional bond issues.**

Figure 8: **Recommendations for bond features in early-stage DLT-based issues**

| Feature | Recommendation |
|---|---|
| Maturity | Focus on shorter tenors (up to 2 years) to enable buy-and-hold strategies.<br>If investor demand permits, move to benchmark maturities (e.g. 3, 5 or 10 years) |
| Coupon | Utilise a fixed-rate coupon to simplify the bonds' terms and conditions. |
| Options | Consider including a switch option allowing investors to redeem the DLT-based bond or switch it for a traditional bond in certain circumstances |
| Governing Law | In deciding on governing law, consider how the jurisdiction:<br>• Applies legal concepts (e.g. transfer and evidence of ownership, regulatory and liability requirements) to DLT-based bonds.<br>• Regulates key activities (e.g. transfer of payments, settlement service provision) for DLT-based bonds.<br>• Provides legal certainty to issuance of DLT-based bonds (see figure x below) |

**CASE STUDIES – DLT-Specific Options**

- SEK 100m - European Investment Bank (June 2023) – included switch options exercisable in the event that **negative capital requirements** are imposed upon the holders of DLT-based bonds.
- World Bank (October 2023) – this transaction saw the inclusion of a switch option that gave the issuer two choices: either (i) to **transfer** the DLT-based bonds to another DLT platform or (ii) **switch** the DLT-based bonds for registered bonds issued in the traditional way.

Figure 9: **Possible legal forms of DLT-based bonds in key European jurisdictions.**

| Jurisdiction | In what form can DLT-based bonds be issued? |
|---|---|
| Luxembourg | As 'dematerialised securities', a separate category of securities. The issuance of other forms, such as registered bonds, is not excluded under Luxembourg law, although remains to be realised. |
| France | Registered form (au nominatif), although bearer form (au porteur) is possible in certain circumstances. |
| Germany | As 'bearer bonds', without the requirement for a physical global or definitive note. |
| Italy | In 'digital form', a distinct form of security. |
| Spain | As bonds represented by means of DLT systems. |
| Netherlands | In the same form as traditional bonds. |
| United Kingdom | As bonds in one of the 4 following forms:<br>1) digital bearer bonds;<br>2) digital claim bonds;<br>3) traditional registered bonds; or<br>4) dematerialised registered securities under the USRs. |
| Poland | As bonds represented in DLT accounts or in a DLT register. |

Source: Clifford Chance

## 3. Bond Structure & Infrastructure

**Key Recommendation to Issuers:** as part of early-stage issuance series select different types of DLT platforms and ledgers to obtain experience with different possible DLT infrastructures.

### Issuance models

DLT platforms available in Europe are managed by either banks or FMIs (CSDs) and link to different permissioned or permissionless ledgers.

**For the early-stage issuance series, issuers are advised to make use of a number of different DLT platforms and different models for structuring DLT-based issue**. This enables issuers to familiarise themselves with, and assess the benefits and drawbacks of, different models for structuring DLT-based bond issues.

**Three different models for structuring DLT-based issues that SSA issuers can deploy and experiment with are set out and compared below**. These are:

#### DLT Native:

This issuance model involves the following steps:

- Bond is created as a token on a distributed ledger using a DLT platform (bank- or FMI-operated).
- Investors then access the bond in token form through access to the distributed ledger, either directly or through their custodian accounts.

#### Tokenisation:

This issuance model involves the following steps:

- Bond is created and registered in a traditional CSD system.
- The bond is then immobilised and tokenised through a DLT platform.
- Investors then access the bond in tokenised form through access to the distributed ledger, either directly or through their custodian accounts.

### Other, hybrid issuance form

Other issuance models in which the bond does not reside on DLT for the full lifecycle have been applied as well. These include:

- Issuing a bond in token form through a DLT platform, subsequently registering the bond in traditional infrastructure (e.g. CSD system), with investors accessing the bond in traditional form.
- Issuing part of the bond in traditional form (registered in a traditional CSD system) and part of the bond in token form through a DLT platform. The two parts share economic and other characteristics (incl. ISIN). Investors can access the bond either in traditional form or on the DLT platform.

### Types of ledgers

Different DLT platforms are built on different (types of) distributed ledgers. Different types of ledgers offer different benefits and trade-offs. **As part of the early-stage issuance series, it is therefore advisable for issuers to experiment with different types of ledgers**.

Roughly, distributed ledgers can be sub-divided into 3 types:

- *Private-permissioned* platforms, which are closed-loop, private networks, which restrict access to only predetermined users and are typically governed by rules agreed to, and that apply to, all users;

- *Public-permissioned* platforms allow anyone to join the network but restrict governance, administration, or other privileges to specific participants.

- *Public-permissionless* platforms, which are open, public networks that do not restrict access or privileges.

To date, **private-permissioned platforms have been the most common type of ledger** used in DLT-based bond transactions, as their key characteristics of central control are most similar to traditional infrastructure and offer an increased regulatory comfort, including in terms of investor onboarding. However, public-permissionless issues have taken place (see Case study below) and public-permissionless could provide innovation benefits over the medium-term.

In deciding which ledgers to include in their early-stage issues, issuers should consider the benefits, potential drawbacks and trade-offs of different ledgers, as outlined in Figure 10 below:

Figure 10: **The benefits, potential drawbacks and trade-offs of different ledgers**

| | | Private-Permissioned | Public-Permissioned | Public-Permissionless |
|---|---|---|---|---|
| Defining Characteristics & Trade-Offs | **Resilience & Security** | Achieved through central governance and restricted access and privileges | Achieved through central governance and restricted access and privileges | Achieved through encryption and incentives |
| | **AML/KYC** | Access to ledger restricted to financial institutions | Privileges to ledger restricted to financial institutions | Emerging solutions including permissioned tokens and permissioned Layer 2 with access restricted to financial institutions. |
| | **Data Confidentiality** | Restrictions on data access | Restrictions on data access | Use of Zero Knowledge Proof |
| | **Scale** | Fewer participants and centralised / coordinated governance can enhance scale | Common standards can enable scaling | Broad accessibility and interoperability can enable scaling |
| | **Interoperability** | APIs and bespoke negotiations between network providers | Based on open-source standards | Based on open-source standards |
| | **Settlement Finality** | Finality determined as part of the design of the network | Finality determined as part of the design of the network | Consensus mechanisms generate probabilistic settlement |
| | **Capital & Liquidity** | DLT-based bonds receive the same prudential treatment as traditional bonds. | DLT-based bonds receive the same prudential treatment as traditional bonds | DLT-based bonds receive a more conservative prudential treatment than traditional bonds |

**CASE STUDIES – Issuance on public-permissionless ledger**

The EIB issued one of its early-stage issuances on the public-permissionless ledger: the EUR 100 mn, 2-year bond was represented using the ERC-20 token standard and was issued on the Ethereum network. Santander, Société Générale and Goldman Sachs collaborated on the issuance.

## Backup systems

DLT may lead to a changed risk profile of a bond:

- *DLT may reduce or remove risks present in traditional market infrastructure:* for instance the default and operational risks of intermediaries on which traditional infrastructure relies.

- *DLT may lead to new risks:* such as platform risk (continuity risk related to the DLT platform), smart contract risk (e.g. bugs, coding errors, vulnerabilities in the smart contract.)

To date, the **use of DLT has had limited impact on credit ratings issued by the most prominent rating agencies**, in part because of the creditworthiness of the issuers and use of off-chain back-up systems for DLT-based issues and payment solutions. SSA issuers can therefore consider requiring that DLT platform providers offer off-chain backup systems for the early-stage issuance series.

## 4. Cash leg

**Key Recommendation to Issuers:** use cash settlement solution as appropriate and available, consider taking part in operational solutions, experiments or trials involving DLT-based central-bank money.

Different solutions have been deployed to settle the cash leg of transactions involving DLT-based bonds. Figure 11 below sets out different possibilities: off-chain and on-chain; central bank money and non-central bank money:

Figure 11: **Available DLT-based cash solutions**

| | Off-chain (Traditional) | On-chain (DLT-based) |
|---|---|---|
| Central Bank Money | TARGET2 (Euro Area)<br>RTGS (UK)<br>SICSystem (CH) | ECB wCBDC solutions (Euro Area)<br>Sterling Fnality Payment System (UK)<br>Swiss National Bank wCBDC (CH) |
| Non-Central Bank Money | Deposit accounts<br>(Commercial Bank Money) | Stablecoins<br>Tokenised Commercial Bank Money |

Delivery-versus-Payment for DLT-based bonds is possible and has been achieved for all four cash solutions categories. This includes off-chain cash solutions, where API connections can enable DvP.

Central-bank money settlement minimises counterparty risk and may therefore be a preferred means of settlement. It is therefore recommended that settlement for **at least one of the bonds in the early-stage series, on-chain (DLT-based) central bank money be used.**

**CASE STUDIES - ECB wCBDC initiative**

**The ECB wholesale CBDC experiments and trials**

- The European Central Bank (ECB) has launched an initiative to make different DLT-based central bank money solutions available for DvP and PvP trials and experiments. The initiative runs until November 2024.
- The ECB has proposed three distinct models for the trials:
  - **Full Integration:** tokenised central bank money on a ledger operated by the Banque de France.
  - **Trigger:** atomic settlement through a trigger chain operated by the Bundesbank.
  - **Hash-Link:** API connection between TARGET2 system and distributed ledgers.
- It is expected that (one or multiple of) these solutions, if the exploratory initiative is successful, will become common means of payment in the medium term.

## 5. Bond Innovation

**Key Recommendation to Issuers:** leverage bond-innovation possibilities offered by DLT by using smart-contract functionality for issuance and redemption, and by issuing a DLT-based green bond.

DLT offers great potential for product innovation, including for SSA bonds. It is recommended that issuers start leveraging that potential right away, as part of early-stage issuance series, in two ways in particular:

### Customised bond features

Smart contract functionality can deliver efficiency and innovative features, e.g. customised coupon payment whose frequency is tailored to investors' needs. As part of early-stage issuance series, **issuers are recommended to deploy smart contracts for key processes such as settlement of primary-market transactions and redemption of the bond**, in order for them to gain experience with smart-contract functionality.

### Green bonds

A key benefit of DLT is the ability to integrate external data, including data related to green or KPI-linked bonds. Especially for issuers that have issued green bonds in the past, **it is recommended to issue a DLT-based green bond as part of the early-stage issuance series.** Such a bond need not include smart-contract functionality and can form the basis for later, more sophisticated DLT green-bond issues.

## 6. Issuance Management

**Key Recommendation to Issuers:** to manage the early-stage issuance series, it is recommended to appoint a (smaller) number of bookrunners, preferably with expertise in DLT.

### Book runners

Operationally, DLT-based SSA and government bonds can be distributed in the same ways as used for traditional bonds, e.g. through syndication or auction. Given the novel nature of DLT-based bonds, it **is recommended for the early-stage issuance series to select a smaller number of book runners,** in particular those that have experience with DLT-based assets.

### Managing access to issuance

Screening and controlling which investors can take part in transactions is key for an issuer to minimise (reputational) risk of a DLT-based bond being acquired by a sanctioned entity or by a category of investors that it was not intended for.

While managers will normally be responsible for investor screening, **issuers are advised to be involved in discussions on the use of traditional or DLT-specific solutions regarding investors screening DLT-based bonds**:

- *Selling restrictions in the offering documentation*, thereby relying on the expertise and checks carried out by) dealers and brokers in both the issuance process and secondary market transfers to ensure compliance with such restrictions.

- *Whitelisting:* whitelisting is an operational solution that enables automated screening of participants in transactions by allowing only pre-approved investors to participate in transactions relating to the DLT-based bond. Such restrictions can be enforced by smart contracts, offering a solution particularly useful for DLT-based bonds issued on a permissionless ledger.

For **early-stage issues, the use of brokers and dealers to screen investors and seek compliance with the relevant selling restrictions in the offering documentation can be applied.** This is in line with traditional issuance and is more straight-forward operationally than deploying whitelisting solutions.

# Phase 2 – Scaling

*Having completed their early-stage issues, issuers will have acquired expertise and experience with DLT-based bonds. It is expected that in the next years, the DLT-based capital market ecosystem as whole will also mature, as for instance custodian and investor onboarding to DLT platforms progresses.*

*These developments set the stage for more frequent, more sizable, and more standardised DLT-based SSA and government bond issues. It is important that issuers set out a strategy for moving from early-stage issues towards this scaling phase. Such a strategy shows commitment to continuing DLT-based issues and will boost market participants' willingness to engage, invest and participate in the issuer's DLT-based issues. This section sets out the outlines of a scaling strategy for issuers.*

## 1. Issuance size & frequency

**Key Recommendation to Issuers:** set frequent and regular issuances and increase issuance size to benchmark size.

In the scaling phase, issuers should focus on achieving greater standardisation and scale of DLT-based issues. Following the early-stage issues, it is therefore recommended that **issuers schedule regular (e.g. quarterly) DLT-based bond issues**. As custodian onboarding, investor familiarity and regulatory and policy frameworks mature, issuers should seek to increase issuance sizes. **If not yet achieved in the early-issuance phase, issuers should aim to achieve a benchmark issuance.**

## 2. Bond Features

**Key Recommendation to Issuers:** issue DLT-based bonds of benchmark maturity and remove DLT-specific options.

As with traditional issues, issuers will need to consider various features and elements of a DLT-based bond, including maturity, coupon, governing law and options to include in the issuance. **These features are likely to be similar for those in traditional issuance features**, but issuers are advised to ensure the features maximise the success of the early-stage DLT-based bond issuance series:

Figure 12: **Recommendations for bond features in early-stage DLT-based issues**

| Feature | Recommendation |
|---|---|
| Maturity | Issue longer maturities, including benchmark maturities (e.g. 3-year, 5-year, 10-year). |
| Coupon | Issue floating-rate bonds in addition to fixed-rate bonds. |
| Options | Do not include DLT-specific options (e.g. switch options) unless explicitly requested by investors. |
| Governing Law | Utilise lessons from experimentation phase to use governing law(s) most appropriate for DLT-based issues. |

## 3. Bond Structuring & Infrastructure

**Key Recommendation to Issuers:** issue DLT-native bonds on platforms and ledgers that enable scale and consider supporting liquidity integration through bridge functionality.

### Issuance models

It is expected that in the coming years, policy frameworks become more accommodative of use of DLT across the trading lifecycle. In addition, it is expected that onboarding of custodians and investors onto (a subset of) DLT platforms will further mature. Both these trends should enable greater optionality for issuers in terms of the issuance models and DLT platforms they select. **Investor demand permitting, issuers are recommended to move away from tokenisation models in favour of DLT-native issues.**

### Types of ledgers

It is recommended that during the scaling phase **issuers make use of platforms based on ledgers that provide scale or scalability, either by offering greater (public) accessibility and/or significant degree of onboarding**. Ledgers that enable greater degrees of interoperability can also provide a greater potential for scale. As markets and regulatory frameworks are expected to continue to evolve, issuers are advised to closely follow developments.

### Interoperability and bridges (commercialisation phase)

- DLT-based bonds are issued on a particular platform and ledger. However, it may be that certain investors – or their custodians – are not onboarded onto that platform or ledger, creating the risk of a 'walled garden' and, in the case of bond markets, fragmented liquidity pools. As indicated, selecting ledgers with greater scale, custodian and investors presence and/or the ability for interoperability with other platforms can help enhance liquidity.

- Nonetheless, during the scaling phase, it is expected that some degree of liquidity fragmentation will persist. **SSA issuers can therefore consider providing liquidity enhancement by operating bridge functionality.** For example, issuers can consider operating a burn-and-mint bridge facility, whereby the SSA issuer would, on request of the bond holder, offer to destroy a token representing a bond on one ledger while simultaneously creating a bond token on another ledger, thus enabling cross-chain transactions. Such a facility could be made available to (whitelisted) market participants for a fee.

- From the issuer perspective, operating a bridge brings greater liquidity for its issues, as well as the potential for greater transparency for issuers in bond holdings and transactions, although this requires full discussion with ecosystem stakeholders including investors.

From an investor perspective, a centralised bridge operated by a sovereign or supranational issuer not only enhances liquidity for that issuer's assets; it also minimises counterparty risk. Alternatively, bridge functions could be performed by regulated third parties.

### Backup systems

As part of the scaling phase, **issuers are recommended to no longer require off-chain back-up systems, to the extent deployed in early-stage issues.** It is important for issuers to continue to engage with Credit Rating Agencies (CRAs) to ensure an understanding of their evolving views and methodologies relating to DLT-based SSA and government bond issues.

## 4. Cash Leg

**Key Recommendation to Issuers:** settle issuances in DLT-based central bank money.

It is expected that over the next few years, DLT-based central bank money solutions will become a more available and permanent feature across Europe. Where available, it is recommended that SSA issuers make use of DLT-based central bank money solutions for settlement of primary-market transactions.

## 5. Bond Innovation

**Key Recommendation to Issuers:** include innovative features in the DLT-based bond based on smart-contract functionality, including customised coupon payments and green-bond transparency.

### Customised bond features

As part of the scaling phase, it is recommended that issuers expand the use of smart contracts functionality to also include asset servicing processes such as coupon payments as well as option notifications. Issuers can for instance experiment with customisation of coupon payments based on investors' preferences.

### Green Bonds

As part of the scaling phase, **it is recommended that issuers issue a DLT-based green bond that includes smart-contract functionality**, including integrating off-chain data on use of proceeds and other key characteristics to enhance transparency for investors (see Case Study below).

**CASE STUDIES – Bond Innovation: HKSAR Digital Green Bond offering**

The Government of Hong Kong Special Administrative Region (HK SAR) a issued a HK$6bn digitally native green bond, settling on 7 February 2024. The proceeds were used to refinance projects that sit in the HK SAR Government's Green Bond Framework. Among other breakthroughs, the HK SAR Government was able to successfully integrate green bond disclosures within the platform (HSBC Orion). Key bond documentation and relevant review reports could be viewed on HSBC Orion, enhancing transparency and ease of access to relevant information related to the DLT-based green bond.

**CASE STUDIES – Bond Innovation: so|bond and the Proof of Climate awaReness Protocol**

CA-CIB and SEB launched a platform, so|bond, that enables real-time data synchronisation across participants. This facilitates issuers to raise capital and manage securities through smart contracts.

The platform is based on the PoCR (Proof of Climate awaReness) protocol. This protocol is intended to encourage a low carbon footprint of node validators. It aligns the token earning of a node operator with the quality of the environmental footprint of its infrastructure. The earning of a node will be higher if it can be demonstrated to be running with a more environmentally friendly setup than other nodes.

### Transparency

In the scaling phase, **issuers are recommended to discuss with the ecosystem (book runners, investors) the optimal degree of transparency.** Depending on platform and ledger setup, DLT may allow direct (e.g. custodians) or indirect (e.g. issuers, investors) participants that connect to a DLT platform to access the data related to instrument holdings. Other information, such as the history of transfers and the environmental impact of the infrastructure (see Case Studies below), could also be made transparent. There is even the possibility to connect private blockchains to public blockchains in order to provide such transparency, as demonstrated by HSBC Orion in the case of the European Investment Bank's GBP DLT-based bond issuance in January 2023.

## 6.Issuance management

**Key Recommendation to Issuers:** appoint a wider syndicate and use whitelisting to control access to the issuances.

### Bookrunners

As markets become more familiar with DLT-based bonds, it **should be possible for issuers to appoint a wider syndicate of investment banks for DLT-based bonds issues in the scaling phase.**

### Managing access to issuance

**Use of whitelisting could be considered in the scaling of issues,** as experience with and maturity of DLT-based whitelisting solutions has further increased. Such solutions would allow only pre-approved investors to participate in transactions relating to the DLT-based bond. The restrictions can be enforced by smart contracts. A whitelisting solution of this kind could be particularly useful if the DLT-based bonds are being issued onto a permissionless blockchain, although it may result in a greater level of operational complexity and increased cost.

# Phase 3 – Maturity

*Mature DLT-based capital markets can be characterised as markets with full onboarding of investors and custodians to DLT platforms, a consolidation in the number of DLT platforms available for issuance of DLT-based assets, interoperability across ledgers and connectivity with off-chain systems to ensure secondary market liquidity, availability of DLT-based central bank money, and a policy framework accommodative of DLT.*

*While such a degree of maturity is still some years away, it is important for SSA issuers to have a high-level strategy for issuance of DLT-based SSA and government bonds in a mature DLT-based market. This helps steer the scaling journey and guide the structuring of the issues conducted in the experimentation and scaling phases. Below, key elements of issues in mature DLT-based markets are set out:*

## 1. Issuance size & frequency

**Key Recommendation to Issuers:** issue a significant percentage of the regular issuance programme in DLT-based bonds. Increase this percentage over time.

In a mature DLT-based capital market, **it is recommended that issuers issue DLT-based bonds as an integral part of their overall issuance programme.** This can be achieved by setting DLT specific issuance targets. That percentage can be increased over time in a predictable way and in line with market developments.

## 2. Bond Features

**Key Recommendation to Issuers:** issue across the full range of maturities included in the regular issuance programme.

In a mature market, it **is recommended that issuers issue bonds across the full range of maturities, as well as both fixed- and floating-rate bonds in line with the regular issuance programme**.

Figure 13: **Recommendations for bond features in mature DLT-based issues**

| Feature | Recommendation |
|---|---|
| Maturity | Issue full range of maturities in line with regular issuance programme |
| Coupon | Issue floating-rate and fixed-rate bonds, including reset and fixed-to-floating coupons |
| Options | Do not include DLT-specific options (e.g. switch options) |
| Governing Law | Same as in regular issuance, as prescribed in the issuance programme |

## 3. Bond Structuring & Infrastructure

**Key Recommendation to Issuers:** issue on a select number of DLT platforms and on related ledgers that provide scale and liquidity. Bridging functionality can be offered on an as-needed basis.

### Issuance models

**It is recommended that in a mature market phase issuers issue only DLT-native bonds,** i.e. bonds that reside on a distributed ledger for the full trade lifecycle.

### Types of Ledgers

**It is recommended that issues are conducted on selected platforms and ledgers that offer scale, liquidity,** and connectivity with off-chain systems. It is expected that permissionless ledgers may play a significant part in future mature markets and issuers it is recommended that issuers engage in discussions around regulatory treatment and development of permissionless ledgers.

### Interoperability and bridges (commercialisation phase)

It is recommended that **issuers continue to consider the use of providing bridge functionality in the mature-market phase on an as-needed basis:** if needed to avoid or reduce liquidity bifurcation, (continued) bridging functionality – provided to whitelisted participants for a fee - can be considered.

### Backup systems

In a mature market, it is **recommended that issuers not make use of off-chain back-up systems**. It is relevant for issuers to continue engagements with CRAs to understand their evolving rating methodology.

## 4. Cash Leg

**Key Recommendation to Issuers:** only make use of DLT-based central bank money to settle primary-market transactions.

In a mature market, it is **recommended that issuers only make use of DLT-based central bank money for settlement of primary-market transactions, provided** that DLT-based central bank money is available on a permanent basis.

## 5. Bond innovation

**Key Recommendation to Issuers:** deploy smart contract functionality for issuance and asset servicing and deploy full smart-contract functionality for green bonds.

### Customised bond features

It is recommended that smart-contract functionality be deployed in all DLT-based bond issues, for the purpose of redemption, customised coupon payments, option notifications and other processes.

### Green Bonds

It is recommended that **issuers deploy and further explore smart-contract functionality to optimise transparency into use of green-bond proceeds and automate sustainability reporting**, thus providing added value for investors.

### Transparency

It is **recommended that issuers develop** agreements with investors and book runners on **the desired and appropriate level of transparency** relating to bond holdings and transactions**.**

## 6. Issuance Management

**Key Recommendation to Issuers:** manage DLT-based bond issuance in the same way as traditional issuances (combination of syndication and auctions).

### Book runners

In the mature phase, it is **recommended that issuance management for DLT-based SSA bonds is aligned with that of traditional issuance**, i.e. a combination of syndicated and auction-based issues. It can be expected that the wider capital market ecosystem will be sufficiently experienced and familiar with DLT-based issues for special syndication requirements to no longer be needed.

### Managing access to issuance

**It is recommended that issuers deploy whitelisting solutions as a standard in their issues.** Whitelisting pertains to the use of smart-contract functionality to safeguard against, for example, sanctioned investors purchasing the bond. This can provide automated and enhanced compliance.

# Annex 1: Further Background on Benefits of DLT-Based Bond Issuance

This Annex further sets out the benefits DLT can offer, with a focus on specific issuance and wider policy objectives relevant for Europan SSA- and government-bond issuers.

## Objective #1 - Efficient and cost-effective management of debt

**DLT can contribute to efficient debt issuance and management by issuers** enabling atomic, transparent and programmable settlement, reducing primary-market settlement time and risk for issuers, enabling the development of greater secondary-market liquidity, and potentially offering SSA issuers greater insight into their investor base.

- **Reduced and customised primary-market settlement time and risk:** Recent DLT-based issues have seen a reduction in primary-market settlement time from T+5 to T+2, T+1 or T+0, achieving corresponding reductions in settlement risk for issuers and allowing faster receipt and use of issuance proceeds.

- **Transparency:** a distributed ledger provides a single and transparent data source for the recording of transactions. The ledger can therefore provide increased transparency for issuers, in particular around bond holdings and liquidity pools.[4] Such transparency enhances the issuer's understanding of the market in their bonds and can potentially better inform the issuance programme, outreach efforts or issuance structuring.

- **Automation of issuance workflow:** bond issuance is a time-consuming and largely manual process. With the aid of smart contract programmability, DLT offers the possibility of issuance workflow being automated. This allows for more efficient and customised bond issues, size and frequency.

- **Automation of corporate actions:** smart contracts allow for the automation of corporate actions processing, including coupon payments and tax withholdings, thus reducing back-office costs.

- **Increased liquidity in secondary markets:** by enabling automated and Delivery-versus-Payment (DvP) settlement, DLT reduces settlement risk in secondary markets. Moreover, smart-contract functionality enables programmable settlement, facilitating intraday repo Band reducing the time collateral (SSA bonds) is locked in (overnight) repo transactions. This enhances dealers' balance-sheet management, by reducing capital costs for dealers. Both can over time help enhance secondary-market liquidity.

## Objective #2 – Broad investor base for issues

**DLT enables innovative features that provide added value for investors** compared to traditional bonds, and as such can help broaden the investor base for SSA and government bonds, in particular:

- **Green (ESG) functionalities:** DLTs can incorporate and provide greater transparency about the way in which proceeds of green bonds are allocated, and whether this is in line with the stated goals and criteria of such bonds. This can be done by including data on bond KPIs in the token, which can be automatically updated and enable automated reporting for investors.

- **Customised interest payments:** smart contract programmability can allow for lifecycle events to be streamlined and tailored to individual investor's needs. For bonds this could entail a customised frequency of coupon payments – e.g. monthly, weekly or even daily payments – aligned with investors' preferences.

- **Enhanced distribution through fractionalisation:** DLT enables broader market access for smaller investors through fractionalisation: the splitting of a (bond) token into multiple tokens representing smaller value, thus reducing the required investment size. Fractionalisation can also enable more personalised allocation of financial instruments like bonds in funds.

4 Where excessive transparency is a concern for investors, there are operational solutions allowing them to be shielded pseudonymously or behind the identity of their custodian banks in line with traditional bonds market's operations.

## Objective #3 - Resilience of Capital Markets

While still evolving, in the medium- to long-term DLT-based market infrastructure is likely to offer significant resilience advantages compared to the current infrastructure:

- **Reduction of single-point-of-failure:** DLT-based market infrastructure enables the possibility for different entities ('nodes' in a DLT-based infrastructure) to assume joint – decentralised - responsibility for transaction settlement. An outage of a single node would therefore not affect the system in the same way in a centralised infrastructure, reducing single-points-of-failure and concentration risk. DLT also creates permanent records of transfers of ownership, assisting in the resolution of disputes as well as implementation of financial crime requirements.

- **Reduction of settlement failure:** use of smart-contract execution mandates pre-funding and pre-positioning of securities, enhancing settlement success and reducing costs associated with settlement failure.

- **Reduced reconciliation needs:** since all processes are conducted on the distributed ledger, DLT reduces the need for multi-party data reconciliation, reducing the risk of settlement mismatches or errors, both "horizontally" between counterparties and "vertically" through the custody chain.

## Objective #4 – Innovation in Capital Markets

DLT is widely considered to be the basis of future financial market infrastructures, as it holds the promise of more accessible and efficient capital markets:

- **Growing capital-market access:** DLT-based issuances would also help create momentum and ecosystem for scaling DLT-based corporate bond markets. Automation of issuance workflow and corporate actions processing can make market-based financing available to a wider range of smaller and less sophisticated corporates, thus helping to advance the development of capital markets in line with the objectives of the UK Wholesale Markets Review and EU Capital Markets Union.

- **Market transparency:** DLT-based securities have the potential to embed a significant amount of information (incl. transaction history, use of proceeds, bond structure, credit information), offering the promise to provide investor information, market transparency and surveillance capabilities. DLT-based infrastructure also provides access to comprehensive and real-time market data on prices and volumes, facilitating the price formation process and best execution.

- **Basis for shortening settlement cycles:** DLT's ability for automated, programmable and shortened settlement cycles fits in with the regulatory objectives for reducing settlement cycles to T+1 and beyond[5].

## Objective #5 – International competitiveness of capital markets

The above benefits and the fact that DLT is considered to be the basis of future capital markets have led **to jurisdictions with major international financial centres to move ahead with DLT-based SSA and government bond issuance**, in particular Hong Kong – notably with a $6bn (USD $752mn) issuance on HSBC Orion in February 2024 which attracted over 50 domestic and international investors - and Switzerland[6] (see also figure 2 below).

Early-mover issuers and jurisdictions can acquire key learnings which can help them move towards commercialisation and maturity more quickly and help ensure that their capital market ecosystem is in the vanguard of developing DLT-based markets. Moreover, early movers will shape the structure for DLT platforms, DLT-based bond issuances and hence the foundation of DLT-based capital markets.

5 US is switching to T+1 settlement, UK has indicated its attention to do by 2027 and the EU is consulting on a similar shift.

6 Sub-sovereign issuances by cantons, including Zurich, Basel, Lugano and St. Gallen.

# Annex 2: Comparison of Traditional and DLT-based Bond Lifecycles

This Annex compares the full lifecycle of a SSA or government bond in the traditional versus DLT-based processes. The lifecycle of sovereign, supranational and agency (SSA) bonds generally adheres to the typical security lifecycle: issuance, secondary market trading, settlement, custody and asset servicing. SSA and government bonds are generally not centrally cleared in the EU and UK.[7] This Annex sets out the similarities and differences in each lifecycle stage.

## How does the full SSA and Government bond lifecycles work?

In the traditional SSA and government bond lifecycles, an issuer typically hires an underwriter to structure the debt instrument and distributes the instrument to investors through auctions or syndicates of primary dealers.

In particular, government bonds are typically issued and registered in the national CSD, and primary market settlement takes place on the accounts of banks that are appointed by the national debt management agency as primary dealers. Primary dealers are used to facilitate the distribution process, and typically are under an obligation to act as a market maker in the secondary market.

In secondary markets, SSA bonds are typically traded over-the-counter or via Multi-Lateral Trading Facilities (MTFs) in high volumes, and Organised Trading Facilities (OTFs) also facilitating on-venue trading between dealers. Generally, MTFs account for the majority of dealer to investor flows. In terms of settlement, SSA and government bonds are usually settled at T+2 by CSDs in the EU, and UK gilts settle T+1.

An investor typically uses a custodian to safekeep its securities and manage its cash account. Asset servicing (including tax withholding, and coupon payments) is performed manually.

## How does a DLT-based SSA and Government bond lifecycles work?

### Issuance

Issuers have a variety of options in deploying DLT partially or fully at different stages of the lifecycle:

- Tokenisation: the bond can be issued in the traditional format, with its record keeping partially or fully held on distributed ledgers ('tokenised bonds'). In this process, the primary dealer / transaction manager can act as the tokenisation agent.
- DLT-native issuance: in this process, the transaction manager / primary dealer provides the tokenisation platform on which the instrument is issued, or acts as a paying agent if the instrument is issued on a non-bank tokenisation platform.
- Hybrid issuance: these are of the form in which the bond does not reside on a distributed ledger throughout the lifecycle, for instance:
    - Issuing a bond in token form through a DLT platform, subsequently registering the bond in traditional infrastructure (e.g. CSD system), with investors accessing the bond in traditional form.
    - Issuing part of the bond in traditional form (registered in a traditional CSD system) and part of the bond in token form through a DLT platform. The two parts share economic and other characteristics (incl. ISIN). Investors can access the bond either in traditional form or on the DLT platform.

As is the case with traditional issuances, DLT-based issuances need to be registered with a CSD to benefit from eligibility for admission to a trading venue.

7 As such, the report does not proposed to focus on implications for clearing from a transition to a DLT-based system

### Secondary-market trading

In secondary trading, the option of trading through traditional methods and venues (regulated markets, MTFs, OTFs) and OTC exists, as does trading through DLT-based venues (e.g. digital exchanges). It is expected that for bonds, secondary-market trading will continue to be conducted off-chain for the foreseeable future.

### Settlement

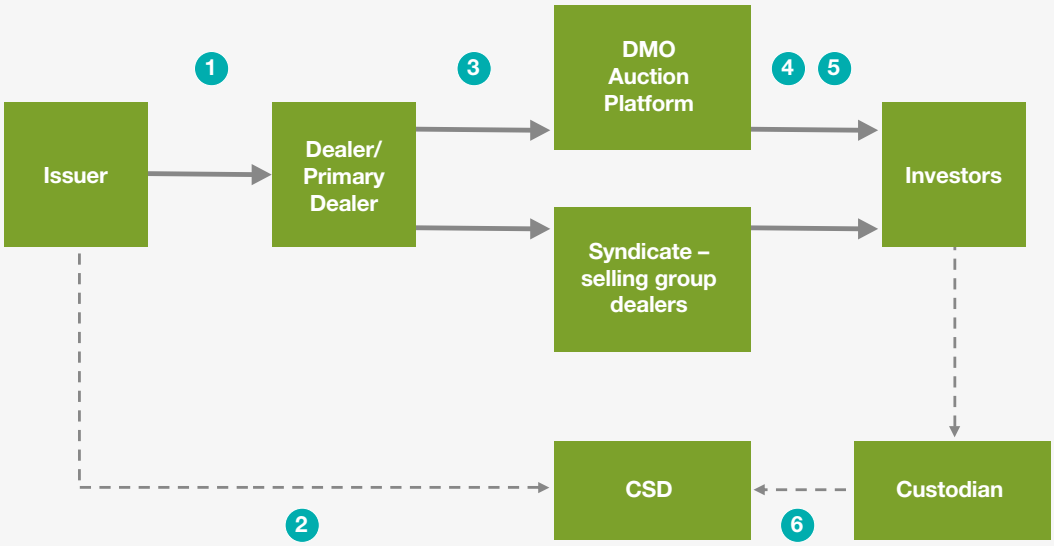
For settlement, a variety of DLT-based settlement models and DLT- or non-DLT based payment systems is available which can be considered for delivery versus payment (DvP) of securities in exchange for cash. In the DLT-based system, the custodian retains the role of safekeeping tokens (assets and funds) on behalf of investors, and these processes can be performed on a distributed ledger. Asset servicing (including coupon payments) can be automated through smart-contract programmability.

# 1. Primary Market Issuance

## 1.1 How does traditional issuance work?

In the current, non-DLT-based system, an SSA issuer generally issue bonds to investors by placing them via public auctions or bank syndicates, and typically pay periodic interest (coupon) payments on the bonds.

Figure 14: **Traditional primary market issuance**




1. **Origination and structuring**: an issuer approaches (a) dealer(s) or primary dealer(s) to arrange transaction and structuring debt instruments. The issuer announces the bond (with its legal counsel and trustee). The CRA issues a rating, and the bond prospectus is published.

2. **Registration of security**: at issuance, the security is immobilised with a CSD which in turn facilitates eligibility for admission to trading.

3. **Initial distribution**: DMO auction platforms or lead manager(s) and other selling group dealers are the most common distributors for initial issuances.

4. **Placing orders**: investors typically place orders through the Debt Management Office's auction platform or through the primary dealer for specific amounts and price. For underwritten deals, dealers underwrite at an agreed price, coupon structure and yield to maturity (YTM).

5. **Finalising price**: in DMO auctions, orders submitted at a specific price or higher are accepted. In underwritten deals, prices/yields are agreed between the issuer, dealer(s) and investors.

6. **Closing – cash settlement**: following an investor purchase, bonds are registered in book-entry form with a CSD against the initial issuance registration record. Bonds which originated from auctioned deals are centrally registered, while the investor identity of underwritten bonds is not typically visible to issuers. Investors are typically connected to CSDs through their custodians.

## 1.2 How does DLT-based issuance work?

Figures below set out in stylised form the SSA and government bond issuance in a DLT environment, considering 3 issuance models: tokenisation, DLT-native issuance on a bank-operated platform and DLT-native issuance on a CSD-operated platform. The solid lines indicate business (economic) flows, the dotted lines indicate technical flows. A further description of the steps is provided below.

Figure 15.1: **Issuance of DLT-based bond through tokenisation of a traditional bond, using a bank-operated platform**

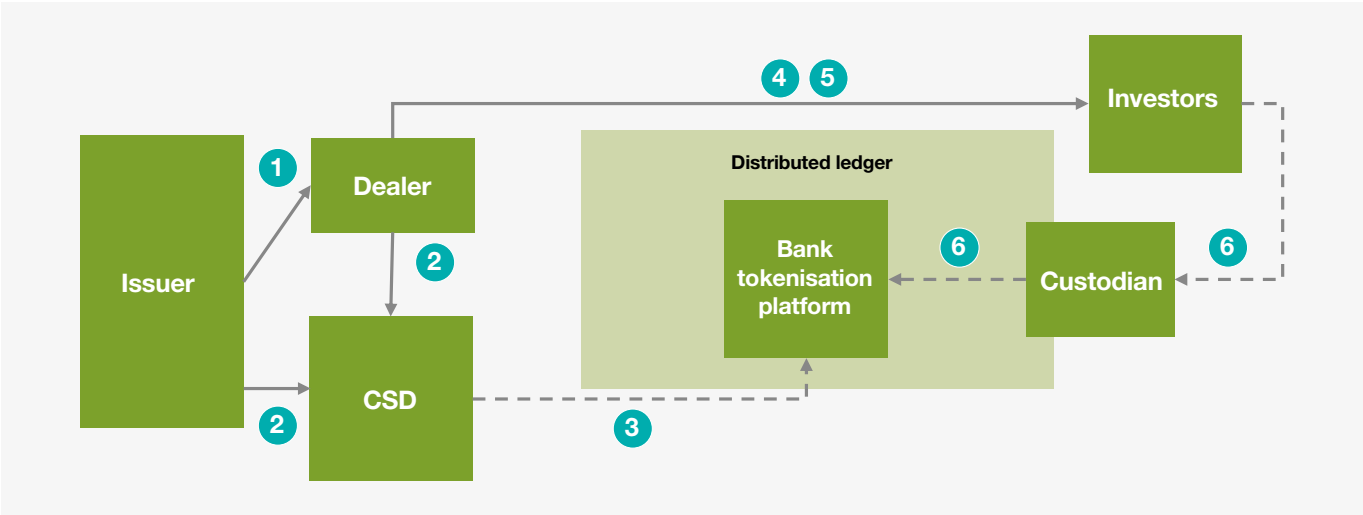



Figure 15.2: **DLT-native issuance of a bond through using a bank-operated platform**

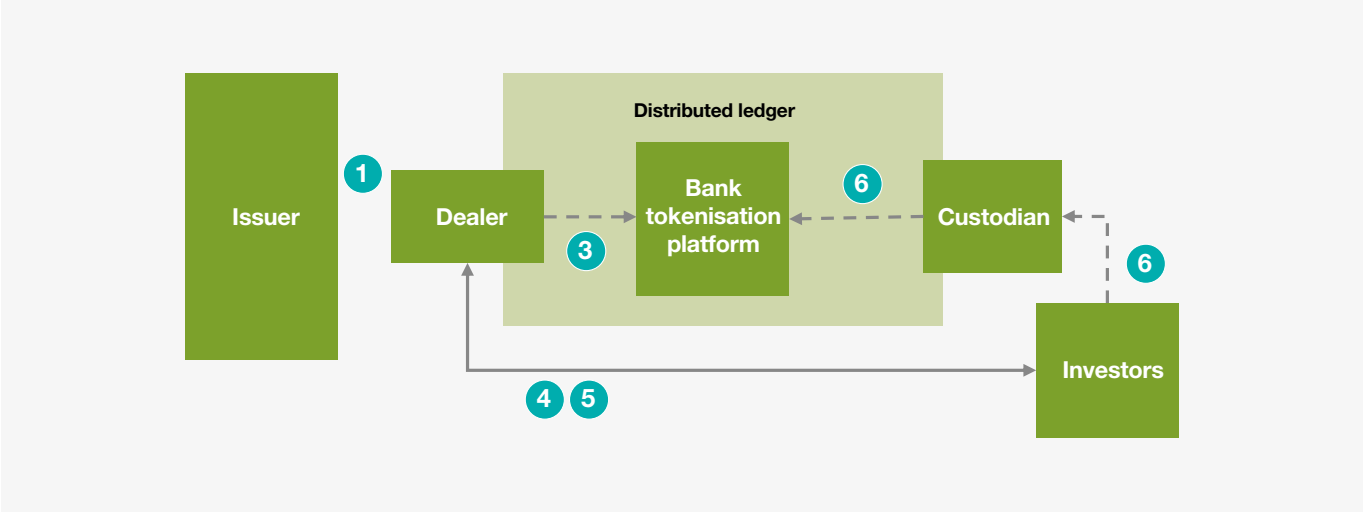
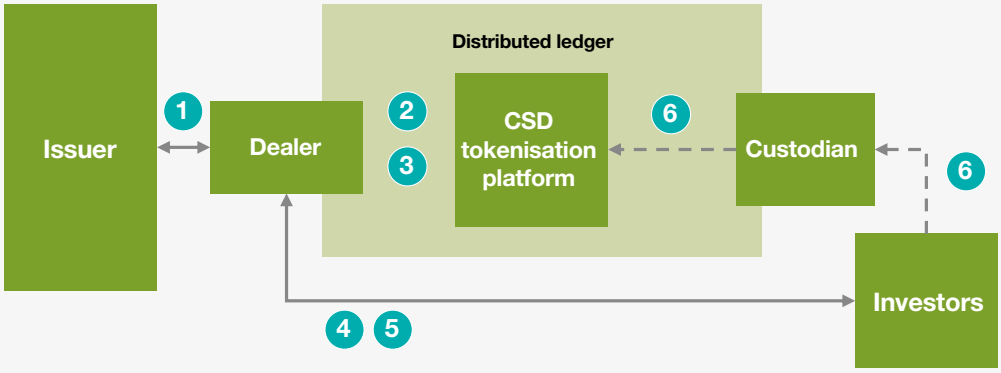


Figure 15.3: **DLT-native issuance of a bond through using a CSD-operated platform**




1. **Origination and structuring**: a DLT platform structures and issues the transaction. DLT platforms can include bank-operated platforms or another entity such as an FMI with tokenisation capabilities.

    **1.1** A bank-operated platform tokenises a bond issued in traditional form.

    **1.2** A bank-operated platform for DLT-native issuance.

    **1.3** An CSD-based DLT platform for issuance with a bank acting as paying agent.

2. **Registration of security**: a DLT-based security can be registered and held by a CSD (subject to its DLT capabilities). This should allow for eligibility for admission to trading venues.

3. **Tokenisation**: the tokenisation of a traditional security or DLT-native issuance can take place through a number of channels, primarily by 1) a bank-operated DLT platform, 2) CSD-operated DLT platform, or 3) another entity that has tokenisation capabilities.

    **3.1** Bank-operated tokenisation agent tokenises the traditional security such that its record keeping is partially or in whole held on DLT ('tokenised bond') or;

    **3.2** Bank-operated tokenisation agent issues a DLT-native bond token on a DLT platform.

    **3.3** FMI-operated tokenisation agent issues a DLT-native bond token on a DLT platform.

4. **Placing orders**: investors place orders at specific amounts and prices or agree underwritten prices with the lead manager dealer(s) running tokenisation platforms or the issuing and paying agent working with a FMI-run tokenisation platforms.

5. **Finalising price**: prices are agreed between issuers, dealer(s) and investors.

6. **Closing – settlement**: following an investor's purchase, bonds are registered on distributed ledgers or in traditional book entry format with the CSD against the initial issuance registration record.

# 2. Secondary Market Trading

## 2.1 How does traditional secondary trading work?

Secondary markets for SSA and government bonds are generally highly resilient and efficient, with a substantial proportion of volumes executed through electronic trading.[8] SSA and government bonds are typically traded over-the-counter (OTC) or through centralised execution venues, including multilateral trading facilities (MTFs) and – to a lesser extent – organised trading facilities (OTFs). Banks and other dealers act as market makers in these instruments. The current secondary-market trading process can be illustrated as follows:

1. **Bids and offers**: buyers and sellers submit requests-for-quote (RFQs) to dealers and other market makers.

2. **Trade execution**:

    **2.1** **MTFs**: investors access dealers through MTFs, which facilitate trading between multiple parties.

    **2.2** **OTFs**: SSA and government bonds are also transacted through OTFs. The main difference is that the operator of an OTF exercises discretion in the order matching process.

    **2.3** **OTC**: investors also trade securities through a broker-dealer network as opposed to centralised venues. Securities which are not registered with a CSD can be transacted OTC.

## 2.2 How does DLT-based trading work?

1. **Bids and offers**: as in traditional markets, buyers and sellers submit RFQs to dealers and other market makers

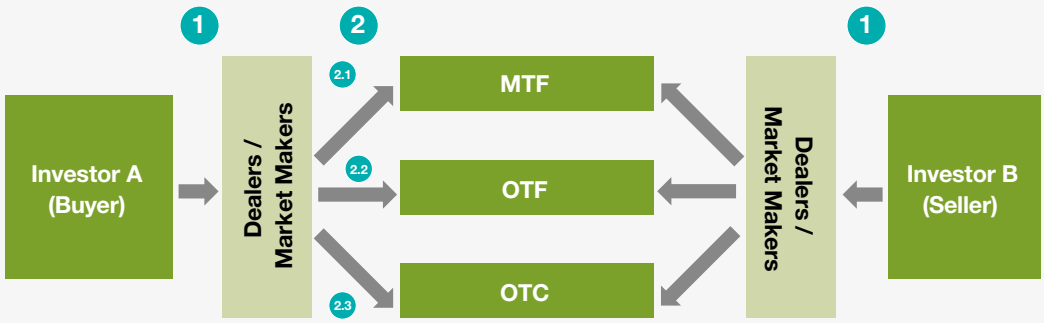
2. **Trade execution**: DLT-based bonds can be transacted through two forms of execution venues, including execution venues for traditional securities (off-chain) and execution venues for DLT-based securities (on-chain).

    **2.1** **MTFs (off-chain)**: most MTFs active in traditional SSA and government bond markets are able to transact DLT-based bonds as long as they have security identifiers such as ISINs. If DLT-based bonds are not registered with a CSD at issuance they can be traded OTC.

    **2.2** **OTF (off-chain)**: investors can also trade tokenised bonds and bond tokens through a dealer-network (OTF). Tokenised bonds and bond tokens which are not registered with a CSD at issuance can be traded OTC.

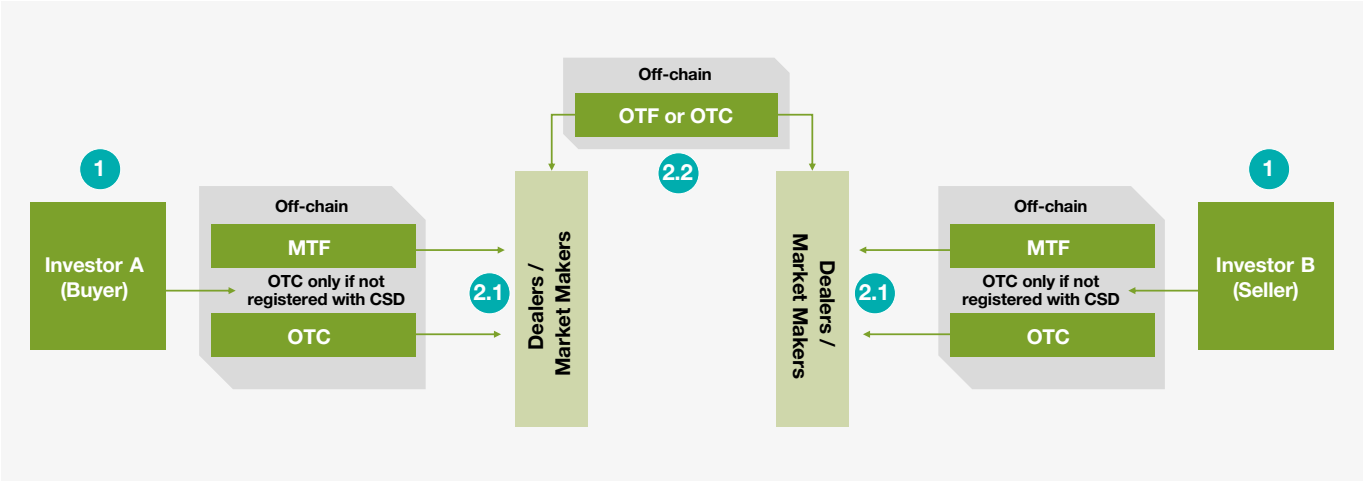
3. **Data extraction:** connectivity between on-chain and off-chain venues and dealers could allow for token data extraction and offer a comprehensive picture of market data, including prices and volumes associated with trades, to market participants.

Figure 16: **Traditional secondary-market trading of SSA and government bonds**




8 FSB Report on Liquidity in Core Government Bond Markets (2022)

Figure 17: **DLT-based secondary trading**



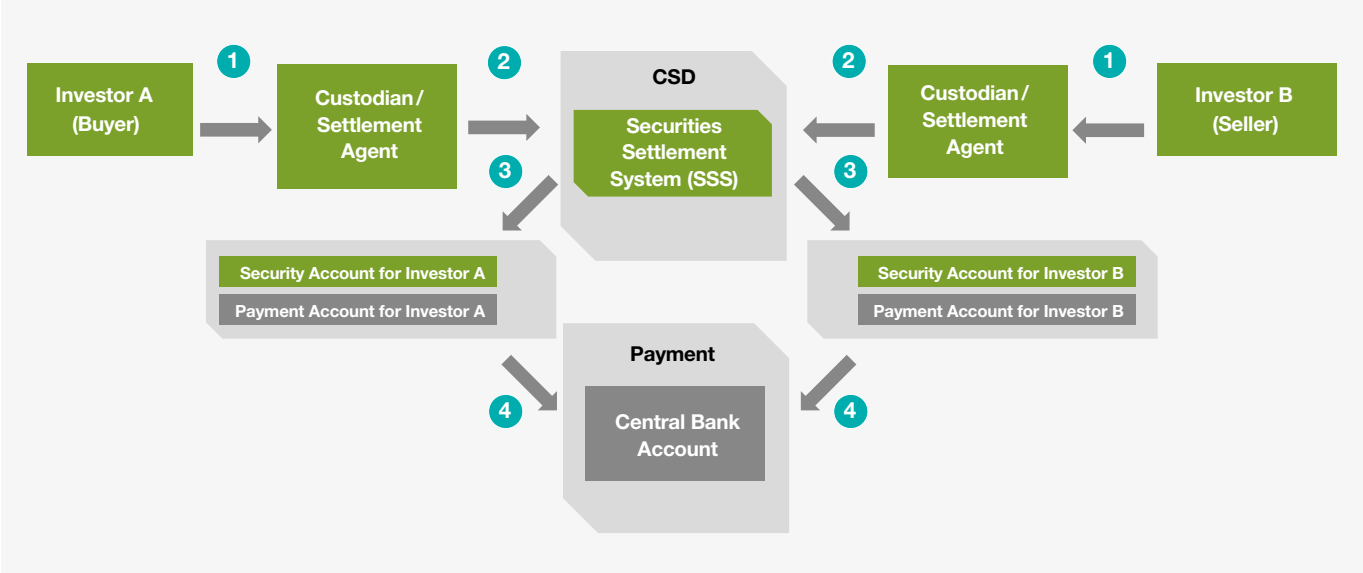

# 3. Settlement

## 3.1 How does traditional settlement work?

At the conclusion of the primary issuance and secondary market trading processes, settlement is the process that finalises the legal transfer of the security from the issuer to the investor, or between investors, typically in exchange for cash. Under EU and UK regulation, the security typically has to be registered via an entry at a Central Securities Depository (CSD) at issuance – this registration allows for the security to be available for distribution, holding, safekeeping and onward secondary market trading by intermediaries.

In traditional issuances, CSDs' records are effectively the "golden source of truth" related to the ownership interest in a bond and determines the point of "settlement finality" – a key legal component of the traditional settlement process, which gives parties clarity as to the precise moment at which a transfer becomes irrevocable and unconditional.

Figure 18: **Traditional settlement process**



1. **Initiating settlement instructions**: trading parties, which could include dealers, asset managers or other types of investors, generally hold their securities through agents (e.g. custodians) at CSDs, rather than directly. To initiate the settlement process, which carries out the exchange of securities against funds, the trading parties (seller of the security and the buyer of the security) send instructions to their settlement agent.

2. **Matching instructions**: the settlement agents subsequently send the instructions onward to the CSD, which matches the corresponding instructions and checks for sufficient securities and funds in the respective accounts of their clients (typically in the name of their custodians and maintained by the CSD).

3. **Legal transfer of bonds against cash**: once the instructions are matched against securities and funds, the CSD transfers the securities against cash. The securities accounts are updated to reflect the transaction.

4. **Central bank payments**: the 'gold standard' for settlement of securities is 'delivery versus payment' (DVP) in risk-free central bank cash. The exchange of payment is typically performed through a separate payment rail in connection with the central bank. In the EU, the settlement participant needs to hold a cash account with the ECB (TARGET2-Securities). In the UK, the settlement participant needs to hold a cash account with the Bank of England (Real-Time Gross Settlement service). The payment accounts are updated to reflect the transaction after the legal transfer of funds.

## 3.2 How does DLT-based settlement work?

### Settlement instruction:

1. **Initiating settlement instructions**: similar to the traditional process, the seller and buyer send instructions to their respective settlement agents. Custodians commonly act as settlement agents.

2. **Matching instructions**: the settlement agent then transmits the instructions to the asset ledger and the payment ledger. This can be facilitated with smart contract programmability.

3. **Transfer of bonds:** smart contracts check for the availability of sufficient tokens and funds to begin the transfer process. The asset ledger transfers the token (tokenised bond or bond token) between the wallets of the respective investors. The wallets can be held in the name of their custodians on the asset ledger.

    3.1 **Asset and cash ledger interoperability:** the payment ledger can be the same ledger as the asset ledger, or a separate ledger. Having a unified asset and payment ledger allows for optimal efficiency. However, in cases where the asset ledger and payment ledgers are separate, connectivity is needed to ensure transmission of instructions and delivery versus payment.

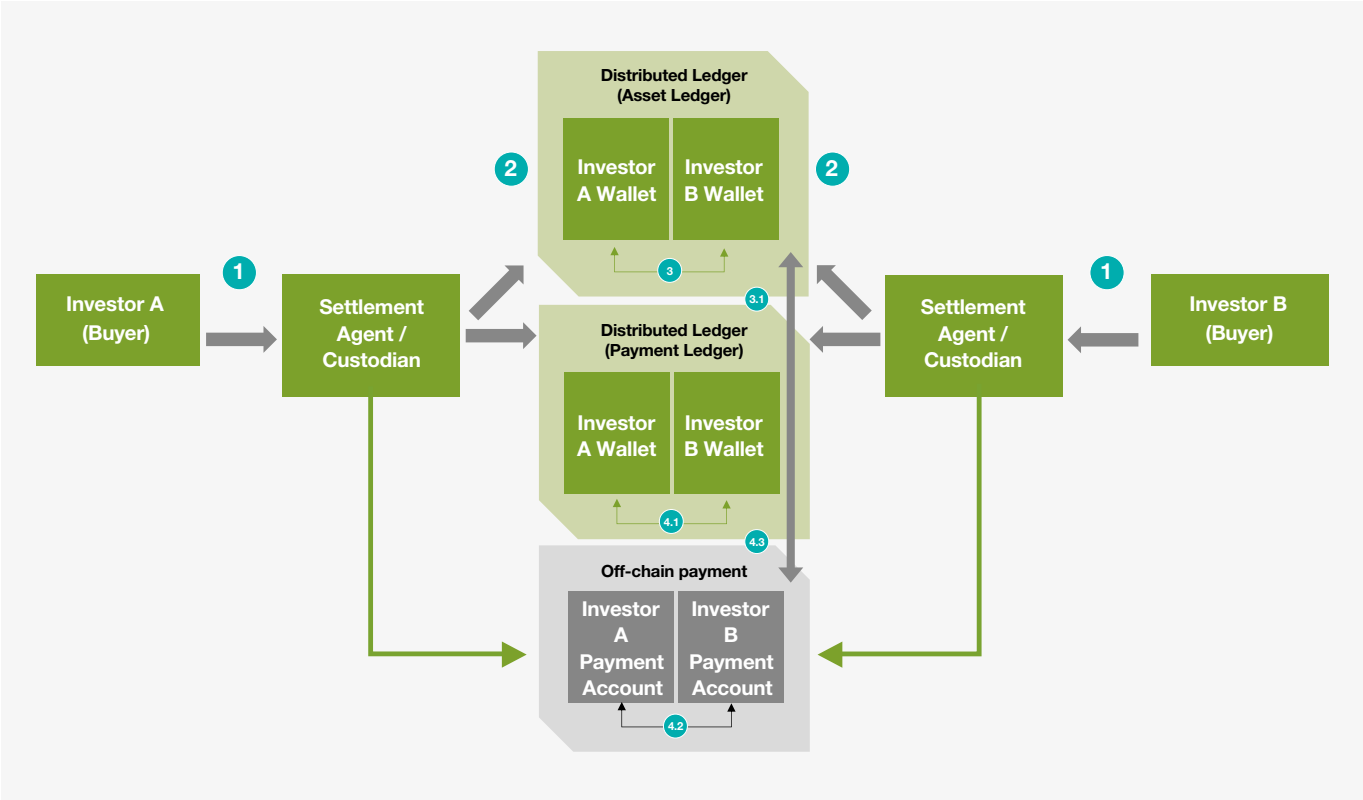
4. **Transfer of funds (on / off-chain):** simultaneous to the transfer of tokens on the asset ledger, the debiting and crediting of the investors' payment accounts take place on the payment ledger. Following the transfer, the update of wallets and payment accounts can be automatically executed through smart contract programmability.

    **4.1 On-chain payment:** APIs and smart contracts can programme the delivery of payment in on-chain cash from one investor's wallet to another. As in traditional settlement, the on-chain payment system is required to provide for connectivity with the central bank money payment system. In the ECB's ongoing experiments, a number of key potential solutions have been identified:

    - **Trigger model**: central bank money settlement occurs through current TARGET2Services by adding a Trigger/ Bridge component between eligible ledgers run by market participants and the settlement component of TARGET2.
    - **Interoperability model**: central bank money settlement occurs on a payment ledger run by the Eurosystem that is interoperable with asset ledgers run by market participants.
    - **Integration model**: a TARGET2 Securities ledger unifies the asset and payment ledgers

    **4.2 Off-chain payment**: in case there is no on-chain cash solution available, the transfer of funds can take place off-chain. However, connectivity between the off-chain payment system and the asset ledger would require additional manual reconciliation and therefore undermine the benefits of DLT-based settlement including efficiency and settlement programmability.

Figure 19: **DLT-based settlement process**

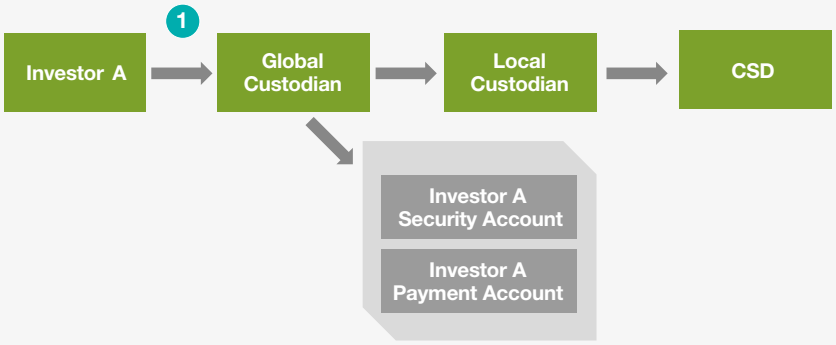


# 4. Custody

## 4.1 How does traditional custody work?

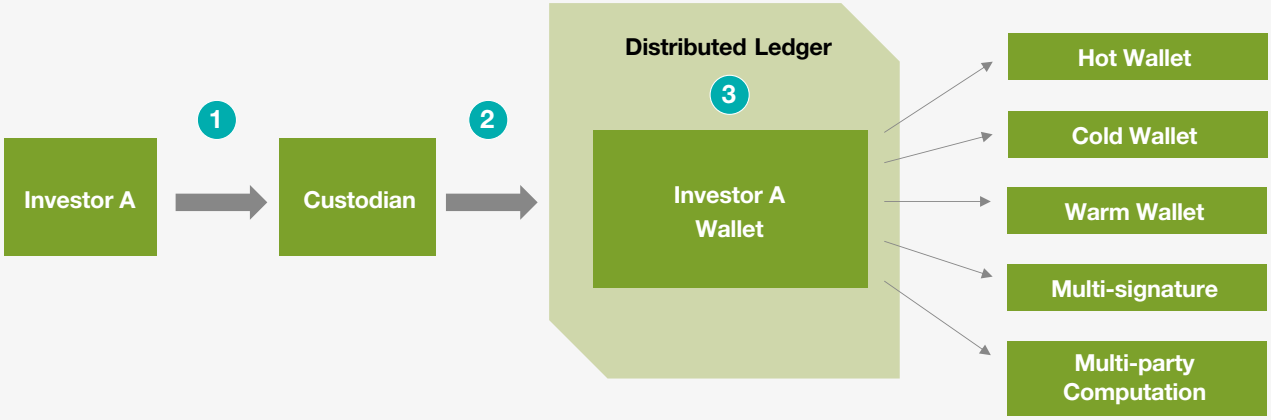
1. **Account management**: in the traditional process, the custodian safekeeps assets and cash on behalf of investors. End investors typically choose a 'global custodian' to safekeep their assets, who may in turn hold these assets directly or indirectly (i.e. through a local sub-custodian) at the CSD.

Figure 20: **Traditional custody process**




## 4.2 How does DLT-based custody work?

Figure 21: **DLT-based custody process**




1. **Account management**: in DLT-based processes, the custodian also safekeeps assets and cash on behalf of investors, but in the form of a token wallet.

2. **On-chain custody**: the custodian performs this function on a DLT-based system by safeguarding cryptographic private keys associated with the ownership of a tokenised bond or bond token, and can also serve as a connector between investors and the distributed ledger. Custodians may also validate and update records related to bond activities on the distributed ledger.

3. **On-chain wallet**: there are several configurations of private key custody techniques that allow custodians to safekeep tokens:

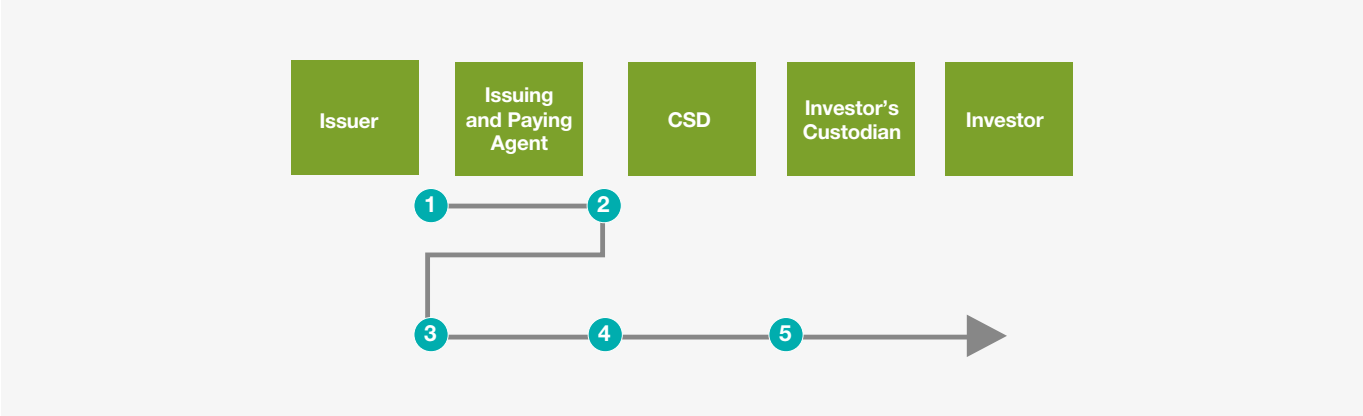
    - **Hot Wallet**: in this configuration, the keys are accessible online, and this provides ease of access for the investor. However, this can make the wallet more vulnerable to theft.
    - **Cold Wallet**: keys are stored offline on a mainframe not linked to the internet. This makes the wallet less vulnerable to theft, however keys are not so easily accessible since it requires a human signature to authorise the transaction and send it on-chain. This method may prove to be too slow to support frequent trading.
    - **Warm Wallet**: this method is a combination of hot and cold wallets. It comes in two forms: the first form involves keys being held online but humans must approve a transaction for it to be recorded on-chain. The second form involves keys held offline but custodians can make small amounts quickly available online.
    - **Multi-Signature**: in this configuration, multiple private keys to authorise a transaction are spread across several different systems. This ensures that if a single system is compromised, the assets are protected against theft.
    - **Multi-Party Computation**: this method splits private keys into "key shares" that can be spread across multiple physical devices. This can help eliminate single-points-of-failure to mitigate against the vulnerabilities of hot wallets.

# 5. Asset Servicing and Lifecycle Management

## 5.1 How does traditional asset servicing work?

Asset servicing refers to a set of tasks and activities provided by custodians and CSDs to the investors around the assets under custody. Traditional asset servicing activities for debt instruments include tax withholding and coupon payments. Tax withholding is usually performed by the custodian with involvement from financial intermediaries. Below we outline the traditional and DLT-based processes for coupon payments.

Figure 22: **Traditional coupon payment process**

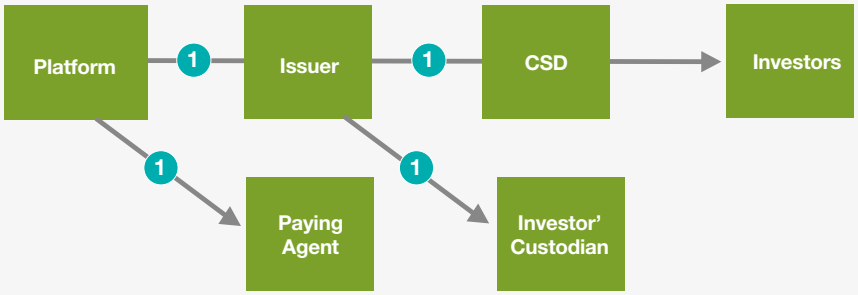



1. **Notification of impending payment**: in traditional processes, the issuing and paying agent notifies the issuer that a coupon payment is due.
2. **Coupon payment report**: the CSD provides a coupon payment report to the issuing and paying agent.
3. **Payment transfer by issuer**: when the payment is due, the issuing and paying agent notifies the issuer, who transfers the funds to the issuing and paying agent.
4. **Payment transfer intermediation**: payment is passed from the paying agent to the CSD.
5. **Receipt of payment**: the CSD passes on the payment to the investor's custodian, which credits the investor's account.

## 5.2 How does DLT-based asset servicing work?

In a DLT-based system, tax withholding may be automated by smart contracts in the network, creating efficiencies in the process. Below is an outline of the DLT-based process for coupon payments.

Figure 23: **DLT-based coupon process**




1. **Notification of impending payment**: in DLT-based processes, smart contracts programmed by the tokenisation platform alert the issuer and paying agent that a coupon payment is due.

2. **Payment transfer by issuer**: the issuer then initiates payment to the CSD, DLT platform or the investor's custodian.

3. **Receipt of payment**: the custodian, CSD or DLT platform then passes on payment to the investor.

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