



# DLT & Capital Markets

A New Realm for the Global  
Financial Infrastructure

*May 2024*



# Glossary

Blockchain Smart Contract CCF  
Tokenization DvP CSD  
Token Oracle STC

## **Cryptocurrency / Digital Asset**

A digital or virtual currency that uses cryptography for secure financial transactions

## **Decentralized Application (DApp)**

An application that runs on a decentralized network, such as a blockchain, rather than a single computer

## **Decentralized Finance (DeFi)**

DeFi refers to the ecosystem of financial services and applications built on blockchain technology

## **Distributed Ledger Technology (DLT)**

Distributed Ledger Technology (DLT), including blockchain, encompasses technologies that leverage decentralized databases to seamlessly record and share data across various sites, organizations, or geographic locations

## **Initial Coin Offering (ICO)**

A fundraising method in which new cryptocurrency projects sell their underlying crypto tokens to investors

## **Smart-Contract**

A self-Executing contract with the terms of the agreement written into code and deployed on a blockchain

## **Tokenization**

Tokenization involves the process of converting real-world assets into digital tokens that can be traded and represented on a blockchain

## **Anti-Money Laundering**

A set of laws, regulations, and procedures designed to prevent and detect money laundering activities

## **Central Counterparty (CCP)**

An entity that acts as an intermediary between buyers and sellers in a financial transaction, ensuring the fulfillment of both parties' obligations

## **Central Securities Depository (CSD)**

An organization that holds securities and facilitates the clearing and settlement of trades

## **Clearing & Settlement**

The process of transferring securities from the seller to the buyer and facilitating the corresponding payment

## **Debt Capital Markets (DCM)**

An umbrella term for technologies that use decentralized databases to record and share data across multiple sites, organization, or geographic locations

## **Equity Capital Markets (ECM)**

A decentralized, distributed digital ledger that records transactions across many computers in a network

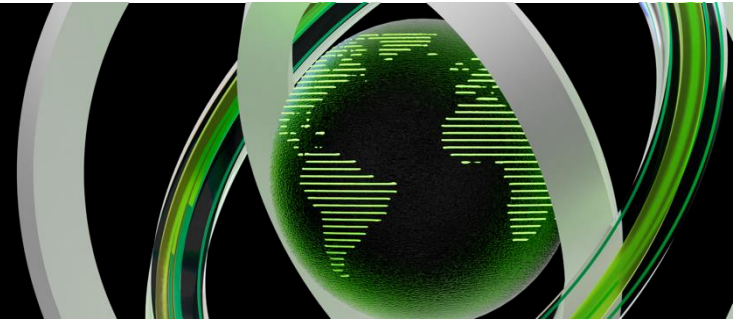
## **Know Your Customer (KYC)**

A set of laws, regulations, and procedures used by financial institutions to verify the identity of their customers and assess potential risks

## **Post-Trade Processing**

The various processes and activities that occur after a trade has been executed, such as clearing, settlement, and asset servicing

# Forewords



Deloitte

## Maud MONIN

Global Financial Services Industry Audit & Assurance Leader

“

The capital markets industry is undergoing significant transformation driven by rapid technological innovation and shifting market dynamics. Our report explores how emerging capabilities like distributed ledger technology (DLT) are part of the multifaceted forces reshaping how firms operate and unlocking new value propositions. From asset tokenization to optimized trading processes, DLT offers new models that businesses ought to explore.

”



Deloitte

## Marie-Line RICARD

Global FSI Assurance Blockchain & Web 3 Leader

“

DLT is catalyzing transformation across the equity & debt capital markets value chains. Both the assets and infrastructures underpinning these domains have opportunities to leverage DLT for enhancing efficiency, broadening access, and enabling product innovation. Realizing these opportunities require the alignment of a multitude of actors: public & private, current operators & other newcomers. Let's discover together this new realm, challenges and opportunities – led by pioneers, well-known corporates, and rising startups.

”

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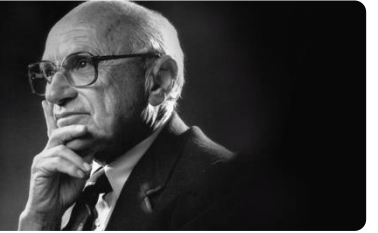
## Milton Friedman

Nobel Prize in Economics - 1999

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I think that the internet is going to be a major force [...] The one thing that's missing but that will soon be developed is a reliable e-cash – a method whereby on the Internet you can transfer funds from A to B without A knowing B or B knowing A.

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## 25 years later, could we say that Distributed Ledger Technology (DLT), is the backbone of Internet 3.0 ?

**The purpose of this report is to explore how traditional capital markets are intersecting with decentralized ledger technology, highlighting the opportunities and challenges that arise.**

We stand at a crucial juncture where innovation, while promising, also brings classical risks and instability. Whether we are talking about investors, both financial and non-financial institutions, or operators, our analysis looks at a full-picture of the broad financial landscape paradigm shift. It is essential to acknowledge the opportunities brought by Decentralized Ledger Technology (DLT) while assessing the challenges and threats it poses. There's no one-size-fits-all statement regarding the matter; we rather look forward to understand potential impacts on a case-by-case basis for the various stakeholders involved.

Capital Markets play a core role within the financial services space, channeling savings, and investments between suppliers and those in need for capital. In this setup, financial operators are crucial in **providing liquidity to the markets** (intermediating stakeholders' capital investment and need for funding), **ensuring market transparency** (pricing and information), and **reducing systemic risks** (clearing activities). Thereby, they constitute a crucial point of exchange and central source of information for the global economies.

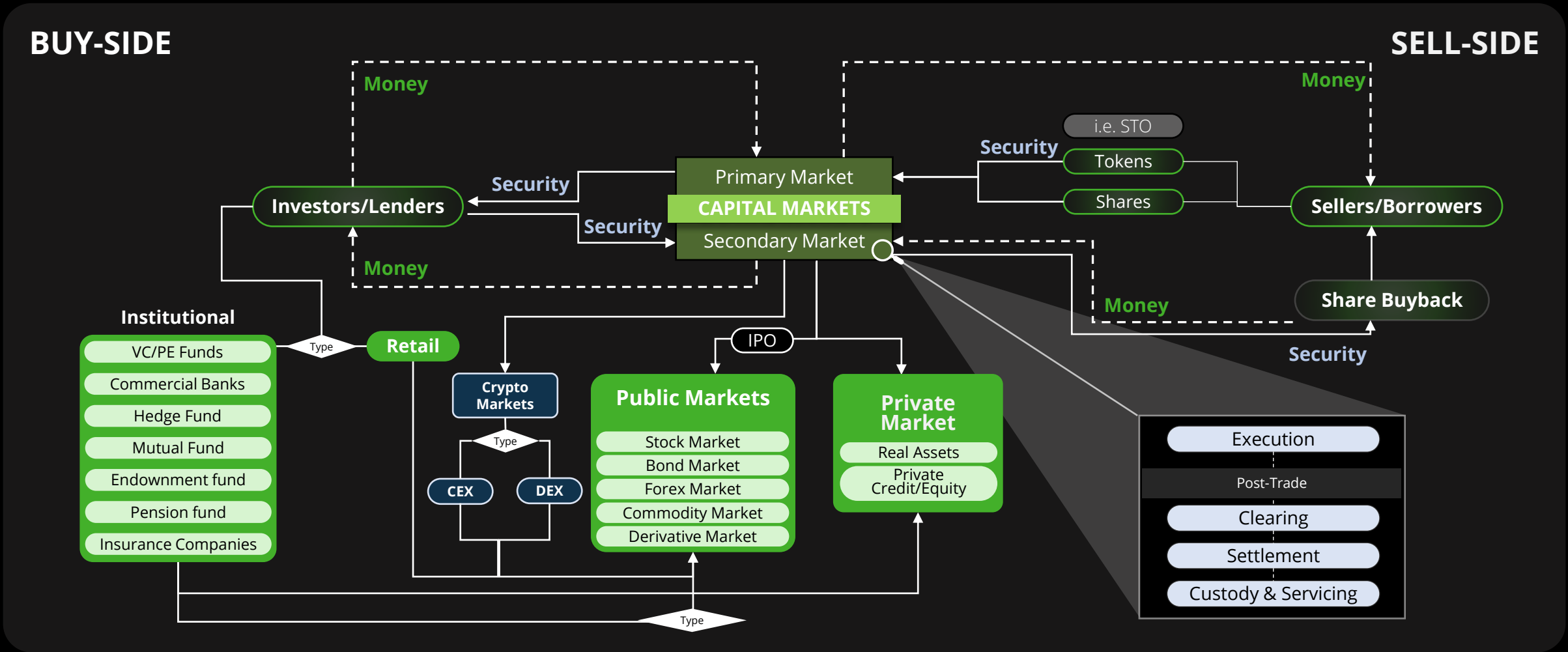
DLT



DLT, Distributed Ledger Technology, is an umbrella term for technologies that use decentralized databases to record & share data across multiple sites, organization, or geographic locations

Figure 01

# Global Capital Markets Infrastructure



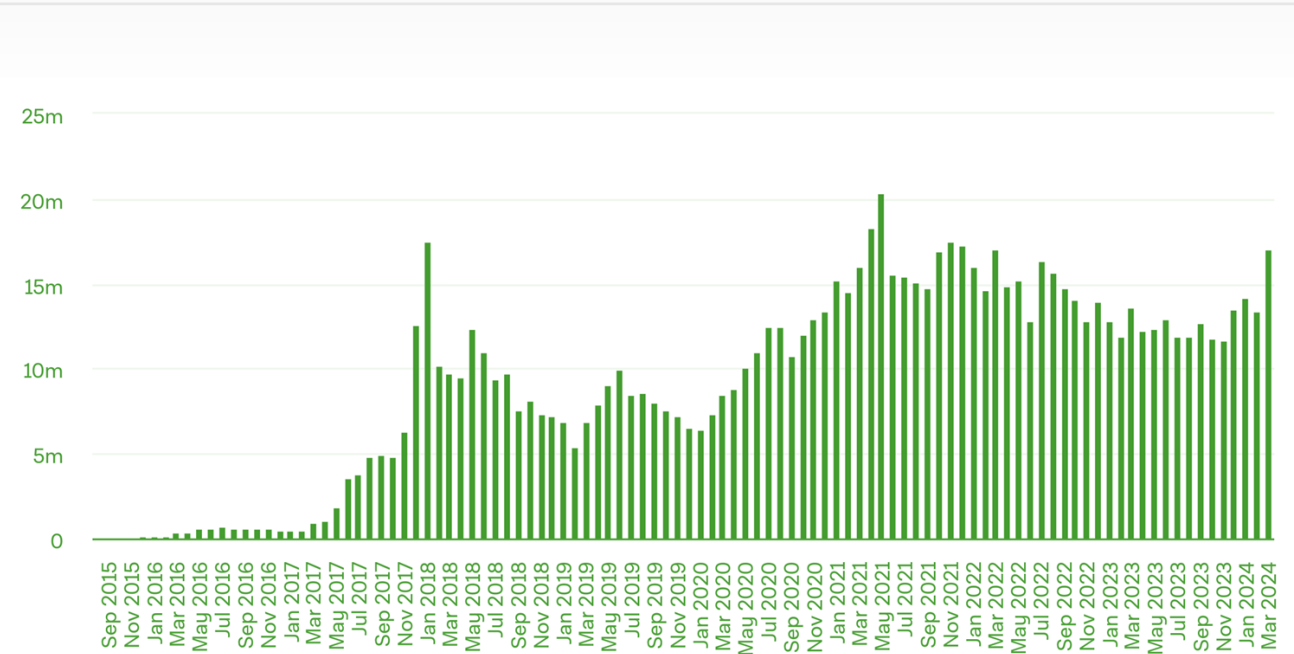
The complexity of financial markets has sharply increased in the recent years. The quantity and variety of negotiated securities on the exchanges fluctuate rapidly, reliant on the evolving investors' needs. Among the focused main markets, we include **stock markets** (i.e., LSE, NYSE, ...), **derivative markets** (including options, futures, and swaps), **foreign exchange, bond markets, debt securities markets, cryptocurrency markets,** and **private markets** (including alternative assets such as venture capital, private equity, real assets, etc.).

In addition to their trading services, markets provide a trusted infrastructure and market data products that cater to the diverse interests of various stakeholders. Traditionally, the key players in the capital markets are simultaneously exchanges, clearing houses, payment intermediaries, and central depositories (CSDs), all of which serve the needs of stakeholders. In some cases, the principal market makers have consolidated their market positions due to the rising importance of cross-border marketplaces.

May have it been perceived as merely a trendy and speculative product in recent years, blockchain has for long been equated with 'cryptocurrencies' to the eyes of the public, the inherent attributes of **Decentralized Ledger Technology (DLT) allow for exploration of various implementation opportunities throughout the value chain of capital markets, generating significant interest among various participants.** At its core, DLT aims to utilize ledgers stored on separate, connected devices in a network to automate operations, ensuring data accuracy, security among various participants, increasing speed, and reducing costs.

Monthly Number of Active Ethereum Addresses

Figure 02

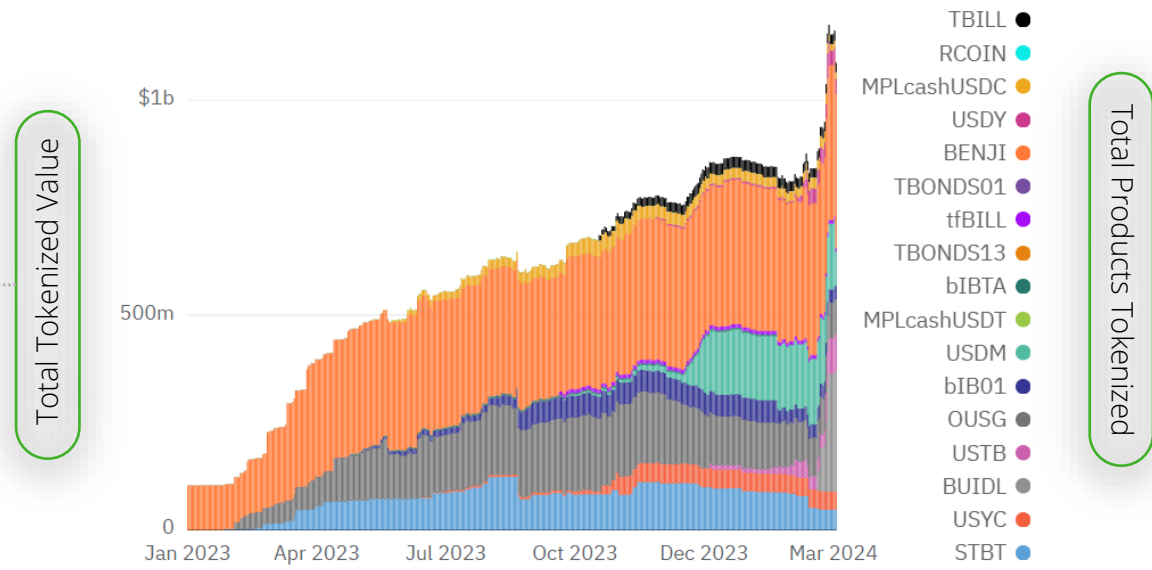


Updated: 1 Apr 2024

Source: The Block

Private markets gained in popularity due to their flexible regulatory properties (off-exchange), creating new opportunities for individual investors. In response, players have begun implementing strategies around this new wave of digital assets within their business activities – i.e., digital asset-related investments. For instance, the beginning of 2024 was marked by the **SEC's approval of Bitcoin Spot ETFs**. By the end of January, these ETFs had a total AUM of \$29.16 billion – while financial institutions have gradually experimented with new architectures where various market participants work from common datasets in near real time, streamlining supporting operations. – i.e., fund tokenization, with actors such as Franklin Templeton and its \$300M tokenized money market fund, or Nomura's group releasing its own fund tokenization infrastructure Libra Protocol. Besides, public markets have gradually been experimenting an array of tradeable products on the blockchain.

**\$1B+**  
AUM of Tokenized US Government Securities



**17+**  
# of Tokenized Government Securities Products

Figure 03

Market Landscape of Tokenized Government Securities by Product

Source: 21.co, Dune Analytics



The journey towards a full realization of the technology's potential will involve multiple iterations and experiments, and a generalized appropriation trend. One should carefully weigh the trade-off between the cost of implementation, risk mitigation, and responding to shifting market demands to navigate this transitional scheme effectively. By adaptation we mean enable operators to support this new wave of digital assets on the market. Adapting to a shifting market demand, notably towards private markets, with a key concern around trust, transparency, and efficiency – all of which being addressed by new tech incumbents with novel infrastructures, exposing traditional players to new menaces of substitutes.

We distinguish in this report two subsections of the capital markets: **Primary and Secondary markets**. The former one relates to the issuance of new debt-based or equity-based securities in private or public markets for financing purposes. Once this initial sale is complete, further trading is conducted on the secondary markets. Various challenges arise for the different stakeholders involved in these operations, among which counterparty risks, liquidity traps, and deals efficiency (including trade settlement and post-trade). As we delve into the paper, we aim to pinpoint the potentials of decentralized ledger technology throughout the lifecycle of various assets, and for the key stakeholders involved through **key expert insights & figures, explanatory illustrations**, and the **view of market leaders in France & Globally**.

We finally propose a view of a **Decentralized Financial (DeFi)** future and its implications on the markets – with perspectives at the short-, middle-, and long-term.

## Report Content Typologies



For improved lecture purposes, the various content typologies are highlighted as follows throughout the report

Key Facts & Figures

Experts Insights

Glossary

Explanatory Schemes

Blockchain Smart Contract CCF  
Tokenization DvP CSD  
Token Oracle STC

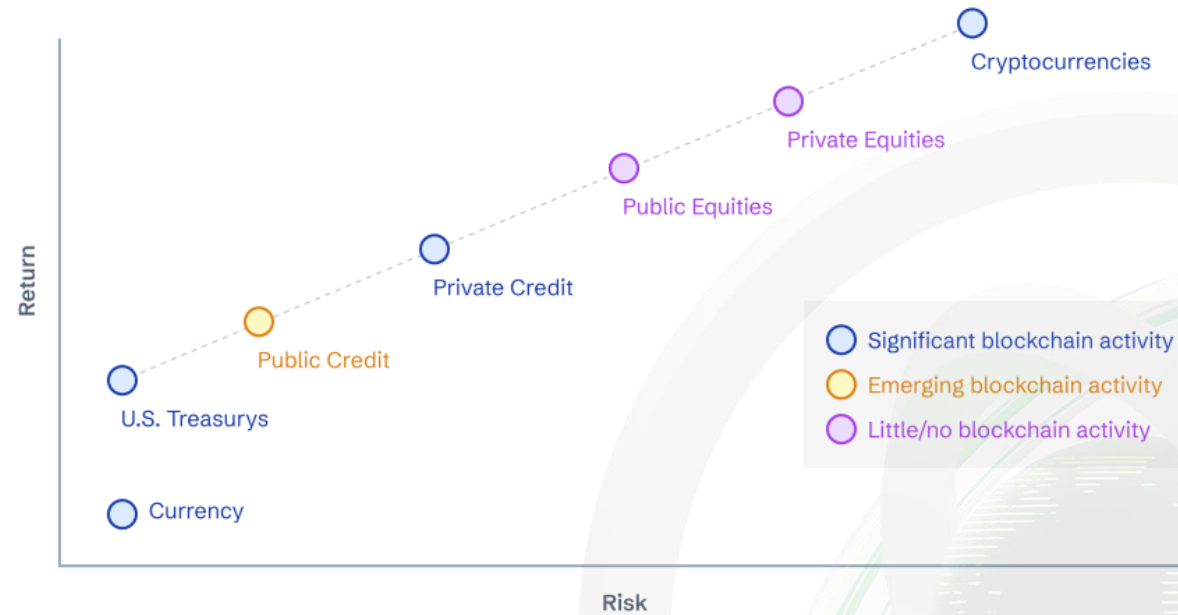
Until 2021, assets in cryptomarkets maintained one of two risk-return profiles along the risk curve:

- At one end **cryptocurrencies**: offering returns through yield farming, token issuance (ICO, STOs), and market speculation.
- On the other side **stablecoins**: offering capital preservation and medium of exchange at the expense of profit potential

In 2021 and beyond, tokenized private credit was introduced filling a gap between these two extremes with risk-adjusted and non-correlated returns. These assets are now known as « real-world assets ». Built upon these assets, lending and borrowing activities collateralized by these assets via blockchain and DeFi (ex. MakerDAO & FORGE). We are witnessing the emergence of a tokenized investment risk curve which currently lacks the full range of investable options compared to traditional financial instruments. Along the curve will appear existing (or traditional asset classes) brought on-chain, as well as new ones natively issued on chain (DAO bonds, ...)

## The Investment Risk Curve, Adapted for Tokenization

Figure 04

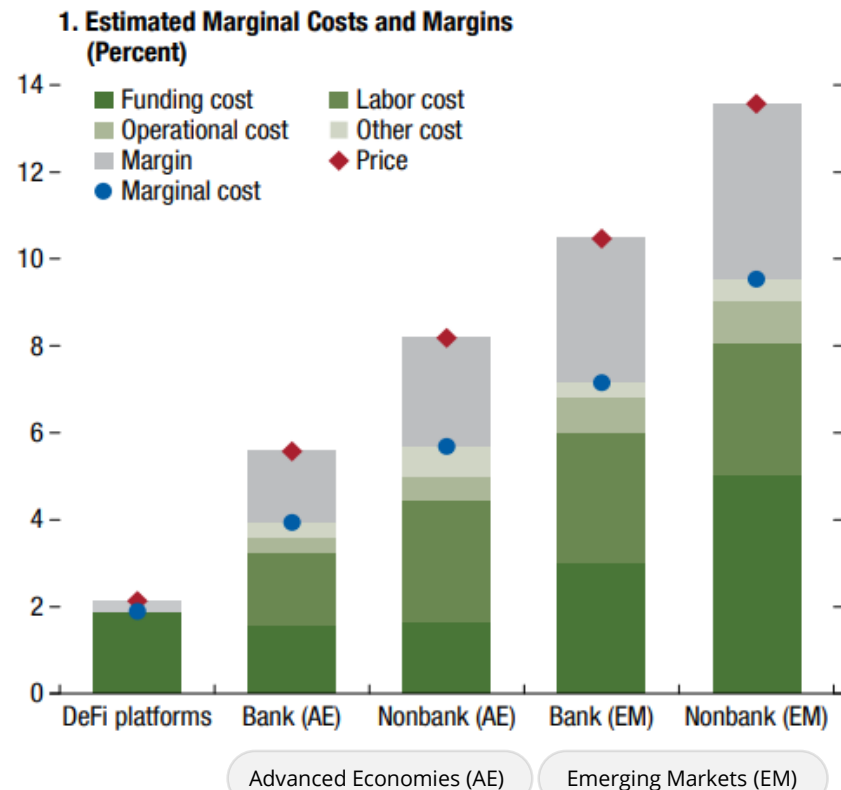


Source: rwa.xyz

## Efficiency, Risks & Costs of DLT

Figure 05

Tokenized Infrastructures have the lowest marginal costs with reduced labor and operational costs



Source: IMF



Caisse des Dépôts et Consignations

Nadia Filali

Head of Innovation & Business Development

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Subject to volume conditions, the advantage of DLT (Distributed Ledger Technology) would be to accelerate liquidity and reduce several processing times (i.e. settlement/delivery), and certain risks. Furthermore, in terms of cost, the technology is potentially less expensive than existing systems. Today, the technologies have reached a certain level of maturity, and even though we are seeing a number of experiments with public blockchains (which are faster and cheaper to implement), the ones that are currently most widely used are centralised, financed by banks or co-financed by investors. One of the obstacles is the risk to the business model of certain intermediary operators when all these activities are carried out on the same platform, which is profitable for several players.

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At the crossroads between the public and competitive private sectors, the Caisse des Dépôts Group is completely dedicated to serving the public interest and its primary aim is to develop France and respond to the challenges that the country faces, and to support the economic development of France, sustainable development and social cohesion.



# Deep Dive 1

Primary Market | The Rise of Tokenization



ECM vs DCM



Public vs Private



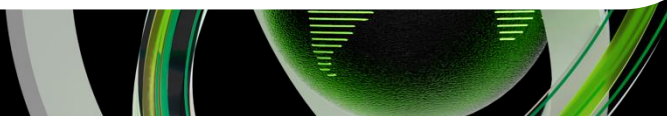
Smart-Contract & Tokens



Direct vs Indirect Tokenization

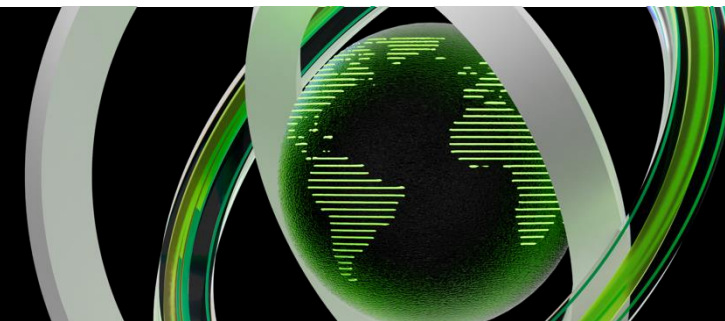


Buy-side vs. Sell-Side

A decorative graphic in the bottom right corner consisting of overlapping green and white circular and rectangular shapes, resembling a stylized globe or data visualization.

## Primary Market

Applications of DLT in the primary market are already a reality and have significant potential to redesign the lifecycle of assets and overall functioning of sub-market operations.



## Debt Capital Markets

€700M+

US Treasuries bonds  
Issued on DLT – *rwa.xyz*

€1.9T+

Tokenized Debt by  
2030 (est.) – *Citibank*

## Public Markets

39%

Of DLT-based projects are beyond revenue  
generation phase  
*The Value Exchange*

## Equity Capital Markets

€100B+

Cost savings for financial  
markets using DLT (est.)  
*Global Financial Markets Association*

€70B+

Bitcoin Spot ETFs  
Market Capitalization  
*Blockworks*

## Private Markets

€4B+

Total Loan Value (TLV) in private credit loans  
to businesses  
*rwa.xyz*

Capital Markets serve as intermediary platforms connecting providers of capital (investors) and users of capital (sellers) by facilitating the exchange of financial assets of various kinds. In this setup, primary markets stand at the genesis of capital formation – where securities are sold for the first time. Conversely, secondary markets facilitate the trading of existing assets among investors, independent of issuing companies' involvement.

The analysis of primary market shouldn't remain partitioned as the cost of capital arising from the issuance of a new security is affected by the secondary markets' liquidity, robustness, and overall efficiency.

As a whole, efficient capital markets are essential in ensuring the accurate and timely reconciliation of relevant information into the price of underlying securities. Organized markets and technological innovations have growingly eased the obtainability of such information for the relevant stakeholders, and various forms of financing have become to some extent standardized in the lifespan of securities.

### Primary Market Key Characteristics

Issuers emit new securities to be sold to investors

Issuers receive capital in exchange of the underlying securities

Newly issued securities are sold through a discrete transaction

Securities issued are sold at a single price



Axa Investment Managers

## Laurence Arnold

Head of Innovation, Client Operations,  
Performance and Reporting

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The focus we are looking for isn't solely on technology, but rather on optimizing market operations for an issuer's benefit. From a European standpoint, the push towards digital currencies will encourage many players to enter the market. Currently, unlike the situation in the American market, major players have yet to heavily invest in financing DLT platforms that could potentially catalyze the development of the financial asset tokenization market.

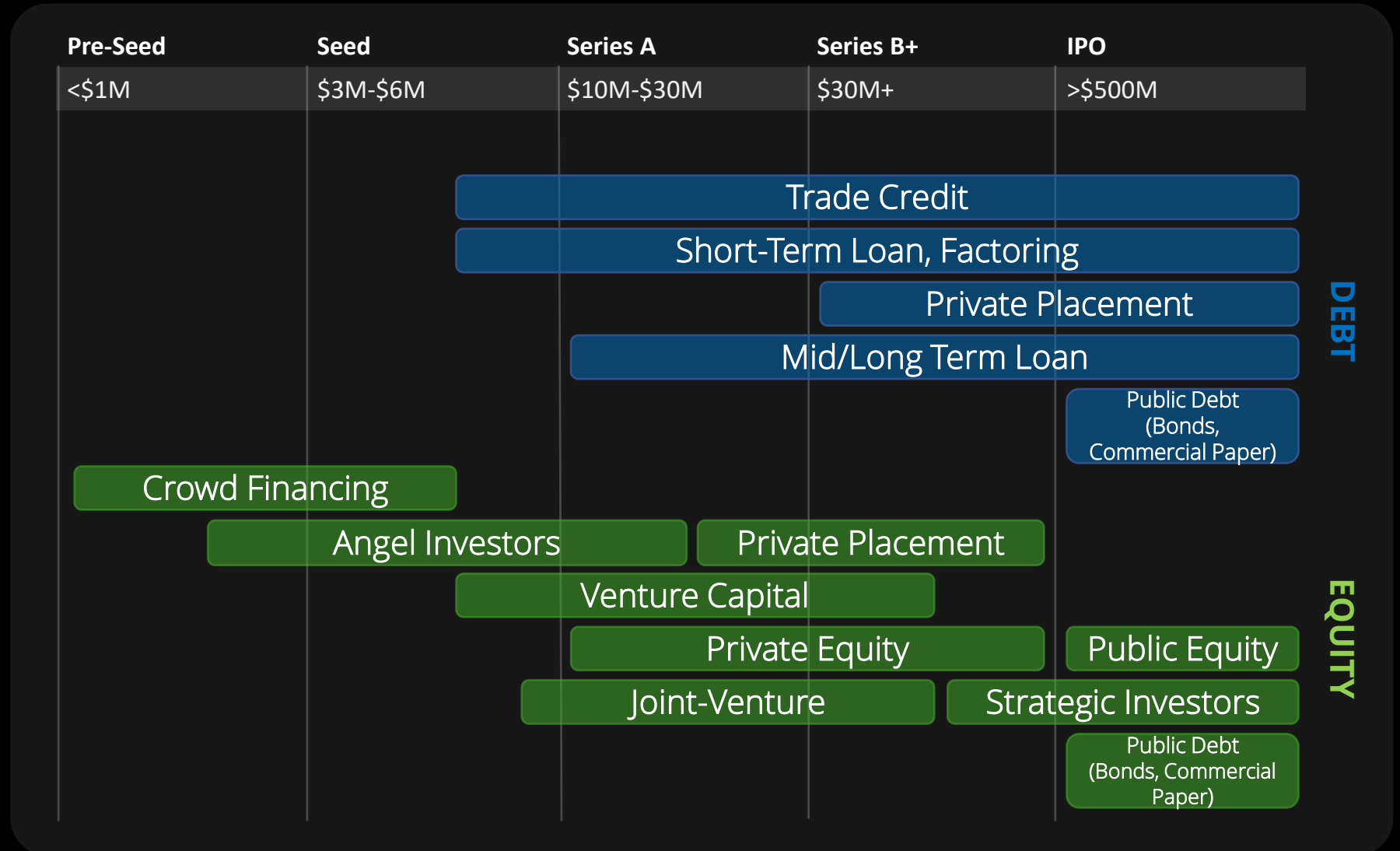
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AXA Investment Managers (AXA IM) is a global multi-asset investor. With an investment philosophy focused on responsible, active and long-term management, AXA IM provides its clients with the solutions they need to secure the future of their investments while having a positive impact on society.

Figure 06

# Standard Capital Formation Along a Firm Lifecycle



DEBT

EQUITY

More generally, fair market practices are enforced and dictated by regulations that aim to promote a healthy environment, also in view of the growing complexity of capital markets at various levels:

- **Type of traded securities**
- **Amount of non-advised investors**
- **Fragmentation of the markets**

European Securities & Markets Authority (ESMA) in Europe, and the Securities Exchange Commission (SEC) or the Financial Industry Regulatory Authority (FINRA) in the US are example of bodies responsible for the framing and maintenance of the market standards. More efficient and impartial activities should subsequently encourage investors to partake, and contribute to the markets, while being protected by secure frameworks.

Therefore, we understand the pivotal role legislation plays in the well-functioning of global markets. At the granular level, stakeholders are legally obligated to disclose relevant information when issuing new securities in the primary market. The various markets – private or public – may adhere to different disclosures requirements depending on the nature of underlying securities and of its investors (i.e., the nature of private markets' investors has initiated a tendency for a more relaxed approach in favor of capital formation at early stages of the securities lifespan). Overall, primary markets are essential to the broader financial ecosystem, playing a key role in initiating capital formation within the global economy.

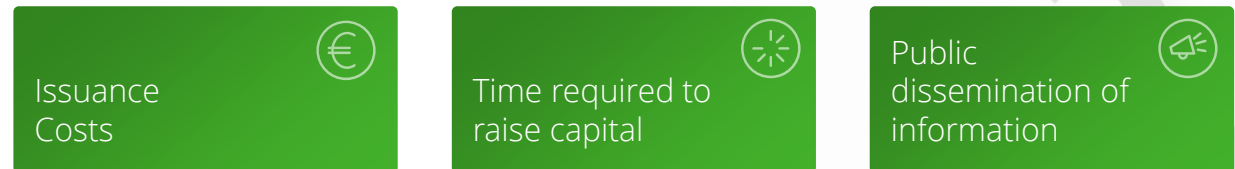
### Public Markets

There exist various mechanisms for users of capital to raise funds. For instance, early-stage companies may answer their capital needs through various forms of private financing options, before ultimately reaching to a wider public through an Initial Public Offering (IPO).

IPO is the first sale of shares in a company to the public (i.e., retail investors). Once an IPO occurs, a company becomes listed on a stock exchange, and its shares begin to trade. This exemplifies a structured process in which companies can raise capital towards the public. Frameworks for the emission of bonds, derivatives, or other assets traded on the capital markets exist – with structures ensuring optimized transactions between providers and users of capital. The sum of these markets englobes the whole capital markets infrastructure.

### Private Markets

On the opposite, the sale of securities in unregistered or private offerings allows young companies to raise capital in advance of an IPO and provides public companies with an additional source of capital. Firms can obtain capital in private offerings by directly issuing securities to investors, or indirectly, through hedge funds, private equity firms, and venture capitalists, who use unregistered offerings to raise funds from investors. Private markets may allow issuers to avoid certain regulatory burdens and the increased scrutiny that comes with a public offering.

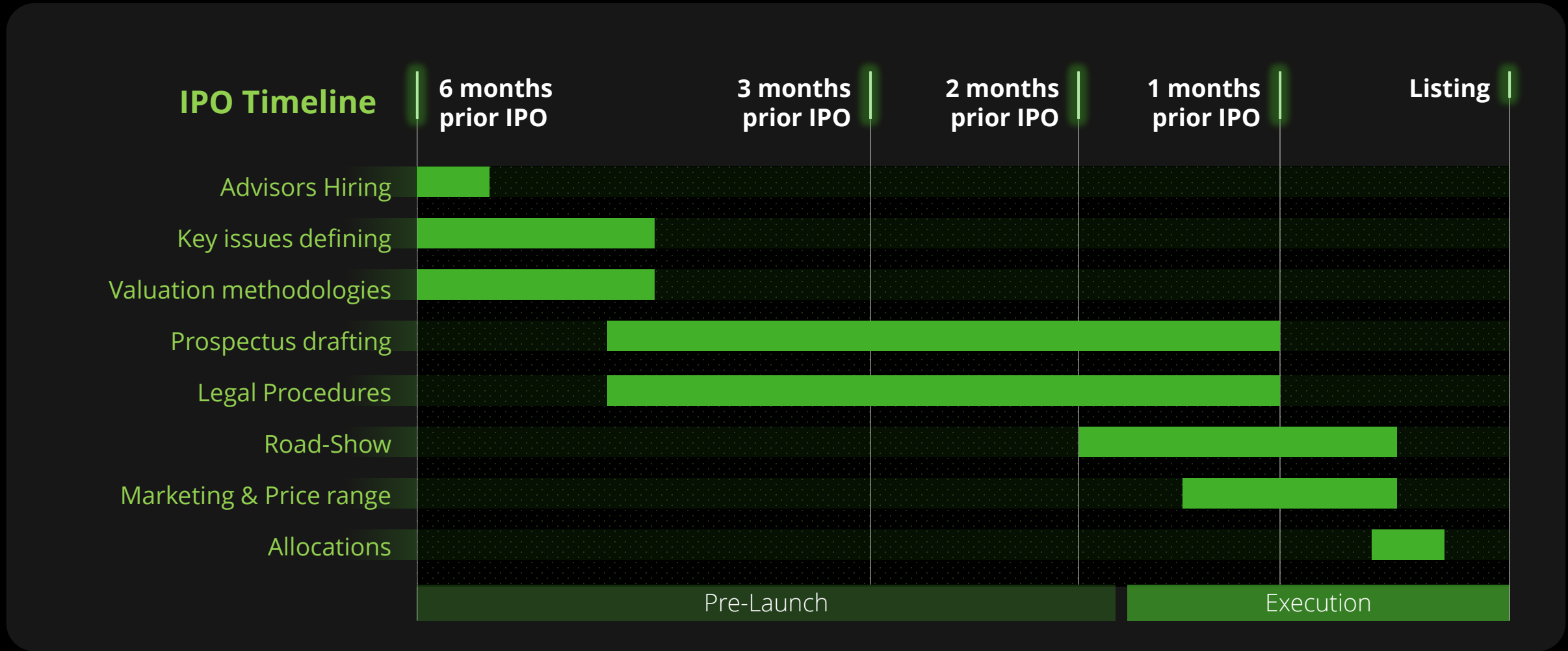


As opposed to IPOs, private offerings are mostly involving sophisticated & institutional investors for various reasons (capital, network, or expertise thresholds). As such, disclosure needs for the underlying investees are also more relaxed.



Figure 07

### Standard IPO Timeline



A **prospectus** is a formal document required regulators that provides details about an investment offering to the public. A prospectus is filed for offerings of stocks, bonds, and mutual funds.

---

5,3x  
Length

---

37  
Years apart

---

47  
pages



Apple IPO  
Prospectus

1980

253  
pages



Snapchat Inc.  
IPO Prospectus

2017

Beyond the regulatory burden and potential information leaks linked to the IPO process, the costs associated with it restrain an amount of SME or other smaller-sized companies from taking the step by lack of profitability.



Kriptown

Mark Kepeneghian  
CEO

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We estimate that an IPO on a traditional exchange may cost on average close to 400 000€ for a company. With us, around 10 000€. As such, we aim to propose through DLT an additional financing solution that is not currently addressed in the market

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Other issues in the primary markets reside in the pricing & other due diligence efforts incurred in the initial purchase of securities as for private than public markets.

The quantity of intermediaries responsible for prospecting, gathering, and structuring relevant data regarding an underlying investment incur costs and time. Moreover, the dissemination of this data among various counterparties eventually leads to highly fragmented ecosystems. This is particularly true for private markets, in which securities have gone under no standardized review processes before the initial investor's one.

Regarding public offerings, there are two widely used mechanisms: the book-building and the auction-based method. In both mechanisms, the main role of the underwriter – intermediary in charge for helping companies in public issuances of stocks – is to price and allocate the shares of the issuer. The key difference of auctioned from book-built offerings is the mechanism under which the underwriter carries his role:

- In the book-building mechanism the underwriter prices and allocates the new issue with complete discretion.
- In the auction mechanism the underwriter has limited discretion, both the pricing and allocations are market driven since both are determined in a uniform price sealed bid auction where all winning bidders pay the clearing price.

Yet, there is still no clear consensus on an optimal pricing mechanism to raise capital. These coupled with macro-economic tendencies has led to a consistent decline in IPOs . The pandemic year of 2021 is an outlier, in part due to the low interest rates implemented to support the economic recovery, making it cheaper for companies to borrow money compared to equity.

On the investors' side, private markets offerings have for long remained restrained to capital and expertise thresholds – high capital commitments requirements, low liquidity with few exit opportunities, and a high dependency on relational networks. These trends have pushed away traditional and retail investors from these markets.

Emerging initiatives have gradually enabled to answer key challenges to open the liquidity and access of private markets. These liberal policies (i.e., JOBS Act ) have favored a conducive environment for the development of new mechanisms in the market. For example, exchanges begun to provide infrastructures for private markets liquidity (i.e., Nasdaq Private Markets). Summing up with the existing challenges in the primary markets, new typologies of stakeholders (i.e., non-advised investors, tech providers, ...) underpins the growing need for novel frameworks to answer new considerations (e.g., investors protection).

Figure 08

### Global IPO Activity Since 2019

■ Number of Transactions  
■ Aggregate Amount Offered (\$B)



Source: Statista

Understanding the pain points and difficulties that impact the primary markets is rather crucial when seeking for practices to optimize it. Over the years, DLT applications have evolved with optimized systems revolving around scalability, interoperability, or security. DLT ecosystem offers functionalities that have the potential to redesign key aspects of the traditional exchange of financial assets between one and another.

In the primary market, pilots and experimentations have successfully been developed across the globe. Regulators have pursued efforts to allow new market mechanisms based on DLT notably with the Pilot Regime in Europe. These clear stances allow for emitters to list and deliver through standardized modalities – with hopes of a higher transparency, lower cost, and time.



Allfunds Blockchain

Romain Devai  
Business Development Manager

“

The reality today is that there are still a certain number of processes, workflows that are managed manually or semi-manually with file exchanges, asynchronous processes, fax, or even phone for order placement. So, we are still operating in modalities that are not 100% digitized. With issuing fund shares on a blockchain, the advantage is that we are dealing with native tokens, and therefore, right from the issuance of fund shares, we can be in a 100% digital environment since all the characteristics of the fund can be specified in the smart contract that will manage the issuance and the entire life of the fund.

”

There is increasing market evidence that the adoption of digital assets and new digital technologies, such as DLT, are maturing, with operating models & pilot experimentations starting to be implemented at scale. Over the next 15 years, digital assets are anticipated to grow in value to around \$16 trillion (*Bank of America Securities, 2023.*). Central elements have bolstered the achievability and development of use cases at scale for market participants as institutions growingly adapt:

- **Technical Maturity**
- **Regulatory Coverage**
- **Market Adoption**

As of today, 39% of financial market participants that use some form of DLT, or digital assets are in revenue generation stages (\*). As mentioned in the abstract of this paper (refer p.x), one of the key catalyzers for the ecosystem has been the shift from proprietary & siloed developments – i.e., at the organization level – towards a more collaborative deployment – with the realization of benefits at an industry-wide scale. One of the key outcomes is the ongoing standardization of practices paralleled with the integration of solutions alongside legacy systems.

Regarding the DLT networks, and their high reliance on network effect, these developments positively drove liquidity within and among ecosystems & protocols, allowing for production scale with more funding, and more participants – a clear shift from learning to commercialization. As such, catalyzers for the ecosystem’s growth still rely on market participants’ collaboration, to (1) growingly connect the existing to the DLT-based operating systems, and (2) liberate these digital assets’ liquidity pockets through investable products bridging both worlds. As it were to succeed, the following are observable outputs to consider as performance indicators:



In addition to the overall automation of the issuance process, DLT (and smart contracts) are eliminating days from asset (bonds, equities, structured products, etc..) issuance cycles – increasing the speed of funding for issuers, reducing pricing risk, and creating new business opportunities – for structured product specifically: more visibility on the whole digital value chain, now more transparent.



BPI France

Ivan de Lastours  
Blockchain & Crypto Lead

66 The main opportunities primarily revolve around the traceability of the operation. In concrete terms, DLT provides a better insight into the lifecycle of the underlying asset: from the primary market (issuance) to secondary transactions. The second aspect, as seen in all the Green bonds issuances made on DLT by various banks, including French banks, is the data you can embed. Because today, you can't really associate a bond paper with real-time data.

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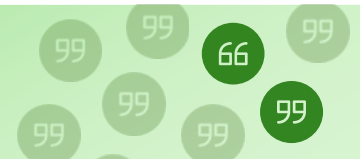
Debt Capital Market



Market Experimentation



Onbrane



## Commercial Paper DLT experimentation overview

Onbrane leads the digitalization of Europe's short-term primary debt market, enhancing processes for diverse institutions, minimizing manual tasks and risks with live market data, and fostering collaboration and transparency on a unified platform.

### Blockchain experimentation

The objective of the experimentation is to define the value that a blockchain technology would have on the short-term debt market. Therefore, Onbrane has chosen to allow testing of this technology on real transactions, in real market conditions, alongside the current system.

### Process

Transactions are negotiated on the Onbrane platform, which acts as an oracle to record the transaction on the blockchain via a smart contract. Each stakeholder in the debt will sign the transaction on the blockchain to validate the information provided by the platform. A token representing ownership of the debt will be created and sent to the investor. Tokens representing currency are transferred from the investor to the issuer. The reverse operation is carried out for repayment.

### Key Performance Indicators



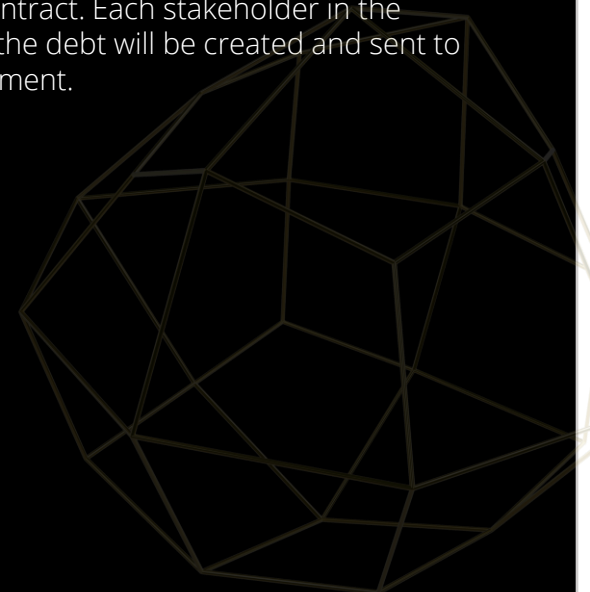
Transaction  
Cost



Transaction  
Time



Cost of Managing the  
Blockchain



### Case Study / Euroclear D-FMI

The ambition from market participants to participate in the DLT ecosystem at scale can be embodied by Euroclear’s most recent developments with its **D-FMI platform: Digital Financial Market Infrastructure**. A pilot consisting in the emission of **€ 100M worth of digital notes** has successfully been processed under the supervision of the World Bank and complying with the Central Securities Depositories Regulation (CSDR) standard, also interfacing with legacy systems. The bond market is one of the biggest yet less innovation-friendly in terms of processes that govern its functioning. Just like other structured products, their issuance relies on various intermediaries – such as issuers, underwriters, and potential new entities involved in the digital era – and comparable regulatory compliance frameworks. Stepping back, the traditional system involves a various set of intermediaries as depicted in the figure below.

Euroclear has envisioned a new standard with DLT at its core. By leveraging R3 Corda and its private DLT infrastructure, the financial institution has developed a streamlined bond emission process with an extensively reduced number of participants – refer to figure below. Beyond the innovative aspect of the project, it represents a milestone for DLT & the bond market vetting the existence of wider developments in the field. Noticeable upsides arise from this new standpoint:

#### Cost of Transaction

Limited intermediaries  
Standardized infrastructure

#### Error Limitation

Transparent and end-to-end all-digital environment

#### Speed of Transaction

Automated screenings and enforcements

#### Interoperability

Interfacing with legacy systems and potentially among markets



Figure 9

### Standard Bond Emission Framework

Secondary Market >

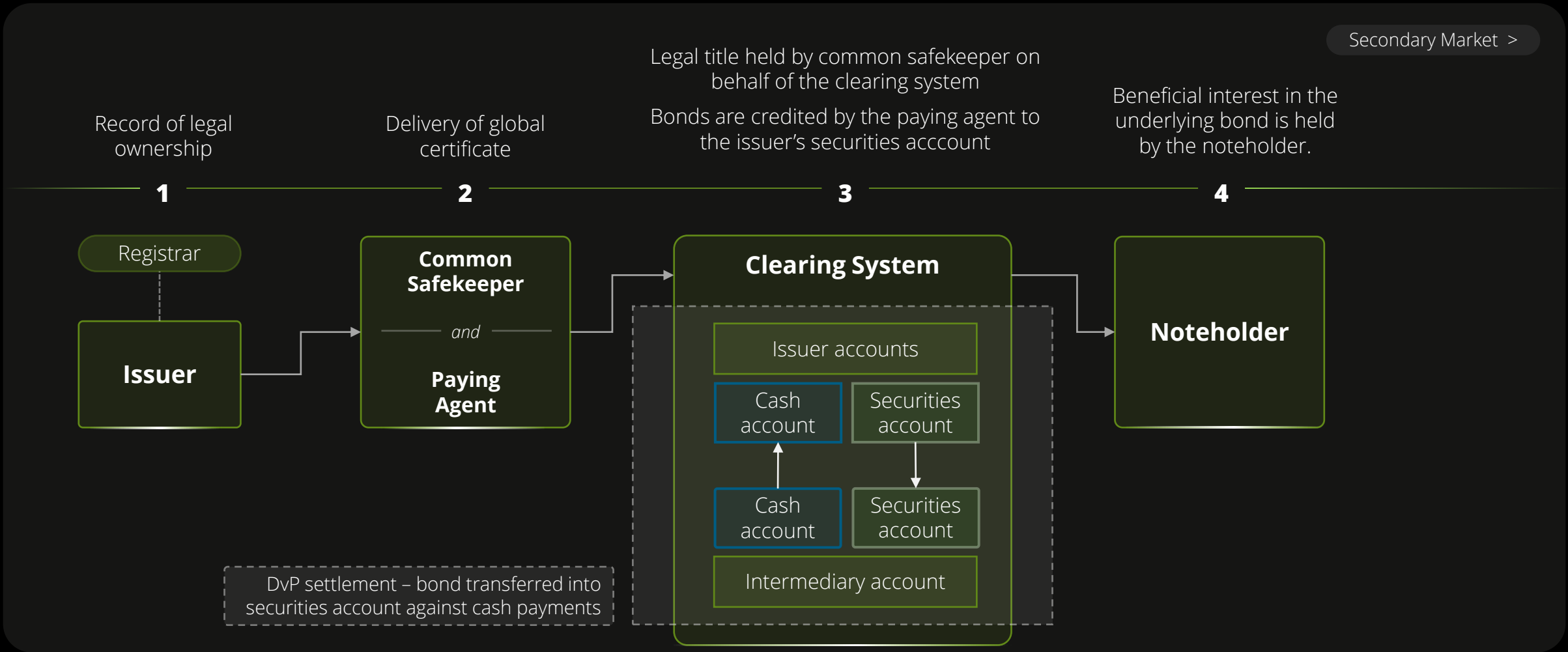
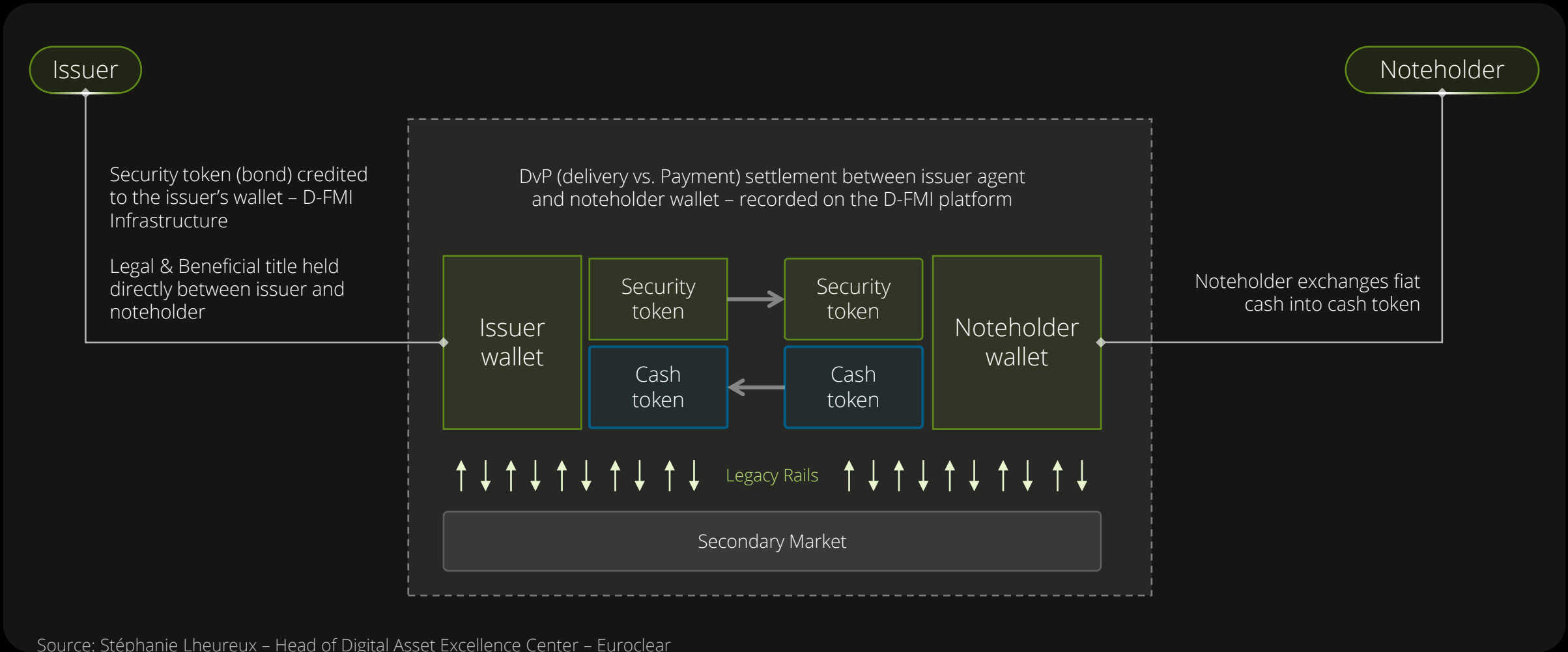


Figure 10

### Digitally Native Bonds Issuance System



Source: Stéphanie Lheureux – Head of Digital Asset Excellence Center – Euroclear

**Tokenization is a concept within the primary market that leverages DLT to transform traditional securities into digital tokens.**

These digital tokens (i.e., with a focus on security tokens in the scope of our report) are programmable and regulated financial titles emitted on a blockchain. They represent the ownership of real-world assets, such as real estate, art, or company shares, and are designed to operate on blockchain networks.

In short, tokenization aims to simplify and automate asset issuance, ownership, and transfer through a unified end-to-end structure. On the investor side, it allows to own fractions of a high-value asset, opening opportunities for a broader range of participants in the primary market, also facilitating liquidity with lower entry barriers.

As for the primary market, Security Token Offerings (STOs) represent the listing of new securities for trading. What DLT allows is to have rather unified and standardized modalities for the primary sale of a security in the market – regardless of their nature.

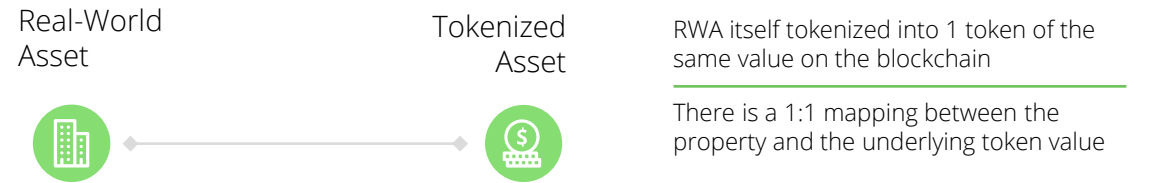
Security tokens do offer a compelling solution to address the challenges in the primary market, providing an efficient, inclusive, and transparent way for companies to raise capital and for investors to participate in the market. All transactions are recorded on an immutable ledger, providing a transparent and tamper-proof record of ownership and transfers. As the regulatory landscape evolves to accommodate this new approach, there remain considerations to partake before a wider scale of operations. Eventually around smart contracts: automated compliance checks, or rules, may be embedded within the smart contract code, ensuring that all transactions adhere to regulatory requirements, and streamline trunks of the emission or transfer modalities. As such, they should themselves become standardized, audited, and regulated to set the floor for a greater appropriability of the technology that has remained siloed for some time.

### Direct or Indirect Tokenization?

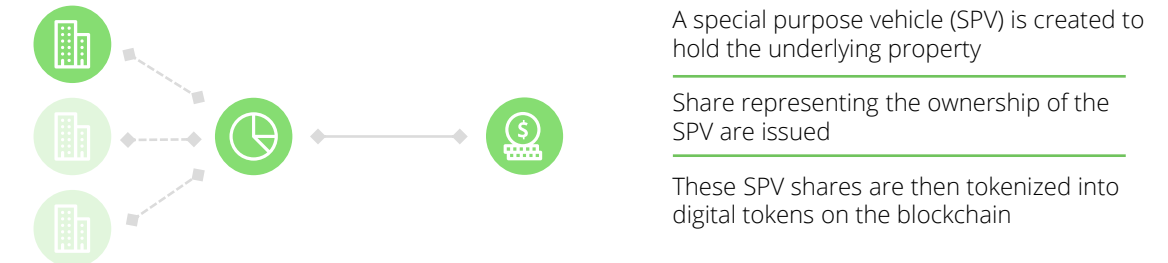


We carefully distinguish direct and indirect tokenization processes.

**Direct tokenization** maps the value of a real-world asset directly in a unique digital token on the blockchain. This direct mapping provides a 1:1 relationship between the token and the asset it represents.



**Indirect tokenization** consists in creating a derivative asset, or a financial instrument backed by the real world asset, which is then tokenized on the blockchain. This adds an additional layer of abstraction



Source: Tokenization of Financial Assets (Xavier Lavayssière, 2024)

Figure 11

### Standard Token Emission Framework

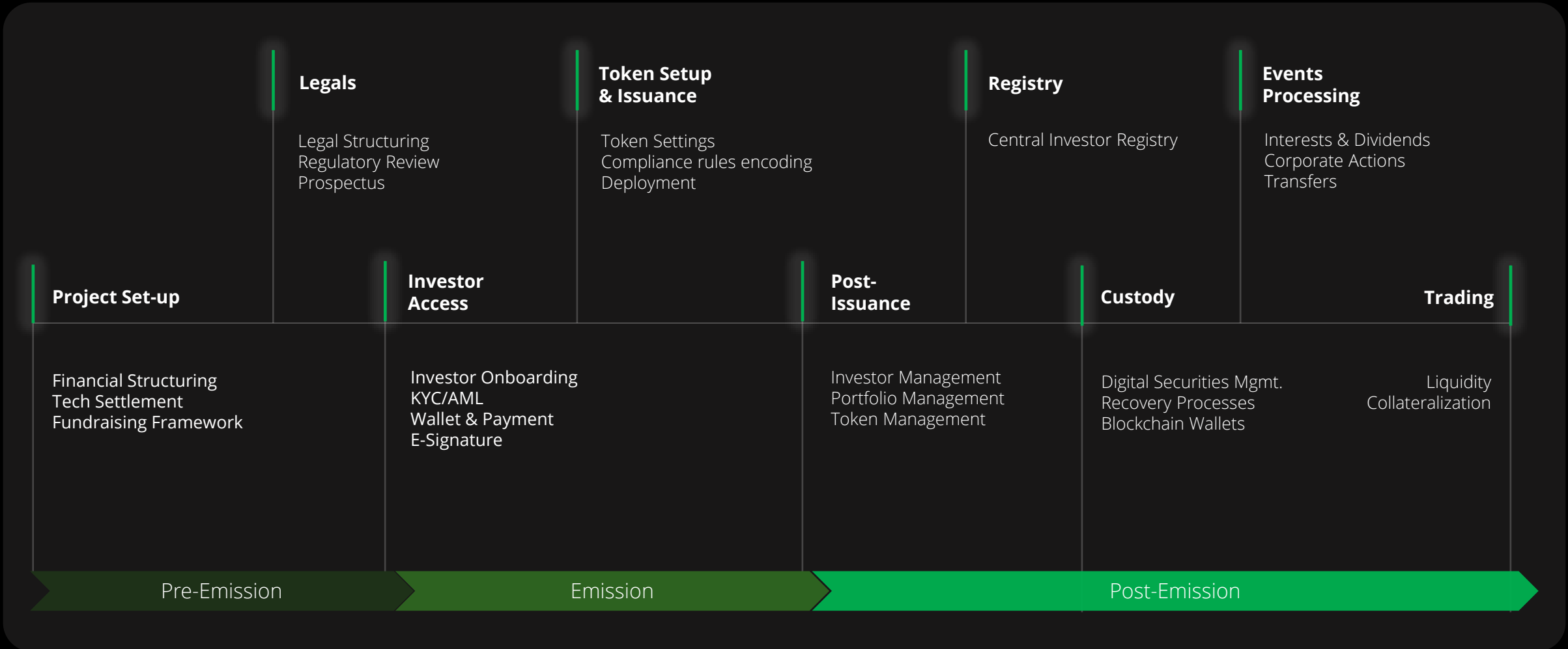


Figure 12

## Operational Structure of a Token Emission

### 01 - ASSET ORIGINATION

The asset origination occurs offline, the originator holds a portfolio of assets that he seeks to tokenize.

### 02 - SPV CREATION

The SPV creation is an online activity.

### 03 - DEAL STRUCTURING

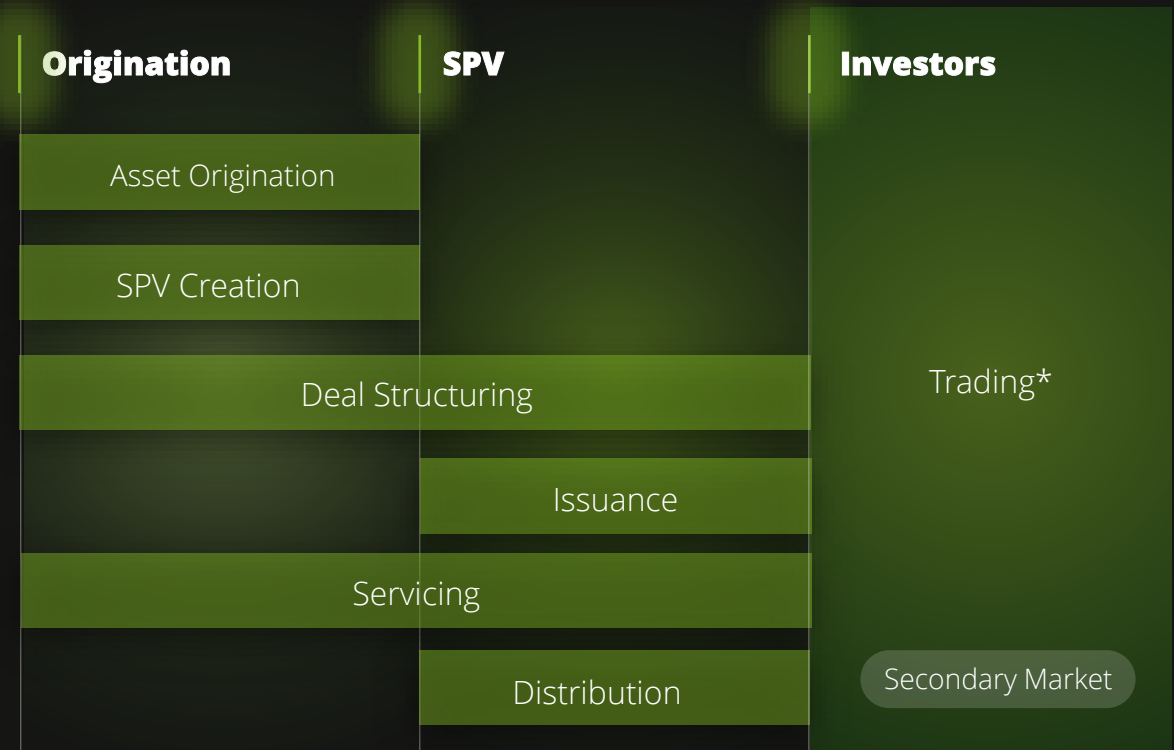
The deal structuring is managed off- chain. The parameters of the deal are configured within a smart-contract based on the client specifications.

### 04 - ISSUANCE

Investors are able to invest in the tokens according to the smart-contract rules, in parity with their investment amount.

### 05 - SERVICING, DISTRIBUTION, TRADE

Servicing, Distribution, and Trade are managed by Tokeny, mainly through their online platform.



### Focus: Understanding Smart-Contracts

Smart contracts are self-executing contracts with the terms of the agreement directly written into code. They are basically made up of two things: the storage and the functions.

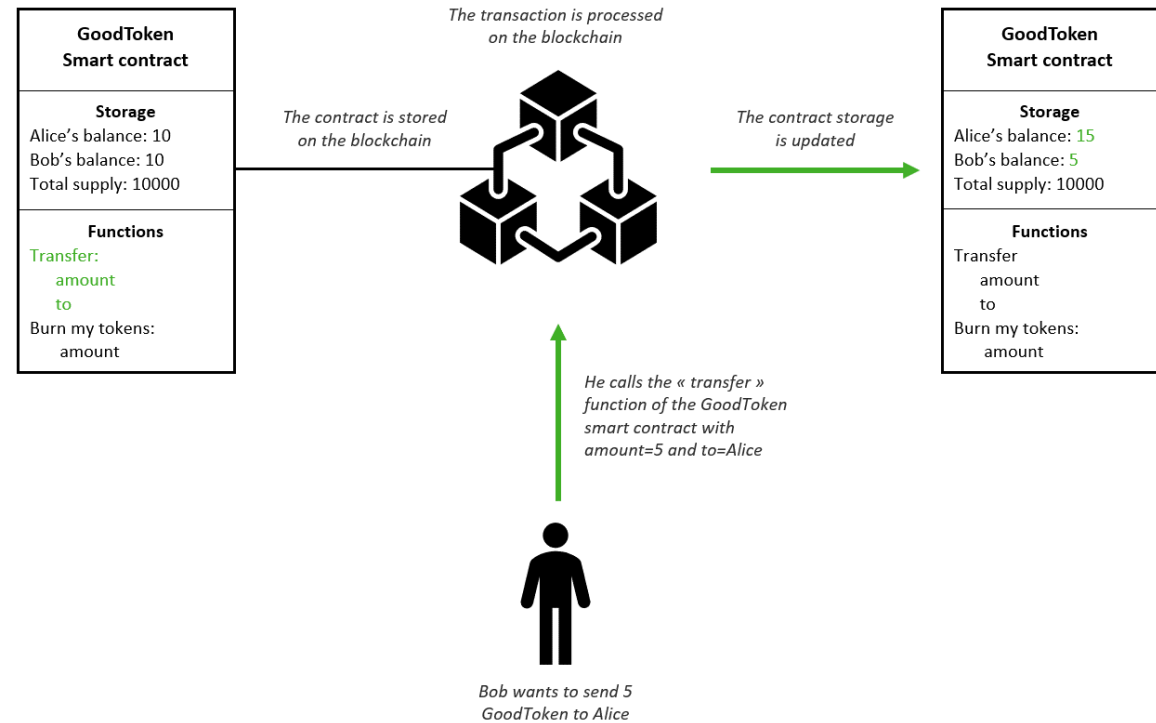
**The storage:** smart contracts can store and manage data on the blockchain. The storage, or state, can include variables, states, and information relevant to the contract's execution. Any changes to the contract's state are recorded as new transactions on the blockchain. At the creation (called the deployment) of the contract on the blockchain, a predefined state is created and associated with the contract.

**The functions:** functions in a smart contract define specific actions or behaviors that the contract can perform. They allow for the execution of code, interaction with external entities, and the modification of the contract's state on the blockchain. Each function encapsulates a particular aspect of the contract's functionality, contributing to the overall behavior of the smart contract.

When predefined conditions are met, these contracts automatically execute actions, such as transferring ownership. In the context of security tokens, this automation greatly simplifies and accelerates processes that previously relied on intermediaries and manual execution.

### How does a smart-contract operates?

Depicted below is a simplified view exemplifying their functioning



To ensure interoperability, comply to regulation and respect security guidelines, the design of smart contracts representing tokens are following specific standards. For example, standards on the Ethereum blockchain are called “ERC” (Ethereum Request for Comments). Some ERC are specifically designed for tokens standards (for example ERC-20 or ERC-721) and describe a set of rules and guidelines on the Ethereum blockchain that defines how a particular type of token should behave.

Here's an explanation of how ERC token standards work:

- **Token Contract development:** Developers create a smart contract on the Ethereum blockchain following the ERC standard. This contract will represent the behavior of the token.
- **Standardized Functions:** The ERC standard specifies a set of functions that the token contract must implement. These functions usually include transferring tokens, checking balances, and approving token transfers. For example, on the ERC-20, the *'transfer'* function allows users to send tokens from one address to another. The *'balanceOf'* function provides information about the token balance of a specific address.
- **Basic Token Information:** The standard includes essential information like the total supply of tokens, the name of the token, its symbol, and the number of decimal places. The information is stored in the state of the smart contract.



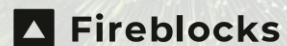
Fireblocks

John Hallahan  
Director, Business Solutions & Advisory

“

I believe having clear standards across different blockchains and types of assets is something that's important. And I think that's not just a regional problem, it's a global problem. Building on those blockchain, smart contract, and standards are really important, and they go hand-in-hand with cyber risk concerns.

”

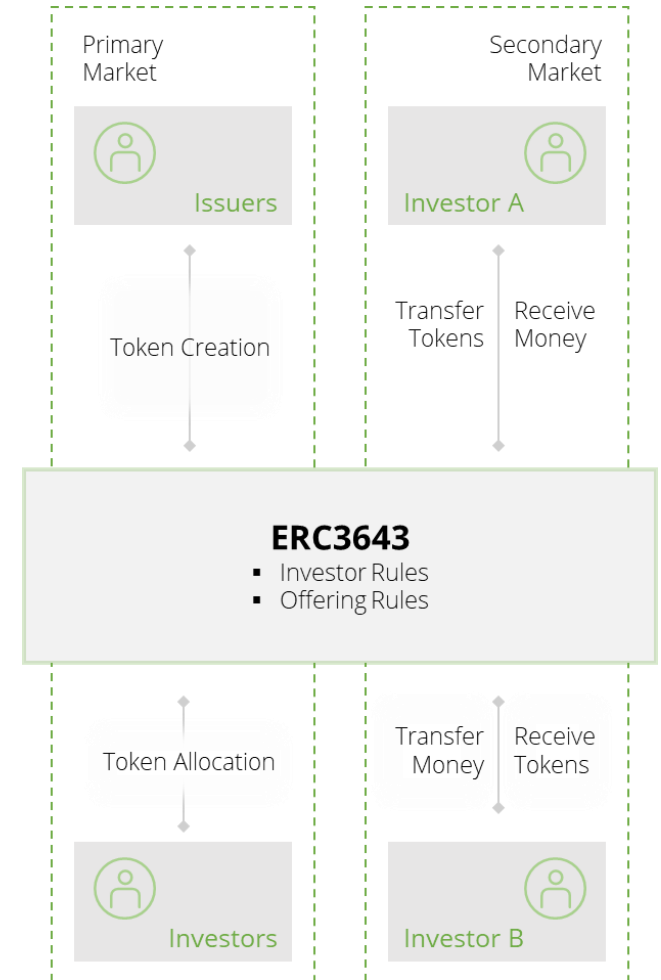


Fireblocks is an easy-to-use platform to create new blockchain based products, and manage day-to-day digital asset operations. Exchanges, banks, PSPs, lending desks, custodians, trading desks, and hedge funds can securely scale their digital asset operations through the Fireblocks Network and MPC-based Wallet Infrastructure. Fireblocks serves thousands of organizations in the financial, payments, and web3 space, has secured the transfer of over \$4 trillion in digital assets and has a unique insurance policy that covers assets in storage & transit.

Regarding tokenization, a lot of standards have been emerging these few years, but not one is widely accepted. When it comes to tokenized securities or security tokens, the situation becomes more complicated than the usual ERC-20 token due to the need to comply with securities laws.

The ERC-3643 standard intends to provide a comprehensive framework for administering the entire lifecycle of security tokens (Real World Assets, Securities, E-Money, Loyalty Programs) from issuance to transfers between eligible investors, while enforcing compliance rules at each stage. In response to regulatory requirements or changes in the status of the token or its holders, the standard also supports additional features such as token pausing and freezing.

Moreover, the standard is intended to function in tandem with an on-chain Identity system, enabling the validation of investors' identities and credentials via signed attestations issued by trusted claim issuers. This ensures that the trading of security tokens is compliant with legal and regulatory requirements.



Tokeny

Luc Falempin  
CEO

66

There is an identifiable trend towards retailization. Essentially, it's about trying to provide investment products more directly to the end investor. In traditional finance, we may observe 6 to 7 layers between the issuer and its investors – distributors, custodians, asset managers, and other intermediaries. The issuers no longer have any connection with their investors, their end clients, struggling to know what they want, what, when, how, and to provide new services. With tokenization, there are two main aspects. On the sell side, it's mainly operational gains that are sought. And on the buy side, the idea is to offer more transferability and new services to investors.

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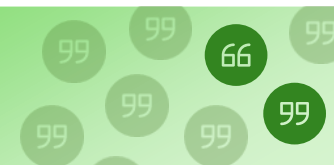




## Ecosystem Orchestration

Fostering innovation, continuous adaptation, and collaboration

Deloitte



The term *ecosystem* refers to a network of interconnected entities that interact with each other to support its development. An efficient ecosystem involves a one where these entities effectively conduct purposeful actions set to participate in its growth. Ultimately, the goal being to unlock the full potential of the products and services delivered, and to coordinate the efforts of firms in optimizing the value created for the end-users and to provide assurance to stakeholders.

In the context of Decentralized Ledger Technology (referred as *DLT* throughout the report), an effective orchestration notably involves the collaboration of hardware manufacturers, tech/software providers, corporates, regulatory bodies, or other field experts, each playing distinct yet interconnected roles, to foster the implementation and optimize DLT in dynamic environments.

At Deloitte we conceptualize the effective orchestration of this DLT ecosystem as a combination of capabilities (tax, legal, business & technical experts, home-made tools, strategies & methodologies, partnerships, etc ...) that enable and drive its development. In this, we differ dynamic capabilities from so-called zero-level capabilities. For instance, the former is essential in innovative ecosystems as they stand as organizations' ability to deliberately adapt their resource base: integrate, build, and reconfigure internal and external resources/competences to address and shape rapidly changing business environments.

- **Sensing** – Vision: identifying and assessing opportunities outside an organization.
- **Seizing** – Investment: mobilizing the resources to capture value from those opportunities.
- **Transforming** – Appropriation: continuous renewal, solving ad-hoc problems and collecting market feedbacks to create and maintain stability (ERC Standards, Legislation, ...).

Beyond the organizational level, efforts made to leverage complementary actors for joint value propositions at the scale of the ecosystem are sensibly equally important.

- Foster partnership: efforts to enhance ecosystem's value: ex. Partnering with crypto-native startups for regulatory watch, self-custody support, and token management.
- Ensuring the appropriability: Development may be restrained due to the complexity of the underlying use cases and their operational realization.

Despite efforts, challenges arise in balancing value creation with competition among the various players – geographically or within verticals. Though, some degree of alignment is essential to set a path toward the shared goal of industrializing the DLT ecosystem, irrespective of individual organizations' objectives.

Over the years, we identified patterns in the development of emerging tech ecosystems (ex.5G, Internet, ...), all driven by sensibly similar structured processes – identifying, evaluating, and capitalizing on new business opportunities while alleviating bottlenecks.



Ecosystem Orchestration

Fostering innovation, continuous adaptation, and collaboration

Deloitte



Deloitte is persuaded that the widespread adoption and implementation of DLT within the primary market is not only a reality but also represents a pivotal opportunity to revolutionize the asset lifecycle management and operational dynamics within sub-market frameworks. **How Deloitte can assist your organization?**

### Project Management & Assurance for Custody projects

Tokenization projects require robust custody solutions to ensure the safekeeping and management of digital assets. It's imperative to establish a comprehensive custody framework. These are the key elements to consider: Conducting an in-depth assessment of custody requirements and regulatory obligations Engage with experts to implement robust internal controls and security measures to safeguard digital assets against unauthorized access or breaches

#### Deloitte Feedback

In a recent engagement with a client, Deloitte provided support in establishing a custody solution for tokenized assets. This involved developing and implementing custody protocols compliant with relevant regulatory frameworks.

### Regulatory Screening & Readiness Analysis

Tokenization introduces complexities related to regulatory compliance. Before starting a tokenization project, it's relevant to understand regulations in each jurisdiction where the tokens will be offered or traded. These are the key elements to consider:

- Conduct comprehensive legal assessments
- Engage with experts to ensure compliance with all applicable regulations
- Consider the regulatory requirements and changes in the status of the tokens or its holders

#### Deloitte Feedback

In a recent project with a client in the financial services industry, Deloitte gave support clients to obtain registration as a Digital Asset Service Provider in the UE, compliant with MiCA regulation. This include service like regulatory monitoring and internal control.

### Technical Infrastructure & Smart Contract

Tokenization relies on blockchain technology, which may be susceptible to technical vulnerabilities, software bugs, and protocol failures. Any technical issues could disrupt tokenized asset transactions or compromise the integrity of the blockchain network. These are the key elements to consider:

- Conduct the review of IT Architecture
- Engage with experts to get the smart contract audited to mitigate any security breach risks
- Consider implementing recommendations

#### Deloitte Feedback

A client approached us to reduce the inherent risks of this technology by requesting our expertise in smart contract auditing. It consists of reviewing the smart contracts code and issuing recommendations to ensure its security and functionality.



# Deep Dive 2

Secondary Market | Digital Assets Trading at Scale



Clearing & Settlement



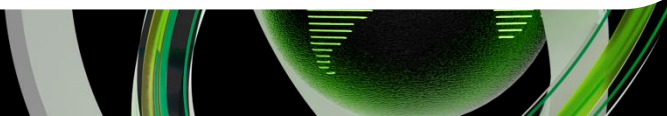
Market Data & Transparency



Post-Trading Processing

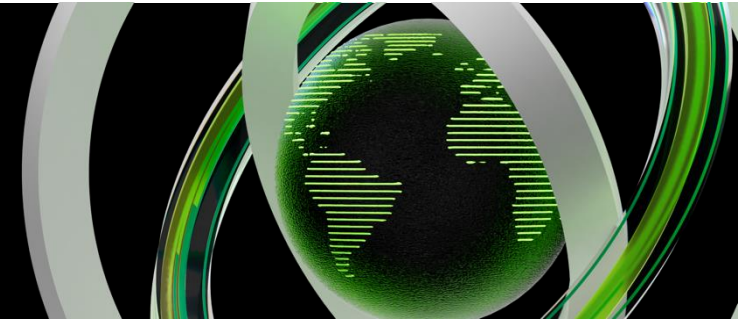


Cross-Border Trading & Execution

A decorative graphic in the bottom right corner featuring overlapping green and white circular patterns, resembling a stylized globe or data visualization.

## Secondary Market

Distributed Ledger Technology is reshaping traditional secondary market operations, driving efficiency gains and unlocking new opportunities across trading, clearing, settlement, and post-trade processes.



### Clearing & Settlement

T+0

Target settlement cycles using DLT

€20B+

Annual reduction in global costs (est)  
*Global Financial Markets Association*

€270B+

Cross-border payments market in 2030  
*BVNK*

€0.00001

Cost of a blockchain transaction (est)  
*Calculation based on Solana blockchain*

### Market Data & Transparency

€2.6T+

Total Crypto market cap in 2024  
*Blockworks*

75M+

Monthly active users on L1 & L2 blockchain  
*Token Terminal*

### Roles of the secondary market: Liquidity Benefits

Secondary Markets are reconciling investors of all kinds needs—retail and institutional—by engaging them in the buying and selling of previously issued securities (i.e., stocks, bonds, derivatives, etc.). In the realm of finance, these markets stand at the heart of securities liquidity by endorsing multiple functions that boost overall economic efficiency:

- **Enhancing price discovery:** Supply and demand interact as securities are traded on the secondary market, leading to the determination of market prices. It ensures that securities are priced at their fair value (i.e., reflecting all available market information and market expectations).
- **Increasing market depth:** As it provides an infrastructure/platform for a wide range of investors and lenders to participate. This broad participation leads to a more liquid market, with more potential interested counterparties at any given time. An increase market depth also tends to reduce transaction costs.
- **Improving capital allocation:** The possibility for investors to quickly reallocate investments based on changing market environments participates in ensuring that capital flows are transferred to the most productive uses (i.e., less capital captured in under-performing asset).
- **Accessing investment opportunities:** It provides an access to a wide range of investment opportunities to investors/entities that may not have access to primary offerings.

Liquidity is the ease with which assets can be bought and sold without causing significant impacts on overall prices. In short, it refers to the ability to convert an asset into cash quickly and with minimal loss in value. As a general rule, the greater the number of investors that participate in each marketplace, and the greater the centralization of that marketplace, the more liquid the market.

Securities, from stocks to bonds, rely on secondary markets to maintain their value and appeal to investors. The same mechanisms apply for all assets transiting in various verticals, including digital assets and crypto. Structural systems exist to organize the exchange of these various asset types, with various specificities for each of them.

The secondary market is a dynamic marketplace, attracting a spectrum of participants. On one end, with retail investors, often individuals, who trade securities for personal investment or wealth management. On the other end, with institutional investors—mutual funds, pension funds, and hedge funds—whose activities can sway market dynamics through bigger investment volumes. To ensure an efficient market, structures and standards have spread, with various intermediaries involved in achieving the core function of ultimately conciliating the needs of both buyers and sellers in a regulated environment.

In this setup, **(1) Trading venues** are digital platforms that centralize the interests of buyers & sellers to perform a transaction. **(2) Clearing House** validates & finalizes an underlying transaction between two or more parties, ensuring that each stakeholder honors its contractual obligation. **(3) Central Securities Depository (CSD)** are specialized financial institutions in charge of holding securities and ensuring their efficient transfer from an entity to another.

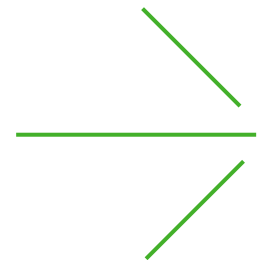
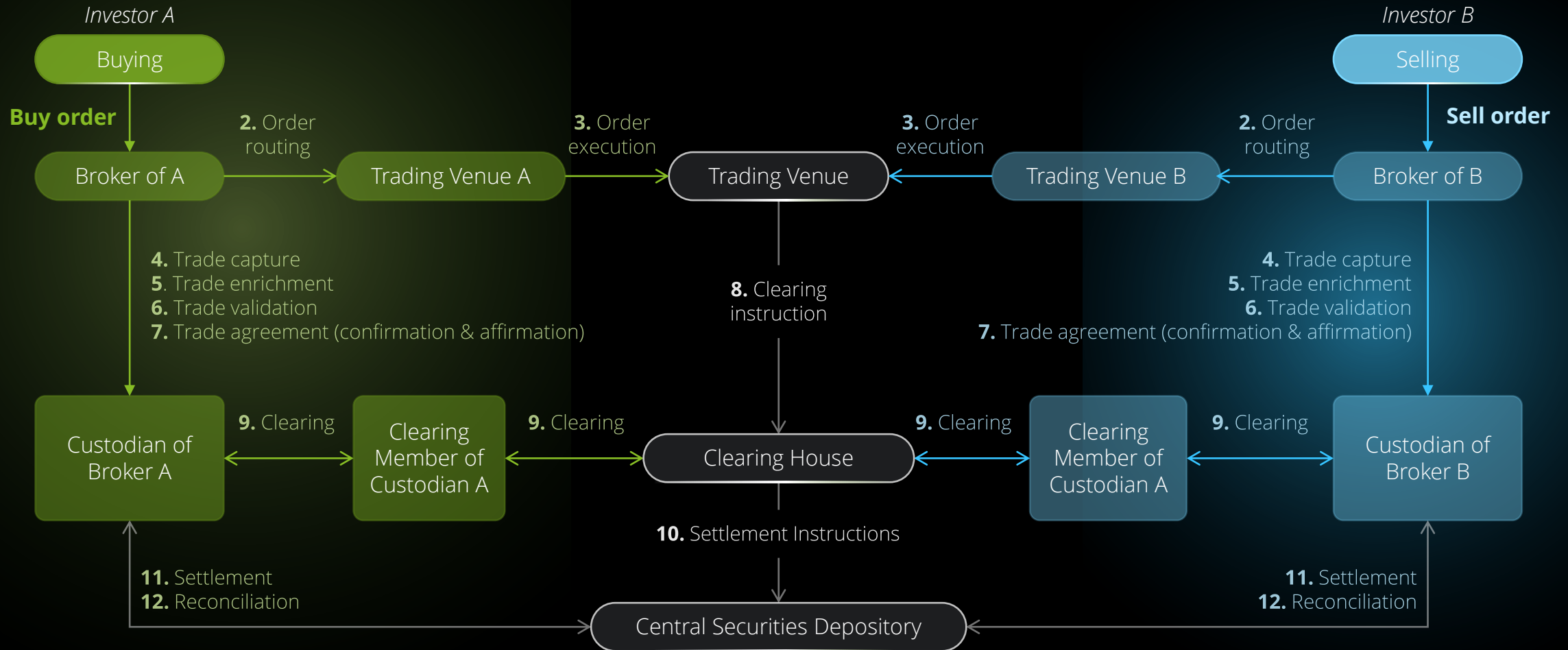


Figure 13

### Overview of Secondary Market Infrastructures



The effectiveness of capital markets is affected by its liquidity, its capacity of correctly reflecting the prices of underlying securities, and ultimately proceeding to the exchange of these securities between participants.

Transactions within capital markets appear fast but are less straightforward in reality – post-trading activities indeed encapsulate most of the optimizable operations. Notable challenges arise in the secondary market among which **delayed settlements and market fragmentation**. These challenges have far-reaching implications for the efficiency and stability of secondary market operations.

The traditional T+2 (Trade Date plus 2 days) settlement process has been a cornerstone of secondary market operations for years.



## Understanding Liquidity Among Asset Classes, Instruments, & Geographies



Instrument	European Union	United States
<b>T-Bills</b>	T+2 business days	T+1 business day
<b>Corporate Bonds</b>	T+2	T+2 (moving to T+1)
<b>Stocks</b>	T+2	T+2 (moving to T+1)
<b>ETFs</b>	T+2	T+2 (moving to T+1)
<b>Mutual Funds</b>	T+1 to T+2	T+1 to T+2
<b>Spot FX</b>	T+2	T+2
<b>Domestic Bank Transfers</b>	T+1 to T+3 (SEPA)	T+1 to T+3 (ACH)
<b>International Bank Transfers</b>	T+1 to T+5	T+1 to T+5 (SWIFT)
<b>Card Networks</b>	T+1 to T+3	T+1 to T+3

Liquidity among instruments in Europe & United States

Figure 14

Asset Class	Liquidity	Frequency of Pricing	Investment horizon(years)
<b>Listed Equities</b>	High	Daily	7-10
<b>Private Equity</b>	Low	Quarterly	7-10
<b>Listed Bonds</b>	High	Daily	1-7
<b>Private Bonds</b>	Low-Medium	Daily	3-7
<b>Listed Property</b>	Medium to High	Daily	7-10
<b>Direct Property</b>	Low	Annual	7-10
<b>Cash</b>	High	Daily	Daily
<b>Unlisted Infrastructure</b>	Low	Quarterly	7-20

Liquidity among asset classes

Figure 15

## The settlement challenge



Reducing the time between the transaction date and the settlement date – when a trade is considered complete



A delayed settlement period exposes market participants to various risks, including price fluctuations and counterparty risk. Price fluctuations during this period can lead to unexpected financial outcomes and the possibility of a counterparty failing to meet its obligations within this timeframe can result in financial losses and increased uncertainty in the market. Furthermore, the extended settlement timeframe hampers the overall liquidity of the market, as capital remains tied up during the settlement period. These risks have prompted market participants to seek faster, more efficient settlement processes to mitigate the challenges associated settlement. The root cause for that is the tech stack that serves as the basis for these transactions.

## Fragmentation of Liquidity & Standards Across Various Exchanges and Platforms

Another challenge that secondary markets grapple with is the fragmentation of liquidity. The European market is aligned on the TARGET2-Securities (T2S) standard, showing significant resilience from a regulatory and infrastructure perspective. However, liquidity mainly remains clustered within national markets, with most transactions happening domestically – EU post-trading market is split across 31 CSDs. The reason being non-uniform regulations among states (taxations, corporate law, insolvency law, etc.) that introduce complexities in building a common & unique framework.

This introduces complexities. Traders must navigate multiple venues to execute their orders, increasing operational overheads and creating inefficiencies. Market fragmentation can lead to price disparities and reduced transparency, making it challenging for investors to access the best prices and execute trades efficiently.



Paymium

Pierre Noizat  
CEO

66

DLT brings reliability. Once you have an exchange recorded on the blockchain, you know at any given moment where your asset is, how it's being traded, and you're not lost in a myriad of intermediaries.

99



The advent of blockchain technology has sparked the rise of innovative models contributing to an increased efficiency and a reduction of costs both for issuers and investors. These harness the power of Distributed Ledger Technology (DLT) to disrupt secondary market operations, particularly for post-trading activities. The DLT Pilote Regime has initiated a baseline standard that fosters the combination of trading and settlement activities – with the centralization of Central Securities Depository (CSD) & Clearinghouse roles to the service provider.



Truffle Capital

Alexis Le Portz  
Fintech Investment Director

“ The true revolution is to have a uniform dataset for everyone. Another topic is the real-time auditability and traceability of all assets. Previously, you could operate on inefficient markets in terms of who owns what. It was precisely the role of brokers, among others, to match supply and demand - to find where the liquidity is and access it. Now, it would be possible to trade directly, by knowing exactly who owns what and communicate with the asset holders. There is a shift in how we think about accessing assets. ”

99



Allfunds Blockchain

Romain Devai  
Business Development Manager

“ In Europe, we are dealing with models that can be very different depending on the jurisdictions. And that's also why the Pilot Regime seems interesting to us at the European Level. Precisely, it allows for more standardization among the different standards or market organizations which are quite disparate in Europe today. ”

Overall, DLT introduces a new level of transparency to the secondary market. Each transaction is recorded on a distributed ledger that is visible to all relevant parties. This transparency ensures that the entire transaction history, from trade initiation to settlement, is readily accessible and immutable. ”

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By providing a tamper-resistant record of all activities, blockchain enhances market integrity and reduces the likelihood of fraud or manipulation. At the granular level, smart-contracts may embed specific functions to streamline specific operations – notably regulatory checks. Nevertheless, certain topics within secondary markets remain complex, requiring substantial transition efforts for the current market operators. The implementation of DLT should seek for interoperability with legacy systems, and not further fragment the market.

Figure 16

# How DLT Impacts Secondary Market Operations

## Clearing & Settlement

- Help to reduce counterparty risks
- Shorten settlement cycles
- Streamline collateral margining process
- Provide alternative netting schemes

## Trade validation, Recording, and Matching

- Automate business processes with smart-contracts
- Increase reliability of data quality from source
- Reduce error correction time

## Record Keeping

- Provide better data transparency
- Reduce reconciliation costs
- Streamline asset/securities issuance and servicing

## Ledger Enterprise TRADELINK: Next Generation Institutional Off-Exchange Trading Network

Ledger Enterprise TRADELINK is a secure trading technology for institutions and asset managers. It allows them to trade on centralized exchanges without directly exposing their capital. Designed as a customizable infrastructure, it enables trading firms to choose one or multiple qualified custodians powered by Ledger Enterprise technology as counterparty to safeguard their assets during the trading cycle. This system facilitates the pledging of assets to liquidity providers via a preconfigured collateral account, enabling seamless off-exchange trading. During the trading journey, custodians manage the custody, clearing, and settlement of assets according to specified instructions, with profit and loss recalculations being carried out independently. This innovative approach guarantees best-in-class risk management and enables compliance with stringent regulatory standards.

By allowing asset managers to build their own trading network with the custodian(s) and liquidity provider(s) of their choice, Ledger Enterprise TRADELINK enables mirroring traditional triparty financial setups. In this setup, the custodians act as trusted clearing counterparty for secure fund management and efficient clearing & settlement. This strategy enhances risk management and swiftly adapts to changing regulations, ensuring operational resilience. Designed for regulated entities, Ledger Enterprise TRADELINK also features robust hardware security, customizable governance, advanced policy engines, and detailed audit trails, ensuring high-level reliability and transparency to address critical institutional needs.



Ledger Enterprise

Sébastien Badault  
VP of Enterprise Revenue

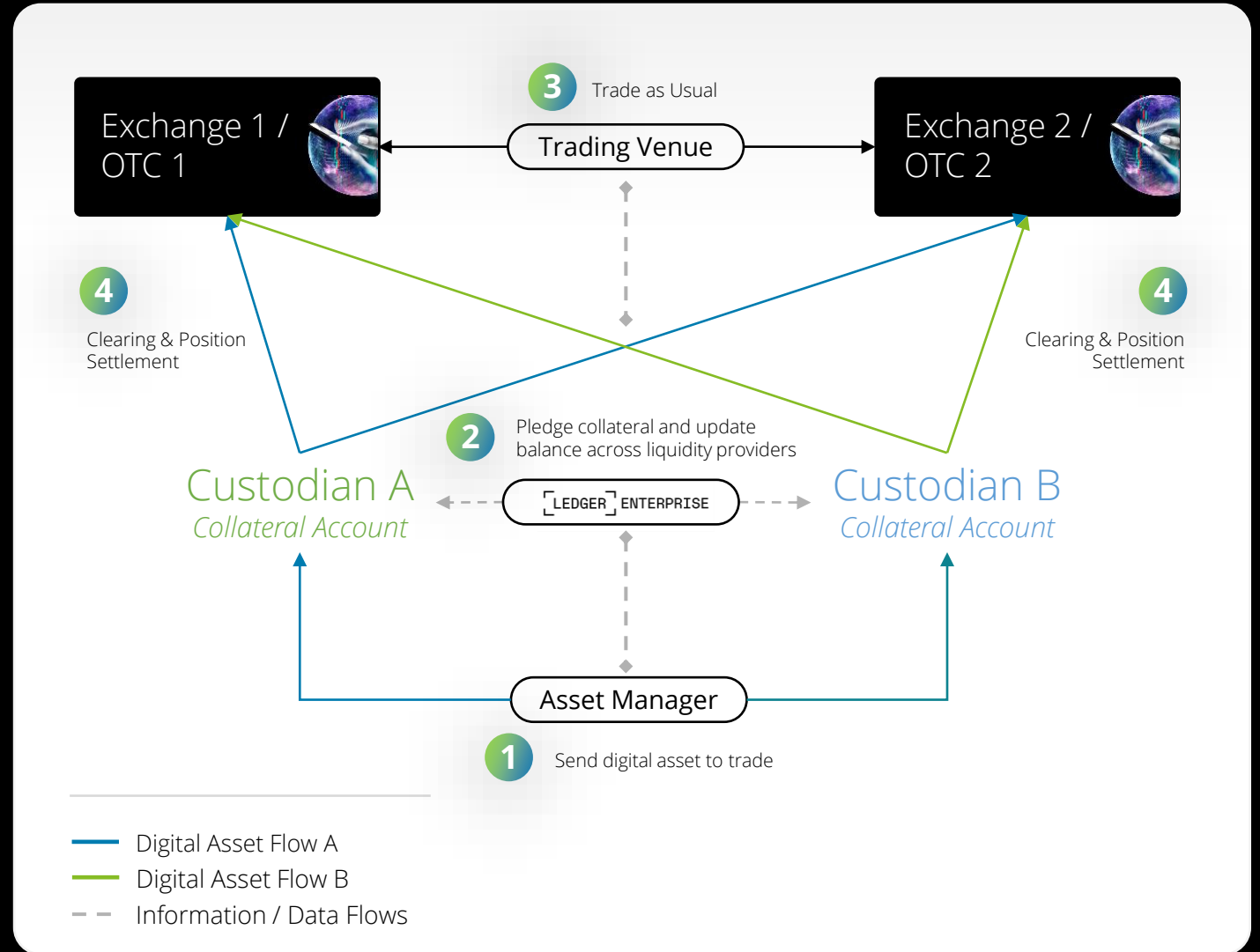
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The introduction of Bitcoin ETFs has driven considerable adoption that is set to continue to grow post-halving. As we enter a new bull market, institutions need solutions that allow them to secure and govern their digital assets at scale. That's why we're launching Ledger Enterprise TRADELINK, the first-of-its-kind off-exchange technology solution set to become an essential part of the institutional trading fabric. With Ledger Enterprise enabling institutional-grade self-custody, and Ledger Enterprise TRADELINK allowing asset managers to build their own off-exchange trading network, institutions can now trade digital assets efficiently and securely. This solution eliminates exchange counterparty risk, prevents FTX-like events, and reduces unnecessary transaction fees.

99

Figure 17

### Illustration of Ledger Enterprise Tradelink Workflow



### Bringing Liquidity to Illiquid Markets

Various markets are affected by a lack of liquidity due to the structural nature of the products traded:

- **Art:** Lack of tradability notably due the lack of centralized place of exchange, leading to few liquidity events, and limited price discoverability
- **Private Market:** These investments are subject to various operational cost incurred in valuing the assets, proceeding to their overall due diligence, and other processes incurred in the sale of a specific asset.
- **Real Estate:** High capital commitment requirements alongside with long holding
- **Bonds & Debt:** Low visibility and discoverability of participants

The standard processes involved in the limitation of liquidity within these markets, may for most become embeddable within smart contracts and their transparency/automation benefits:

- **Automate Diligences**
- **Automate information, Data transfers, and Asset Exchange**
- **Automate Regulatory & Legislative Enforcements**

DLT ecosystem unifies modalities of exchange under one end-to-end platform with visibility for all participants as opposed to traditional systems involving sets of intermediaries.



Societe Generale – FORGE

Jean-Marc Stenger  
CEO

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Data recorded on a blockchain is immutable and unfalsifiable. As such, it's a source of trust for everyone. This way, the different market operators interacting with financial securities can each execute their tasks asynchronously, without temporal dependence on the previous actor. This is a radical change. In classic market operations, everything is sequential – going through front offices, middle offices, back offices. This notably explains settlement delays. DLT offers completely different operating modalities which, ultimately, allow for an environment where we have much less, or even no reconciliation between parties. It may eliminate a large part of the settlement delivery risk, counterparty risk with a solution that is extremely fast and much cheaper than what we have today.

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At the infrastructure level, the multiplicity of DLT networks that operate independently may lead to other liquidity challenges. On the one hand, there is the possibility of multiple DLT networks operating independently, with siloed developments. On the other hand, there is the possibility of a monopolistic network that leads the market, with a concentration of control. Therefore, interoperability is a core subject to consider and develop – within protocols (i.e., Ethereum Virtual Machines (EVMs)), and among protocols (i.e., bridges).

### Bringing stability in the markets: The role of Stablecoins & CBDCs (Retail & Wholesale)

As mentioned, the quantity of protocols and DLT networks has become extensive, offering a great flexibility for operators to enter the space. From an investor perspective, it also offers diversified investment opportunities with short-term potential benefits (i.e., for trading), with new projects flourishing each year. Nevertheless, stability remains key for market efficiency – in respect to the long-term financing roles of capital markets.



Banque de France is the French Central Bank, and its main charge is to ensure the financial stability by regulating payment and securities settlement systems and supervising credit institutions and investment firms.



Banque de France

Frédéric Faure  
Head of Blockchain



The challenge with the interbank CBDC (Central Bank Digital Currency) is precisely to offer a tokenized settlement asset that can be used in the delivery versus payment settlement process, because there is a feeling that it can bring speed and security to transactions.

To settle a transaction today from front-to-back, it takes several days. We are convinced that the tokenization of securities and the tokenization of central bank money can greatly accelerate these processes and ensure transactions that are in real-time or near real-time. Additionally, it can bring security through atomicity of transactions. Cash and securities will be exchanged instantaneously and irrevocably between the two investors as soon as the transaction conditions are met. And so more security because it reduces what is called counterparty risk in this way.

So, this is really a strong focus for us, on the central bank side, with our work as part of the pilot regime, to provide a tokenized settlement asset that can improve delivery versus payment in terms of speed and security.



In emerging markets especially, development is driven by stability, with the need for currencies/assets that answer to the three following pillars.

- **Provide a Pivotal Value** to trade with digital assets in the DeFi ecosystem, bypassing the volatility of crypto assets through stablecoins/CBDC.
- **Serve as payment mean** for tokenized assets: bridging TradFi & DeFi
- **Act as settlement asset** in the scope of Pilote Regime (longer term perspective)

In DLT networks, answers to this challenge have mainly been emerging through three formats, each playing a role for specific use cases – but all centered around the utility of bringing stability to the market.

- **Centralized and Private:** USDT/USDC
- **Centralized and Public:** Digital Euro
- **Decentralized:** USDD

Their existence is crucial for the overall growth of the ecosystem, giving birth to multiple benefits in the market. Bringing (stable) cash on-chain should help to bolster developments, as it will inevitably have to flow within the market – notably with long-term investment perspectives helping to add depth & assurance in the ecosystem, both participating in incentivizing traditional stakeholders to take part of it.

Initiatives have begun to be implemented both by public and private actors. The topic has become one key priority for current experimentations, notably in Europe with the current workings on rCBDC (retail CBDC) and wCBDC (wholesale CBDC).

Developing further on cross-border trading and settlement, interoperability between the domestic markets is crucial, and has gradually been improved through technological innovation that allowed to align stakeholders on commonly used norms:

- International Securities Identification Number (ISIN)
- Bank Identification Codes (BIC)
- Straight Through Processing (SWIFT)

In summary, the secondary market is at a crossroads, facing both challenges and opportunities. The adoption of blockchain technology promises increased transparency, real-time settlement, and global accessibility. However, it also presents regulatory complexities that must be navigated. The key to a thriving secondary market lies in modernizing infrastructure, reducing inefficiencies, and fostering a safe and efficient trading environment that benefits all market participants.

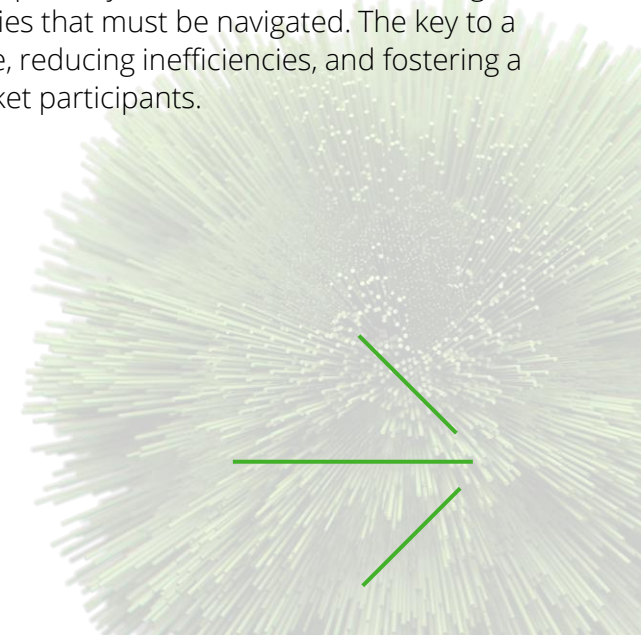


Figure 18

### Spot BTC ETF vs. Futures BTC ETF

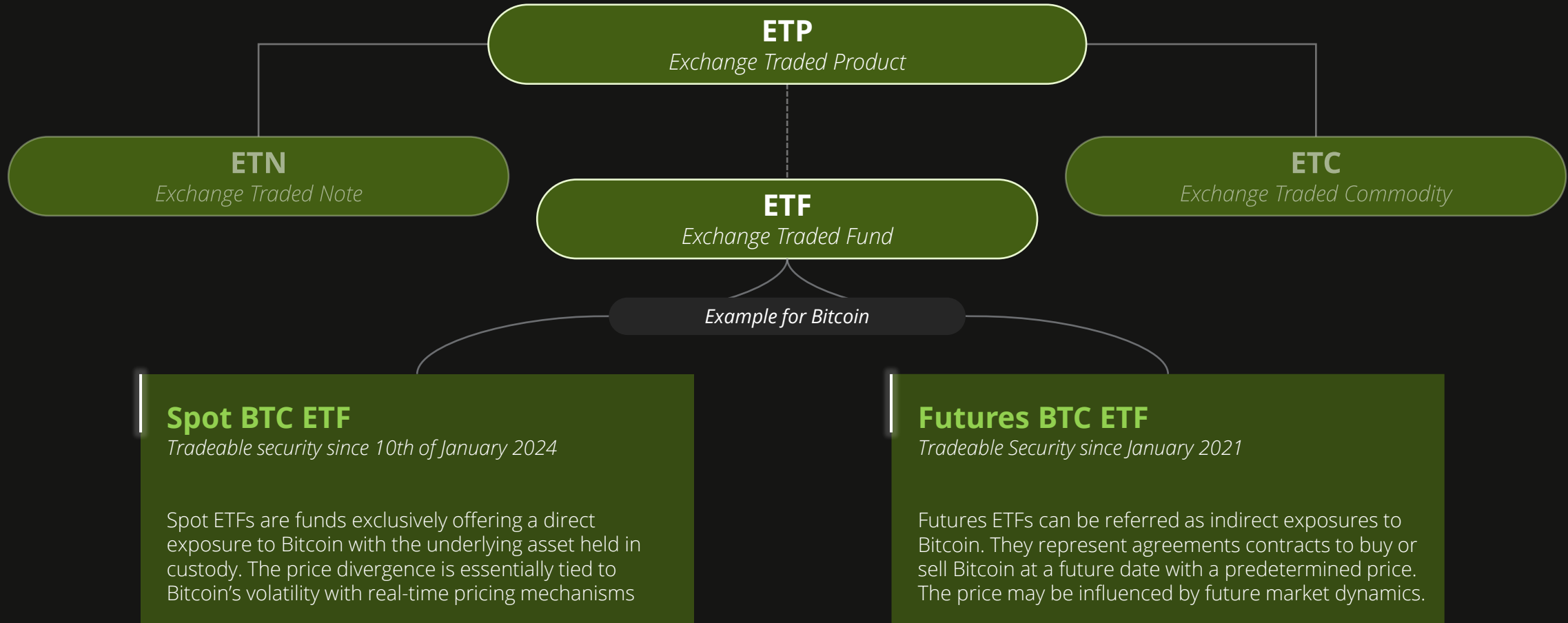




Figure 19

### Top-10 ETF Bitcoin Tickers by AUM

As of 05/14/2024

**ETF Bitcoin Tracker**

Total Marketcap: **\$74.23B**

Ticker	Issuer	ETF Name	Type	AUM	Custodian
GBTC	Grayscale	Grayscale Bitcoin Trust	Spot	\$24.33B	Coinbase
IBIT	BlackRock	iShares Bitcoin Trust	Spot	\$17.24B	Coinbase
FBTC	Fidelity	Wise Origin Bitcoin Trust by Fidelity	Spot	\$9.90B	Self-Custody
ARKB	Ark/21 Shares	Ark/21 Shares Bitcoin Trust	Spot	\$2.85B	Coinbase
BITB	Bitwise	Bitwise Bitcoin ETP	Spot	\$2.16B	Coinbase
BITO	ProShares	ProShares Bitcoin Strategy ETF	Futures	\$598.78M	-
HODL	VanEck	VanEck Bitcoin Trust	Spot	\$529.70M	Gemini
BRRR	Valkyrie	Valkyrie Bitcoin Fund	Spot	\$501.80M	Coinbase
BTCO	Invesco/Galaxy	Invesco Galaxy Bitcoin ETF	Spot	\$383.40M	Coinbase
EZBC	Franklin Templeton	Franklin Bitcoin ETF	Spot	\$312.00M	Coinbase

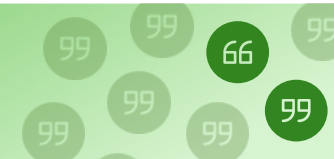


Market Infrastructure



Market Experimentation

BANQUE DE FRANCE



## Exploring DL3S: Banque de France's DLT Initiative

The Banque de France has significantly advanced its exploration of distributed ledger technology (DLT) through the development of its proprietary platform, DL3S (Distributed Ledger for Securities Settlement System), in partnership with IBM France. DL3S, built on Hyperledger Fabric, has been selected as the DLT solution for the Banque de France's participation in the European Pilot Regime, and it will play a key role in the Eurosystem's investigations into settling wholesale financial transactions using central bank money.

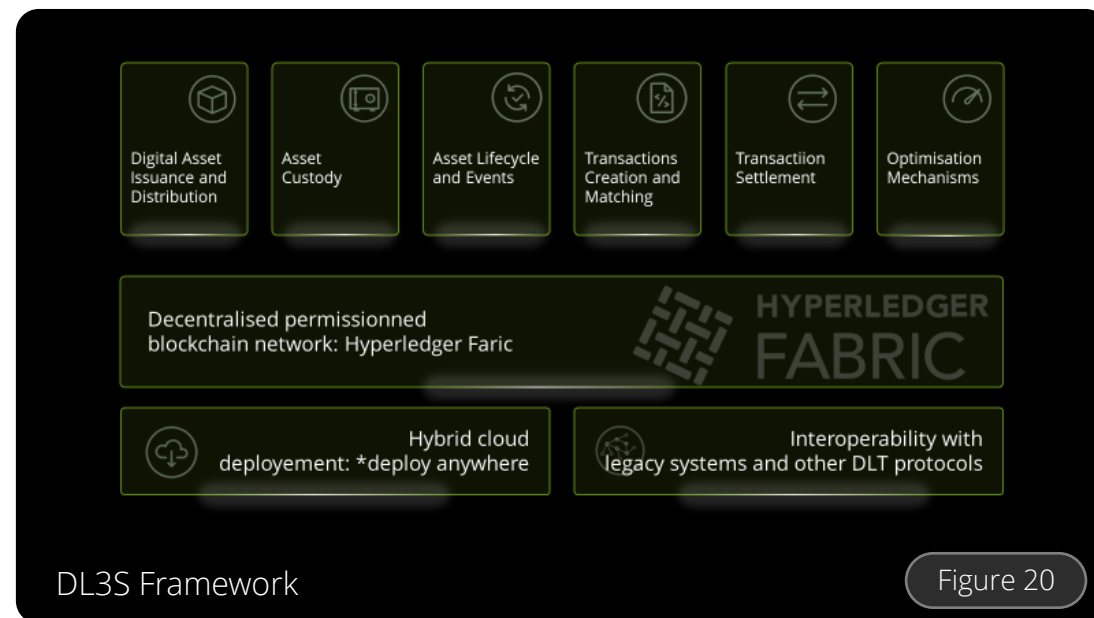
### Key features

DL3S has an array of capabilities, including digital asset issuance, custody, lifecycle management, and event handling. The platform also facilitates transaction creation, settlement and optimization, as well as seamless interconnectivity with other DLTs and TARGET services through various mechanisms, including notary schemes and Hash Time Lock Contracts (HTLC).

Confidentiality and privacy management are at the forefront of DL3S's design. Through the implementation of access control, local collections, identity mixer, confidential tokens, and a settlement engine, the platform ensures financial confidentiality, data privacy, anonymity, and transaction execution privacy.

As performance is a critical aspect of any DLT platform, DL3S delivers by ensuring the settlement of transactions within a two-minute timeframe. The platform has been rigorously tested and can support several thousand transactions per second.

DL3S accommodates various participants and roles, including cash custodians (T2 RTGS participants) who manage cash operations for themselves and third parties,



cash custodian clients with read-only access, and central banks forming a consortium responsible for issuing, distributing, and redeeming wCBDC, as well as supervising DLT activity.

The DL3S project at Banque de France represents a significant step forward in exploring the potential of DLT in the capital markets. By leveraging the benefits of DLT for securities settlement, the project aims to enhance efficiency, reduce risks and promote interoperability. While challenges remain, the insights gained from the DL3S project could contribute to the broader adoption and development of DLT in the financial sector.



# Deep Dive 3

Decentralized Finance (DeFi) | Transforming Financial Ecosystems



Accessibility & Interoperability



Stablecoins & CBDC



Decentralized Transactions



## DeFi

DeFi protocols built on DLT networks enable secure and transparent financial transactions, fostering innovation – in areas such as lending, borrowing, trading – while challenging the centralized models of traditional finance.



### Decentralized Transactions

---

€87B+

Total Value Locked on  
Decentralized Protocol  
*DefiLlama*

31M+

Monthly transactions on  
Ethereum network  
*The Block*

### Stablecoin

---

€138B+

Market capitalisation  
*DefiLlama*

0.14%

EUR's market share

### Accessibility & Interoperability

---

24/7

Decentralized protocols available

€4B+

Funds via bridges in march 2024  
*Messari*

## The principle of disintermediation

*Considerations & Opportunities – From Dissociation of Banking activities to the centralization of Central Securities Depository (CSD) & Clearinghouse to the service provider by the Pilote Regime*

Prior to 1980 the finance sector was heavily regulated to protect both consumer and the economy more generally from the concentration of speculative investment and financial power. Most banking activity had to occur domestically; deposit-taking, insurance, and investment banking required different firms.

A progressive deregulation of commercial banks led to the expansion of bank holding companies, which operated simultaneously in all financial markets, and created a new consolidated financial services industry in which household and commercial banking, insurance, and investment services could all be provided by a single firm.

- **1985:** US Federal Reserve allows bank holding companies to own banks in multiple states
- **1994:** Riegle-Neal Interstate Banking and Branching Act allowed interstate banking.
- **1999:** Gramm-Leach-Bliley Act make it now legal for investment banks, commercial banks, and insurance companies to become affiliates through a common holding company.

In the early 2000s, a rise of institutional/retail investors (private & public) fed the development of financialization, the development of new financial instruments (such as mutual funds, hedge funds, structured products...), a lowered cost for financial engineering, democratization of 24/7 trading for certain asset classes – fostering liquidity & speed. As the size of assets (in real dollars) controlled by the banking sectors consistently increased, the total number of banking institutions experienced a sharp decline since the late 1980s. This eventually generated the systemic risk (i.e., densely concentrated network) associated with the financial collapse of the later 2000s. In this context, Bitcoin was born in 2008.



Banque de France

Frédéric Faure  
Head of Blockchain

66 Major financial institutions, such as the International Monetary Fund (IMF) and the Bank for International Settlements (BIS), are indeed exploring the concept of more global financial infrastructures. The IMF is discussing the potential benefits of a global network, while the BIS is considering the implementation of a unified ledger. These ideas are detailed in papers which explores these concepts in detail.

I align with this vision and believe that the establishment of a multi-currency global network could significantly enhance cross-border payments. However, it's important to note that a global network would also enable us to expand and improve our existing interbanking financial networks. This includes Real-Time Gross Settlement (RTGS) systems, delivery versus payment systems, instant and payment systems.

I believe that the tokenization of finance represents a profound and transformative phenomenon that will significantly reshape information systems within the banking ecosystem over the next decade.

Moreover, I think the advancements in tokenized finance and the emergence of various forms of digital currencies, including Central Bank Digital Currencies (CBDC), Asset-Referenced Tokens (ART), Electronic Money Tokens (EMT), and stablecoins, should serve to enhance the interactions and use cases between Traditional Finance (TradFi), Centralized Finance (CeFi), and Decentralized Finance (DeFi).

Decentralized finance (DeFi) introduces a financial system built on DLT that aims to enable open, permissionless, and transparent access to financial services without relying on traditional intermediaries. The transition of capital markets involves the migration of traditional finance (TradFi) modalities towards DLT-based infrastructures for operators, custodians, asset managers, and distributors. At a high level, digital securities are natively issued on-chain. For existing assets, this involves a shift from book-entry mechanisms to smart contracts.

### The New market standards

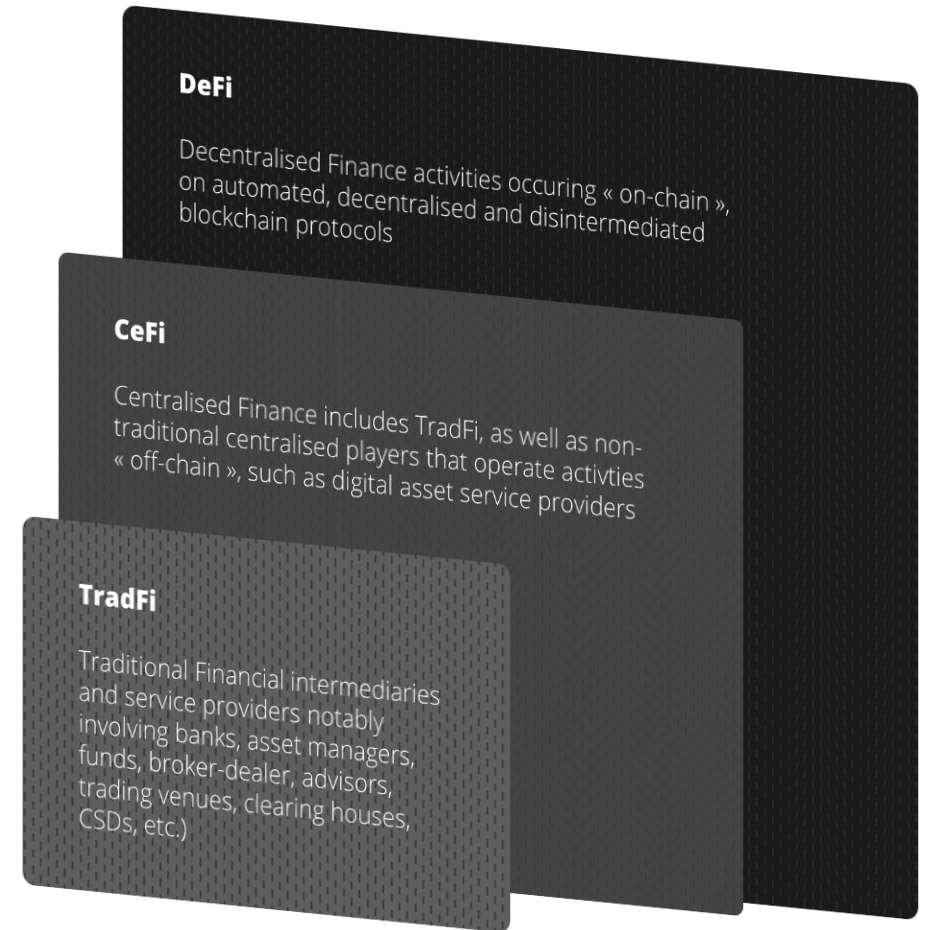
#### | Shifting role of central & commercial banks towards DLT

At the grassroots of the fundamental purpose of a commercial bank, its role is, under the aegis of a central bank, to manage its customers' savings and means of payment, as well as to create scriptural money and grant credit. In holding with their role, banks will need to adapt their structure to continue to meet the evolving needs of their customers.

The new modalities introduced by DLT networks are set to restructure standard front- and back-office banking operations. The current development of use cases is particularly relevant for wholesale banking activities, with incumbents grappling market shares with answers adapted to the market needs (e.g., Ledger, Fireblocks, Taurus...). Therefore, we are observing mutation from historical players with a growing participation to experimentations and the development of solutions adapted to their existing client base.

In France, against the backdrop of the growing impact of DLT on capital markets, Forge has been built within Société Générale around three pillars, defined to provide end-to-end support to customers and prepare the Group - and its various businesses - for this new asset class:

- **Pillar 1: the Primary Market** – the ability to structure and emit digital assets by its own.
- **Pillar 2: the Secondary Market** – once the asset is created, allow clients to buy/sell these assets, creating liquidity in the market.
- **Pillar 3: the Custody** – or the fact of securitize the asset on clients' behalf (CASP)



### Adoption Path & Considerations for End-Users

Challenges related to DLT underpinned by our report include the current lack of appropriability of the technology for current players in various sub-market activities – shift from book-entry to smart-contract for ownership tracking, blockchain-based registrars, etc.

Moreover, the identification of accessible use cases tailored for the current regulatory landscape requires an active public-private collaboration and targeted financial commitments. We understand that the adoption path of the technology for market participants is iterative, gradually fix the existing challenges to deploy solutions fit to the market with capabilities that outperform traditional infrastructures. The three following pillars may exemplify the transitory phase necessary to drive the growth of the DeFi ecosystem.

#### COINHOUSE

Founded in 2014, Coinhouse is the historic French platform, offering individuals and businesses the best experience for buying, selling, safekeeping and making payments in cryptoassets. Coinhouse combines a trusted framework with ease of use and different levels of service

## Setting the Path Towards Adoption

### 01 Use Cases

DLT is not a panacea approach to all subsectors of the financial markets. Among them, many function well, with costs of replacements outweighing the opportunities potentially brought by the reshaping of current systems & frameworks in place. Rather, emerging use cases benefiting operators while interfacing with legacy system remains crucial.

### 02 The Network Effect

Interesting Use Cases build a user base willing to enter the network. Knowledge enables these use cases to be built. In turn, liquidity enables the growth of these use cases at scale and allowing for a structural consolidation of the market. Liquidity is itself enhanced by refuge values such as Stablecoins & CBDCs). As mentioned in *Deep Dive 2 – DLT in the Secondary Market*, the advents of Stablecoins and CBDCs will bolster the future key development of DLT in the financial markets - making the asset investable

### 03 Time

Once use cases have been identified, and a network effect has begun, there remains the need for actors to appropriate themselves with the technology and rails enabling a wider appropriability along with the traditional finance ecosystem.



Coinhouse

Nicolas Louvet  
CEO



We understand catalyzers to be the following. (1) Make the asset investable - with institutions and traditional players being surrounded by regulation, rules, and clear definitions. (2) Concrete projects that justify the price of an asset (RWA) - a healthier monetary system. The vision of the future is focused on automating flows, and a more transparent, reliable, and automated system that would benefit the financial industry. See the example of cross-border transfers which should eventually allow the exchange of assets in just a few minutes.



## Functional & Financial Risks & Considerations

The rapid development of the DeFi ecosystem imposes risks and considerations at various levels – i.e., for digital assets and the DLT infrastructure. Again, public/private partnerships remain crucial to ensure a correct understanding of the technology to lead the orchestration of the market.

### Major Risk Typologies for DeFi Applications

The inherent capabilities of DLT networks and their underlying DeFi applications may underpin risks, and considerations to apprehend.

#### Volatility Risk

Certain crypto assets may be highly volatile, leading to rapid and significant price variations.

#### Counterparty Risk

While DLT seeks to reduce or eliminate counterparty risk, digital assets remain exposed through interlinkages with traditional systems

#### Liquidity Risk

The fragmentation of liquidity remains a key challenge for the DeFi ecosystem with siloed developments leading to lesser interoperable networks

#### Supplier Risk

Risks stemming from outsourced operations to external providers should be considered and accounted for

#### Operational Risk

The development of DLT-based projects involve the coordination of teams and legacy systems. Errors may arise due to these complexities

#### Technological & IT Risk

Beyond traditional IT risks that should be accounted for, there are considerations around smart-contracts, key management, governance, or interoperability

Digital Assets

DLT Infrastructure



## Defragmenting & Interoperating Markets (EVM & CCIP)

### Interoperability within networks: The Case of EVMs

Blockchain is made up of a multitude of distinct networks, each designed with unique specifications and capabilities. Some networks, such as Bitcoin, are optimized primarily for digital value transfer. In contrast, other blockchains, such as Ethereum and EVM-accounting blockchains, offer more extensive flexibility, making it easier to deploy and run decentralized applications (dApps).

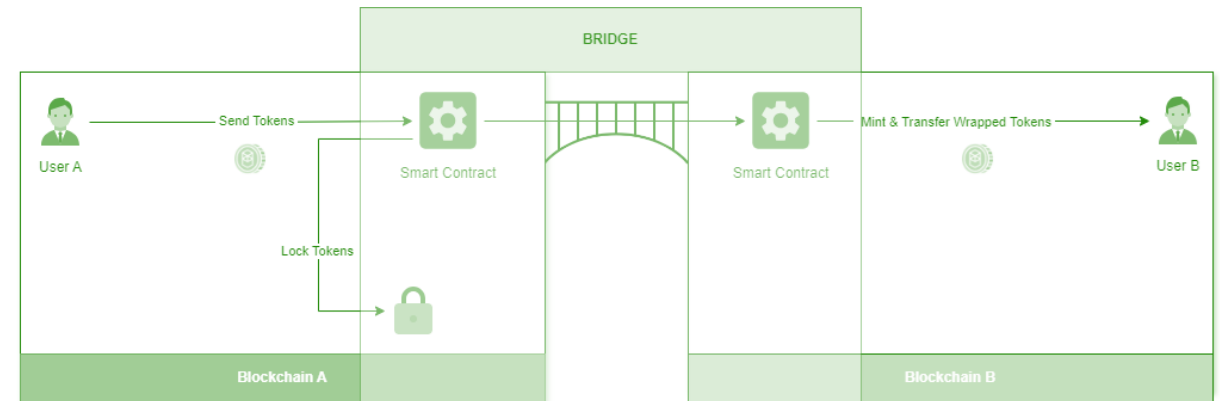
Each blockchain is governed by a separate technical framework, consisting of precise protocols and rules that regulate transaction processing and data management. This heterogeneity of standards can create technical challenges in terms of interoperability, complicating information exchange and inter-chain communication.

Ethereum, dominates the market for the development and adoption of decentralized applications, thanks to its key infrastructure, the *Ethereum Virtual Machine* (EVM). The EVM, acting as a decentralized supercomputer, enables the execution of complex *smart contracts*. A crucial feature of this system is its interoperability with other EVM-based blockchains. This communication between EVM-based blockchains is mainly done through *bridges*, which are mechanisms for the secure transfer of information and value, thus facilitating the transfer of information and value across various EVM-enabled blockchain networks.

Bridges act as intermediaries between different blockchains, facilitating the movement of assets, data, or even users between them. They achieve this through diverse techniques, primarily smart contracts, and cryptographic mechanisms. Smart contracts are deployed on both sides of the bridge, enabling trustless interaction between networks. Bridges can bridge various types of data and assets, including cryptocurrencies, stablecoins and NFTs.

### The Functioning of Bridges

Figure 21



### Defragmenting & Interoperating Markets (EVM & CCIP)

#### Interoperability among networks: The Case of CCIP

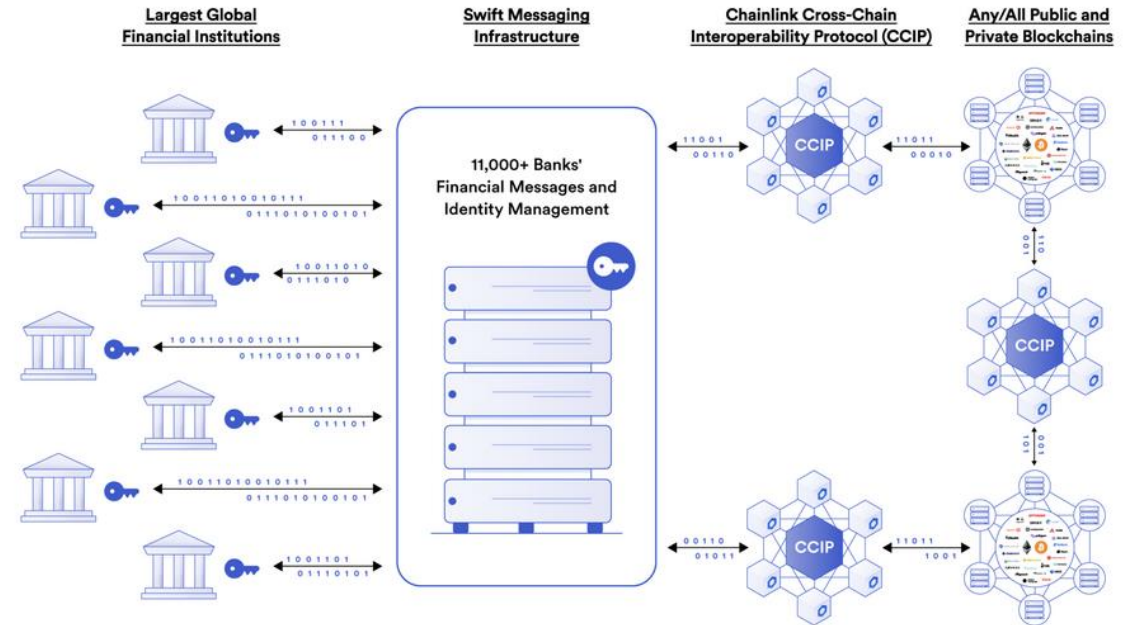
Chainlink's Cross-Chain Interoperability Protocol (CCIP) is a major innovation that has the potential to transform interoperability on the blockchain. It makes it easy for users to access DeFi applications and interact with other DeFi applications across different blockchains through a single interface, enabling a smooth flow of assets and financial services on-chain.

Cross-chain bridges have experienced major security breaches that have resulted in considerable financial losses. For example, in 2021, the Poly Network Bridge suffered a hack resulting in the theft of over \$600 million in cryptocurrency. Similarly, Axie Infinity's Ronin Bridge was hacked for around \$625 million in 2022. These incidents underscore the critical importance of robust solutions like CCIP to ensure security and reliability in the field of blockchain interoperability.

In the capital markets space, Chainlink's CCIP facilitates the overcoming of connectivity and interoperability challenges between different blockchains, making universal and seamless connectivity possible. This protocol drives the tokenization and migration of assets to the blockchain, with the support of major financial institutions and infrastructure providers such as DTCC and Swift. Recently, a notable experiment was conducted by Chainlink in collaboration with BNP Paribas and Swift, exploring the integration of traditional financial systems with blockchain technology, marking a significant step towards modernizing and increasing the efficiency of capital markets operations.

#### The Cross-Chain Interoperability Protocol (CCIP) by Chainlink

Figure 22



### \*Universal\* Collateralization of Securities/Real Assets/Private Assets/etc.

Collateralization refers to the action of providing assets as collateral to secure loans or to participate in a financial operation within a blockchain network. Unlike traditional finance, where banks often ask for physical assets or extensive paperwork as collateral, DeFi may use smart contracts and cryptographic methods to make sure collateralized transactions happen in time and are enforced.

It is crucial to highlight the difference between traditional and DLT-based collateral to understand the structural change it implies. Traditional collaterals usually involve tangible assets like real estate or valuable possessions that borrowers offer as security to lenders. This process, deeply ingrained in financial systems, often includes complex legal steps and intermediaries to handle and confirm the collateral.

On the other side, collateralization in DeFi adapts the process in a fully digital ecosystem. DLTs' inherent capabilities of openness and transparency play a big role in ensuring that collateralized transactions are trustworthy, while limiting the involvement of plural counterparties.

- **Transparency** of collateral ownership across the lifecycle of asset transfers
- Automated **reconciliation** reduces manual processing.
- Enhanced **collateral mobility** eliminates the need for market moves thereby reducing cost and settlement timelines.
- **Real-time transfer** of collateral ownerships
- Ability to use **tokenized collateral** within other applications in the DLT ecosystem.

This structure can benefit various stakeholders including the following:

- **Portfolio managers** – Continue to earn returns on assets while using as collateral for new investments.
- **Credit & Collateral Risk Managers** – Utilize financial assets as collateral while eliminating operational burdens and risk settlement failures.
- **Product Managers** – Leverage DLT platforms for unified operations, bridging traditional finance, its legacy infrastructure, and DeFi on the other side.

## DEXs, Liquidity Provisions (AMM), & Liquidity Pools

Previously, activities like market-making, insurance underwriting, and the development of structured products were predominantly within the reach of institutions possessing the necessary amount of capital and expertise. However, **the advent of DeFi (Decentralized Finance) has considerably lowered these entry barriers**, democratizing access to these activities for a wider audience. DeFi indeed covers TradFi services such as Lending and Borrowing, but extends beyond with new products including Yield Farming, Liquidity Mining, with new ways of connecting investors and sellers (e.g., Decentralized Exchanges (DEX)).

### | Decentralized Exchanges (DEXs)

A *decentralized exchange* (DEX) is a platform that facilitates trading and swapping tokens in a straightforward manner, without the need for an intermediary. Unlike a *centralized exchange* (CEX), where custody is managed through the intermediary, in a DEX, custody remains in the hands of users, enhancing security and sovereignty over their assets. A DEX is a *decentralized application* (dApp), with rules embedded in a smart contract, ensuring increased transparency and autonomy. There are two types of DEXs:

#### The Order-Book-Based DEX



An order book is a system that records offers to buy and sell assets at different prices. Platforms like DyDx or Loopring, which are examples of DEXs using order books, operate in a similar way to CEXs by allowing traders to set their buy and sell orders at predefined prices or according to market prices. The major distinction lies in asset management: on a CEX, assets are deposited into the exchange's wallets, while in a DEX, they remain in users' personal wallets. In terms of infrastructure, DEX order books can be integrated directly on the blockchain or run off-chain.

Off-chain DEXs work by storing trading orders in an off-chain database. This helps reduce transaction latency, as exchanges don't have to be recorded on the blockchain every time. However, this also means that off-chain DEXs are not fully decentralized, as they depend on a centralized authority to manage the order database.

#### The Liquidity Pool-Based DEX



Liquidity pools are smart contracts that store tokens. Users can deposit tokens into a pool to provide liquidity to the DEX and receive rewards in return in the form of transaction fees. Liquidity pools allow users to trade tokens easily and without having to go through a centralized intermediary. They are also responsible for determining the prices of tokens on the DEX.

Most decentralized exchanges (DEXs) that operate with liquidity pools use so-called Automated Market Makers (AMMs). These AMMs are mathematical algorithms designed to automatically set asset prices.

## | Automated Market Makers (AMMS)

Unlike centralized exchanges, which have bids to buy and sell placed on order books, **AMMs rely on liquidity pools**, which are essentially reserves of two or more tokens that reside on a DEX's smart contract and are available for immediate trading.

Let's take a real-world example: if a user wants to exchange ETH for USDC, they interact with the ETH/USDC liquidity pool. The transaction is done according to an algorithmic formula that determines the number of DAI received in exchange for the deposited ETH. This formula considers the reserve ratio of the two tokens in the pool to set the price.

People who provide tokens, called **Liquidity Providers (LPs)**, play a key role in this system. They deposit their tokens into liquidity pools, often respecting a specific proportion (e.g., 50% of each token). In exchange, they receive a share of the transaction fees generated by trading in the pool, which creates an economic incentive to maintain and increase liquidity on the DEX.

A major advantage of AMMs is that they allow for quick and direct order execution without requiring a centralized market maker to provide liquidity, unlike centralized exchanges like Binance or OKX . Transactions are managed by smart contracts that calculate prices algorithmically, taking into account potential slippage, *i.e. the price difference that can occur during a large transaction compared to the liquidity available in the pool.*

In summary, **AMMs offer a decentralized and automated trading model**, where rules and prices are dictated by algorithms rather than market participants, transforming the way digital assets are traded in the DeFi ecosystem.



## | The bricks for a successful DeFi Future

Beyond DeFi, many innovations such as Decentralized identity (DID) and zero-knowledge proof (ZKP) are two revolutionary concepts in the world of blockchain and distributed ledger technologies (DLT). They promise to bring an unprecedented degree of privacy, security, and efficiency to online financial transactions.

### Decentralized Identity

Decentralized identity is a digital identity system that is not controlled by a central authority. Instead, DIDs are created, managed, and verified through a decentralized network, often a blockchain. This means that users can prove their identity without having to reveal excessive personal information and without relying on centralized entities like banks or governments.

DIDs give users full control over their digital credentials, reducing the risk of identity theft and fraud. In financial transactions, this means that parties can engage with confidence, knowing that each party's identity has been verified without requiring full disclosure of identity information.

### Zero-Knowledge Proof

Zero-knowledge proof is a cryptographic method that allows one party to prove to another party that a statement is true, without revealing any other information other than the fact that the claim is true. In the context of blockchain, ZKPs can be used to confirm the validity of a transaction without revealing the details of that transaction to miners or even the public.

The use of ZKPs in financial transactions on the blockchain increases privacy and security. For example, a financial transaction can be verified to comply with regulatory rules without the need to reveal the amounts or parties involved.



## Conclusion, Acknowledgements & Bibliography



## Concluding Remarks

Distributed Ledger technology (DLT) applications aim to gradually upend long-standing paradigms towards a new realm for capital markets. While proofs-of-concept and experimentations predominate in the market today, DLT's impact is likely to become profound across asset life cycles and market infrastructures – reshaping the roles of current operators, and integrating new incumbents that embody and fuel this shift.

Overall, challenges remain, but **innovation is accelerating and collaborative efforts can overcome these hurdles**. Developing institutional-grade security standards, ensuring a regulatory clarity that fosters innovation while ensuring stability, and technical certification (and standardization) processes will be crucial for instilling confidence. Interoperability between blockchains and with legacy infrastructures is pivotal for realizing network effects and seamless asset issuance and transfers.

**Ultimately, unlocking a full-scale DLT impact relies upon aligning stakeholders – both private and public –** behind common utility solutions and use cases delivering quantifiable value. Complex and multifaceted, DLT's evolution within capital markets is gradually materializing over multiple transitory cycles. Leading institutions begin recognize the imperative to embrace these transformative technologies in order to apprehend the risk of being disrupted.



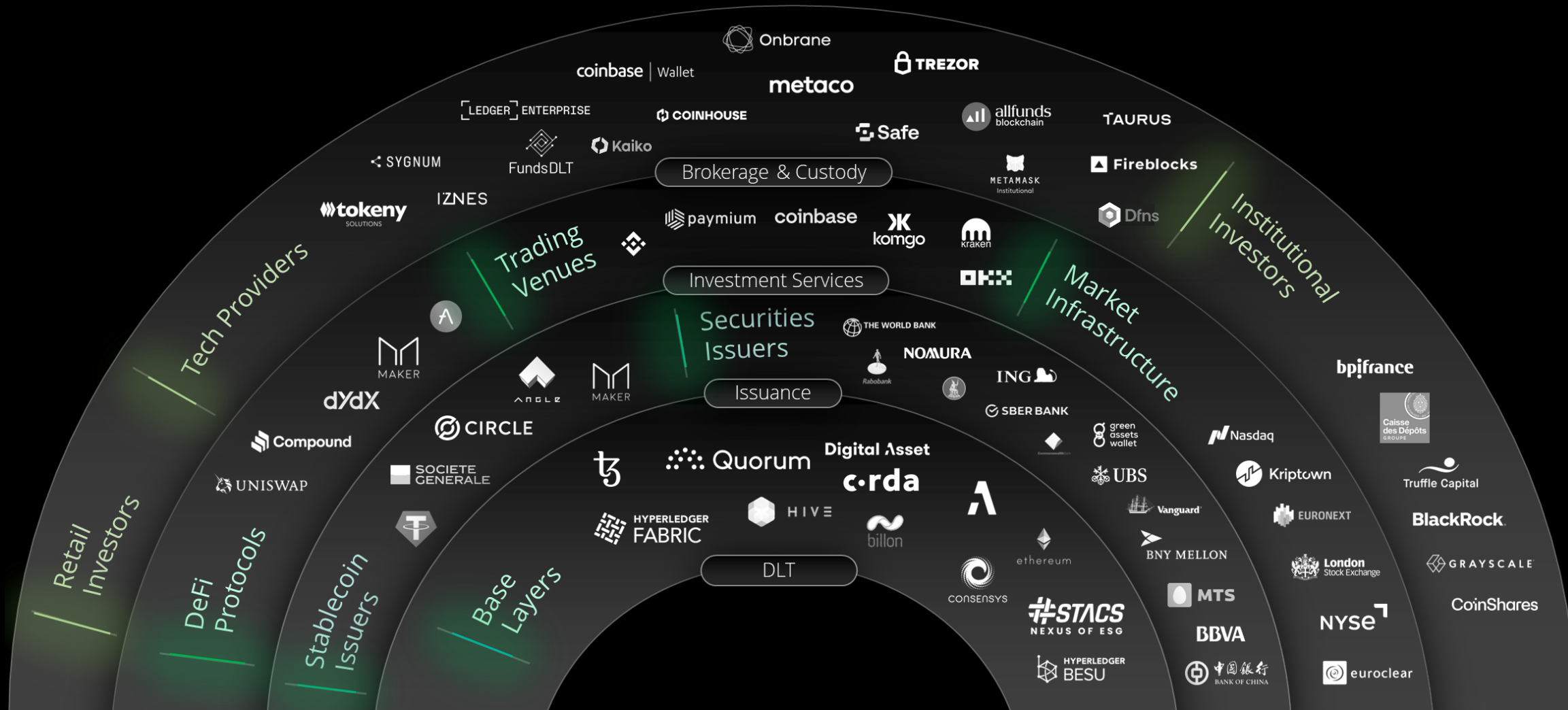


\* The figure should not be considered exhaustive

For Illustrative purposes

Figure 23

# The Capital Markets & DLT Ecosystem



# Acknowledgements

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