

# Tokenization

Digital Assets - Week 7 (Lecture)

Rhys Bidder

[rhys.m.bidder@kcl.ac.uk](mailto:rhys.m.bidder@kcl.ac.uk)

KBS, QCGBF

Autumn 2024

*Disclaimer 1:* Any opinions expressed, errors or omissions should be regarded as those of the author and not necessarily those of KCL, KBS, QCGBF, QCB, CBI, BoE, or Chainlink Labs.

*Disclaimer 2:* Any references to cryptography are heavily simplified and leave out many important details. For any real-world security applications these notes should not be relied upon. Instead you should consult appropriate security resources and reliable security professionals.

*Disclaimer 3:* Cryptoasset transactions are illegal in some jurisdictions. Do not violate these or any other laws. I am not promoting the use of crypto in countries where it is illegal in any form and these slides are not a promotion of crypto or an invitation to participate in crypto-related activities in such countries. They are purely for educational purposes.

*Disclaimer 4:* I currently am an advisor to Chainlink Labs.

# Outline

Introduction

How does tokenization work?

Tokenization use cases

- Tokenized deposits

- Tokenized Treasuries, bonds, and MMFs

A growing private sector ecosystem

# Introduction

# Introduction

- ▶ We have discussed how a smart contract can be used to create a token (in fact, you have done so in exercises/assessment)
- ▶ An important class of tokenization applications are those that represent an underlying 'real world asset' (RWA)
- ▶ Tokenization of on chain assets (e.g. representing/wrapping assets from other chains) is another important application, but we will focus on RWA tokenization
- ▶ There are few hotter topics in crypto/web3 right now than RWA tokenization - partly because it is seeing support from tradfi players and even regulators



# Introduction

- ▶ In theory, tokenization allows all of the power of blockchain to be applied to assets that, until now, have relied upon traditional forms of trading and record keeping
- ▶ Provided a legal framework is established to clarify the nature of ownership (if I own the token then I own the underlying asset) then smart contracts, self-custody, composability, unified record keeping are all benefits that can be obtained
- ▶ Operationally, there must be reliable data flows (oracles are prominent) ensuring the existence of the RWAs and that actions on chain have corresponding results off chain (and *vice versa*)

*The tokenization of asset classes offers the prospect of driving efficiencies in capital markets, shortening value chains, and improving cost and access for investors. At BlackRock we continue to explore the digital assets ecosystem, especially areas most relevant to our clients such as permissioned blockchains and tokenization of stocks and bonds*

- [Larry Fink](#), CEO of Blackrock, 2024 Letter to Investors

# Introduction

- ▶ What are the aims (hopes?) of RWA tokenization?
  - **Efficiency:** elimination of reconciliation of multiple ledgers, greater automation/STP, reduction in processing steps
  - **Safety:** DvP/atomic settlement, automated compliance, interaction with digital (possibly decentralized) ID layers
  - **Cost reduction:** decentralization should enable lower spend on security, less collateralization due to quicker/atomic trades, efficient use of collateral, reduction in intermediaries' fees
  - **Transparency:** exposed source code of smart contracts, single visible record of truth, structured data aids audit
  - **Liquidity:** greater pool of investors, fractional ownership (e.g. [real estate](#)), [intraday repo](#), 24/7/365, unified international markets (remember wCBDC pilots)

## Global Market Overview

Welcome to RWA.xyz. Explore tokenized real-world assets and the investors, issuers, and service providers participating on public blockchains. [i]

Total RWA Onchain

**\$13.26B**

▲ +0.81% from 30d ago

Total Asset Holders

**65,987**

▲ +3.58% from 30d ago

Total Asset Issuers

**114**

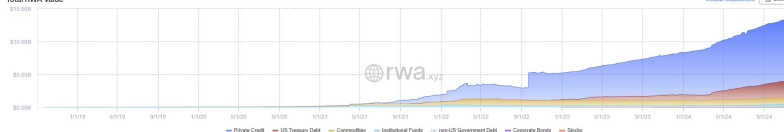
Total Stablecoin Value

**\$184.02B**

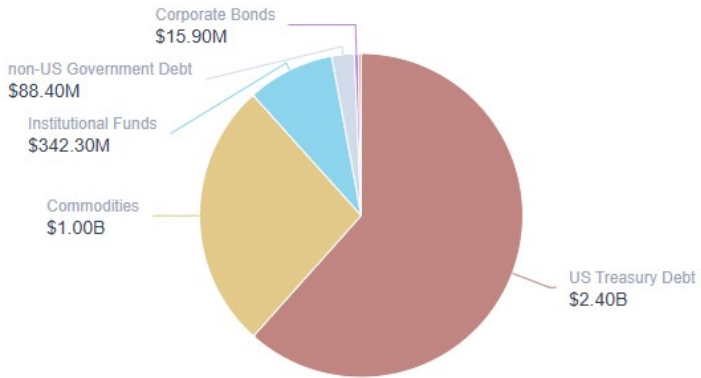
▲ +104% from 30d ago

Total RWA Value

Include Stablecoins [Download](#)



RWA tokenization activity is growing Source: [rwa.xyz](https://rwa.xyz), Nov 20, 2024



Current dominance of tokenized Treasuries. *Source:* [rwa.xyz](https://rwa.xyz), Nov 20, 2024

View Original STI Measures, BORD, and Cash-Equivalents and understand the nuances between them. Read our deep-dive research report on related measures on the [S&P 500 Research Blog](#).

\$2.42B

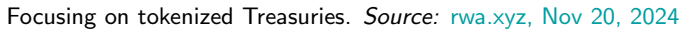
▲ +1.38% from 3d ago

4.49%

35

8,705

▲ +0.05% from 7th report

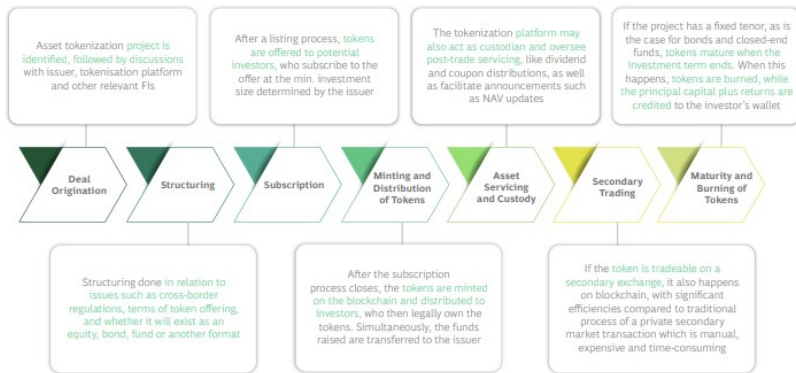


How does tokenization work?

# How does tokenization work?

- ▶ *Pick a RWA*
  - Perhaps a Treasury or fund of Treasuries, or a house/portfolio of houses
- ▶ *Decide on blockchain(s)*
  - Depending on scalability/security/centralization requirements or smart contract capability/developer ecosystem, this might be a L1, a rollup/L2, or possibly multiple
- ▶ *Decide on token type/smart contract*
  - Fungible ERC20, or non-fungible ERC721, or designed for regulated exchanges ERC3643. . .
  - How is it minted, who can mint it, how many tokens are minted. . .
- ▶ *Ensure reliable interface between on and off chain*
  - Secure and reliable oracle service (to relay transactions, collateral info, prices. . .), legal protections, clear definition of ownership (especially in bankruptcy), custody arrangements
- ▶ *Securely mint the token*
  - Smart contract deployment and/or mint function creates token

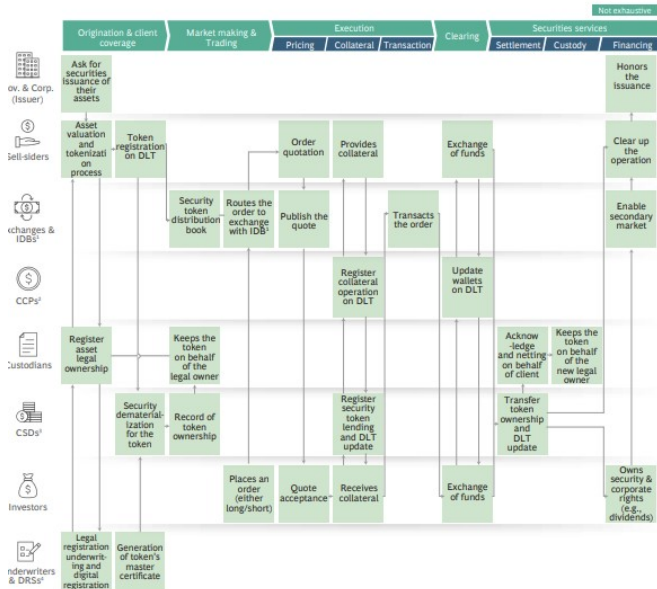




Tokenization steps. Source: BCG, 2022

# How does tokenization work?

- ▶ Beyond the basics of issuance, some tokenized assets (e.g. bonds) may have the security lifecycle administered by smart contracts / on chain transactions
- ▶ For example, distributions (dividends, coupons)
- ▶ Even ostensibly simple assets involve complex lifecycles, but the scope to operate using smart contracts allows automation and STP, avoiding error prone manual and disparate (multiple parties working separately and then reconciling) processing



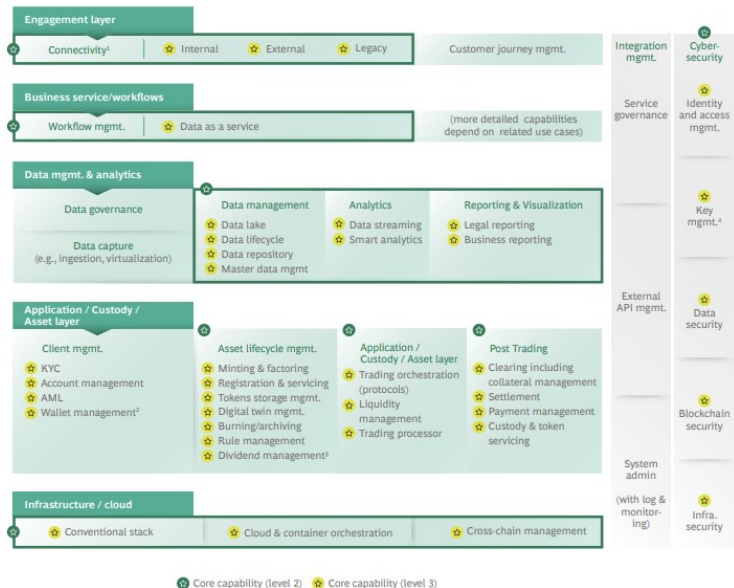
Tokenization lifecycle and roles of stakeholders. Source: BCG, 2022

# How does tokenization work?

Some **simple** examples can be found online:

- ▶ Nice discussion [here](#) of how to tokenize Apple stock
- ▶ Paxos Gold (PAXG) [example](#) (Pausable ERC20 token with Burn and Mint controlled by a central 'SupplyController')
- ▶ Chainlink Real Estate tokenization [example](#) (elaborate ERC721 token)
- ▶ Example to tokenize [street art](#)

But this stuff is not **simple** in reality. . .



Tokenization tech stack. *Source:* BCG, 2022

## Tokenization use cases

# Tokenization use cases

- ▶ Tokenized deposits
- ▶ Tokenized Treasuries, bonds, and MMFs

# Tokenized deposits

- ▶ We have discussed CBDC and stablecoins as providing digital cash on chain
- ▶ CBDC is controversial (though less so for wholesale) and stablecoins are immature and treated as suspicious by regulators
- ▶ We already have a form of digital money, which underpins a large fraction of transactions: bank deposits
- ▶ But bank deposits do not operate on the blockchain
- ▶ *Solution:* Tokenize the bank deposits



# Tokenized deposits

- ▶ Unlike stablecoins, tokenized deposits are not 'bearer instruments' (see [here](#) and [here](#))
- ▶ For bearer instruments, 'possession is ownership' and trading instantaneously implies settlement of the transfer of ownership, without reference to any other parties (such as banks or the central bank)
- ▶ Bearer instruments such as stablecoins may (as we discussed) trade away from par (break their peg)

# Tokenized deposits

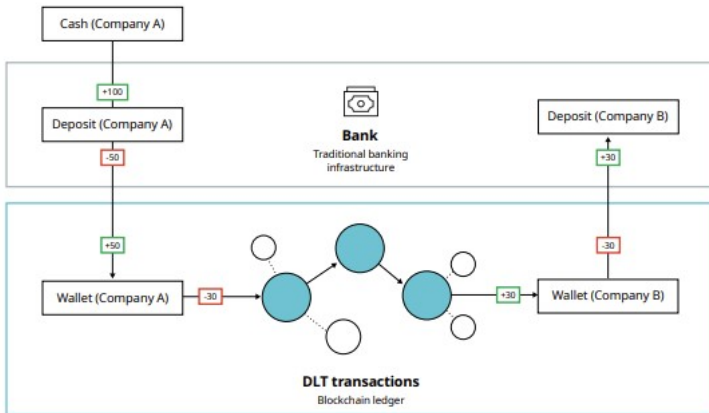
- ▶ Some people believe that a money asset's deviation from par represent an unacceptable failure of the 'singleness of money' (*Disclaimer: I do not agree*)
- ▶ They argue (correctly) that our traditional two tier monetary system (T1: Central bank reserves, T2: Commercial bank money) maintains singleness/fungibility of money
  - All our transactions with bank deposits are ultimately connected to interbank settlement on the central bank's balance sheet (reserve accounts being credited and debited)
  - Either settlement happens at par (\$1 of reserves for \$1 of the underlying transactions) or it doesn't settle at all
- ▶ This underlying settlement structure will be preserved with tokenized deposits (regardless of whether the reserves system is replaced with wCBDC, which it might)
- ▶ Transactions on the blockchain will involve representations of underlying deposits, and ultimate settlement will continue to occur through the central bank

*In one model, which resembles current asset-backed stablecoins, private tokenised money circulates as a digital bearer instrument. Such a model may not be compatible with singleness for reasons to be outlined below.*

*The second model – that of “tokenised deposits” – does not involve a direct transfer of claims. The model of tokenised deposits envisages participants to be customers of regulated financial institutions (such as banks), and transfers are recorded at the individual bank level and settled automatically using tokenised central bank money (ie CBDC). Under this model of non-transferable liabilities, a person or firm knows that when they accept a payment from the customer of any bank, the payment will be credited to their own account at face value.*

*Settlement using central bank money is the key feature that promotes singleness*

- Stablecoins versus tokenised deposits, [BIS, 2023](#)



Deposit tokens process. *Source:* [Oliver Wyman/JP Morgan, 2022](#)

# Tokenized deposits

- ▶ Essentially, tokenized deposits are... deposits
- ▶ But they allow commercial bank money to take advantage of the benefits of blockchain
- ▶ There is an active debate over which is 'better' (and it may depend on use case) out of CBDC (retail or wholesale), stablecoins, tokenized deposits
- ▶ Regulators/central banks seem to like tokenized deposits - perhaps because, for all its faults, they are familiar with the legacy banking system, have regulatory oversight over banks, and stablecoins/crypto are still not 'mature' (and *some people argue* because they are captured/under the influence of the bank lobby!)

# Tokenized deposits

- ▶ *Disclaimer (personal opinion):* There are many problems with our existing banking system - very few of which arise from the absence of blockchain capability (competitive distortions, TBTF, too complex to fail, unfairly priced deposit insurance, run risks)
- ▶ So it is strange to me how protective some regulatory institutions are of banks' payments franchise, rather than encouraging - or at least entertaining - stablecoins (see my [BoE response](#))
- ▶ Having said that - stablecoins need to get their act together on custody, backing assets, audit, KYC, efficiency of redemption,...
- ▶ But in the long run, stablecoins seem pretty 'safe' - so the market should be allowed to decide on whether they serve a purpose, not a small number of regulators

# Tokenized deposits

- ▶ Tokenized deposits are not yet circulating widely - for transactions between depositors at different banks (though [Partior](#) in Singapore is a counterexample)
- ▶ However, some very prominent 'walled garden' tokenized deposit products have been developed and are in use
- ▶ Perhaps most prominent is JP Morgan's 'JPM Coin' on Onyx (recently renamed as [Kinexys](#))
- ▶ The system is for JPM clients, and thus settlement occurs across JPM's balance sheet (not the central bank's) - allows clients to make rapid payments to their international subsidiaries or to other JPM clients - and use smart contract functionality)
- ▶ Is embedded in JPM's broader tokenization/blockchain systems - e.g. for [intraday repo](#)

# Tokenized Treasuries, bonds, and MMFs

- ▶ As shown earlier, tokenization is growing, particularly in the area of tokenized Treasuries/sovereign debt
  - Key elements of international finance, commonly used as collateral - and (relatively) simple
  - Hence these being a natural early use case
- ▶ Ultimately, there are likely to be *natively* on-chain digital bonds (in fact some have **already been issued** and the UK government recently expressed an interest in '**digital gilts**') but for now, the dominant form of issuance will be off-chain



# Tokenized Treasuries, bonds, and MMFs

- ▶ Arguably the most prominent example of tokenized sovereigns is [BUIDL](#): Blackrock USD Institutional Digital Liquidity Fund
- ▶ It is deployed on several chains: [Ethereum](#), Aptos, Arbitrum, Avalanche, Optimism, and Polygon...
- ▶ Aimed at institutional investors
- ▶ A great example of the possible convergence between tradfi (Blackrock) and crypto ([Securitize](#) and [Coinbase](#))
- ▶ In fact, BUIDL doesn't exclusively invest in Treasuries (also cash like assets, repo...), so this is an example of a tokenized *fund*

A growing private sector ecosystem

# A growing private sector ecosystem

- ▶ We have already touched on some prominent private sector players (notably Blackrock)
- ▶ But most people think tokenization has only scratched the surface - and it is still a tiny fraction of tradfi's size
- ▶ Some people think that the market could be worth [\\$10tn by 2030](#) (some people toss out numbers like \$17tn)
- ▶ While others (see this [recent McKinsey note](#)) are more cautious
- ▶ There is intense competition to capture this value: new players are emerging and traditional players are beginning to take notice / partner with emerging firms

# Tokenizers

- ▶ Platforms and advisory companies are emerging to enable tokenization and the post-tokenization ecosystem
- ▶ We have already mentioned [securitize](#) - who have implemented Blackrock's [BUIDL](#)
- ▶ Another important player is [centrifuge](#) (they provided an app, [Tinlake](#), now replaced with the [Centrifuge app](#))

# Tokenizers: How tinlake/centrifuge worked

From [Gemini.com](https://gemini.com):

*Each time an asset originator bridges an RWA using Tinlake, they convert their assets into non-fungible tokens (NFTs) that are embedded with relevant legal documentation.*

*Unlike most NFTs on platforms like OpenSea and rarity.tools, Centrifuge's NFTs are tokenized representations of individual assets, such as an invoice or a mortgage, that can be used as collateral in Tinlake.*

*From there, these users can create an asset pool collateralized with their tokenized RWA NFTs and use it to issue two kinds of ERC-20 tokens: Drop tokens and Tin tokens.*

# HQLA<sup>x</sup>

- ▶ **HQLA<sup>x</sup>**: DLT solution for efficient collateral mobility
  - Aim is to create a unified pool of collateral, tracked with 'Digital Collateral Records'
  - On chain registry of tokenized assets allows mobilization without 'physically' (or using traditional methods) moving underlying between custodians, **CSDs**, **triparty agents**...
  - Speeds up important underpinnings of financial markets (**intraday repo** is a commonly cited use case)
  - HQLA<sup>x</sup> have received significant funding from tradfi backers

# Finality

- ▶ **Finality:** Solution to allow safe, efficient on-chain payments
  - Grew out of the 'Utility Settlement Coin' project
  - Some people might call it a reserves backed stablecoin or 'synthetic CBDC' (see analysis [here](#))
  - In UK it is now **operational**
  - Relies on an 'omnibus' account at **BoE**: pools reserves of multiple banks, allowing safe/rapid settlement among them
  - Also backed by (many) tradfi players

Fnality now boasts 20 major institutions as shareholders: Banco Santander, BNY Mellon, Barclays, BNP Paribas, CIBC, Commerzbank, DTCC, Euroclear, Goldman Sachs, ING, KBC Group, Lloyds Banking Group, Mizuho Financial Group, MUFG Bank, Nasdaq, Nomura, Sumitomo Mitsui Banking Corporation, State Street Corporation, UBS, and Wisdom Tree.

Some Fnality shareholders. *Source:* [Fnality](#)



# Finality and HQLA<sup>x</sup>

*Finality and HQLA<sup>x</sup> have completed the first successful end-to-end (E2E) testing of a cross-chain intraday repo settlement. The trade was submitted in Eurex Repo F7, collateral was earmarked on HQLA<sup>x</sup>, and cash was earmarked on the Sterling Finality Payment System TestNet.*

*Upon the trade conditions being fulfilled, both legs were atomically released, completing the settlement at a predetermined precise moment in time. The trade execution was fully automated and programmed via smart contracts and done on a STP basis after it was entered into Eurex Repo F7.*

*This testing follows on from Finality and HQLA<sup>x</sup> completing their first proof of concept (PoC) delivery versus payment (DvP) repo settlement in Q4 2022. The PoC was the first cross-chain repo swap pilot across R3's Corda platform and Enterprise Ethereum, setting the foundations for the rapid settlement of intraday transactions.*

- [Fnality press release](#), June 2024

# HSBC Orion

- ▶ We have already mentioned JP Morgan's [Kinexys](#)
- ▶ HSBC are also heavily involved in digital assets
- ▶ Especially influential in Asia - long tradition in the sort of businesses being disrupted by blockchain
- ▶ [HSBC Orion](#) is a platform to allow the issuance of natively digital bonds
- ▶ Importantly, they seem to have been working hand in hand with HKMA's '[Central Money Markets unit](#)' (their [CSD](#)) in issuing some benchmark bonds
- ▶ Allows rapid issuance (1 day rather than 5 day primary settlement), on-chain secondary market settlement and lifecycle events (coupons), and can connect to other CSDs (Euroclear and Clearstream)

# SDX

- ▶ [SIX Digital Exchange \(SDX\)](#) is a Swiss-based institution that is fully regulated as an exchange and CSD
- ▶ In Europe they have pioneered the issuance and trading of digital bonds, tokenized securities and other digital assets
- ▶ They have also been prominent in [Project Helvetia](#), the BIS/SNB's wholesale CBDC pilot
- ▶ Interestingly, as part of that pilot they issued their own stablecoin which (I think) they may still use on SDX...

# Euroclear, Clearstream and DTCC

- ▶ Enormously important CSDs (Euroclear, Clearstream and DTCC) are **working hard** to upgrade their systems to enable DLT adoption
- ▶ Tokenization will receive a huge boost if they get on board (though what about decentralization?)

# Finternet and government schemes

- ▶ Tokenization (and the ability to settle on unified ledger(s) with fiat on-chain) is a key element of the BIS's 'finternet' proposals
- ▶ BIS (apparently) seems to be thinking in terms of CBDC or tokenized deposits as the settlement asset (though I personally hope there will eventually be more openness to stables)
- ▶ Similar motivations underpin projects like Singapore's [Project Guardian](#) and HKMA's [e-HKD+](#) and [Project Ensemble](#)
- ▶ These are examples (and more are likely to follow) of private-public partnerships

Thanks for listening