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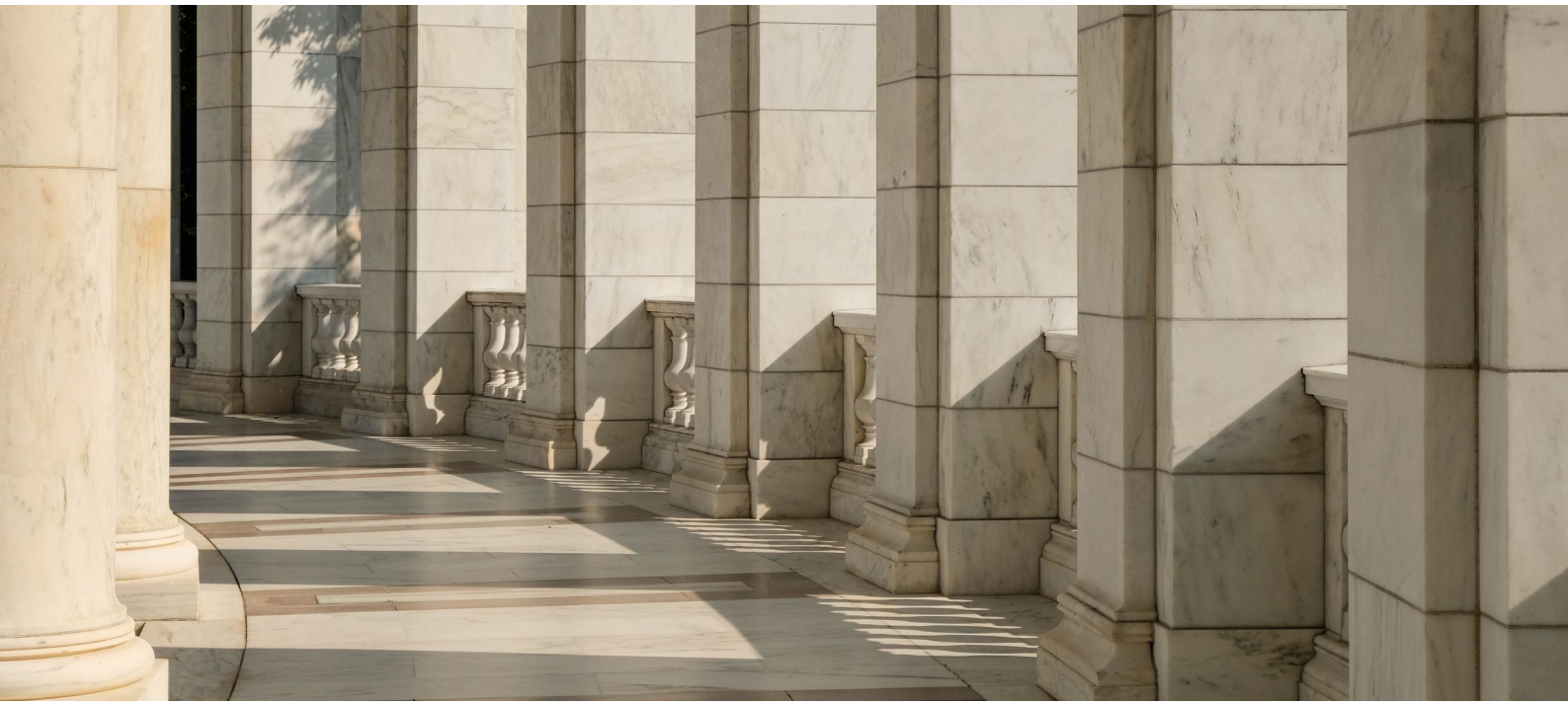


The Spectrum of Tokenization

A novel framework for understanding tokenized asset finance.

Written by Collin Erickson, Mac Naggar, and Jack Chong

In association with Tokenized Asset Coalition

Fall 2023

Executive Summary

The Spectrum of Tokenization offers a novel and comprehensive framework for understanding tokenized asset finance.

Until this point, assets have been characterized in a binary fashion, as either tokenized or not tokenized. However, as tokenized asset markets evolve, this binary characterization is both limiting and outdated.

In tokenized asset markets today, there exists a spectrum of ways that assets and financial relationships can be digitized; no longer are assets confined to either offchain or onchain realms, but rather, can interface with both worlds in varying ways and capacities.

As such, we need an updated way to characterize and discuss tokenized asset finance. We created the Spectrum of Tokenization with this purpose in mind, and with the hope that it will foster long-standing common dialogue and understanding amongst stakeholders.

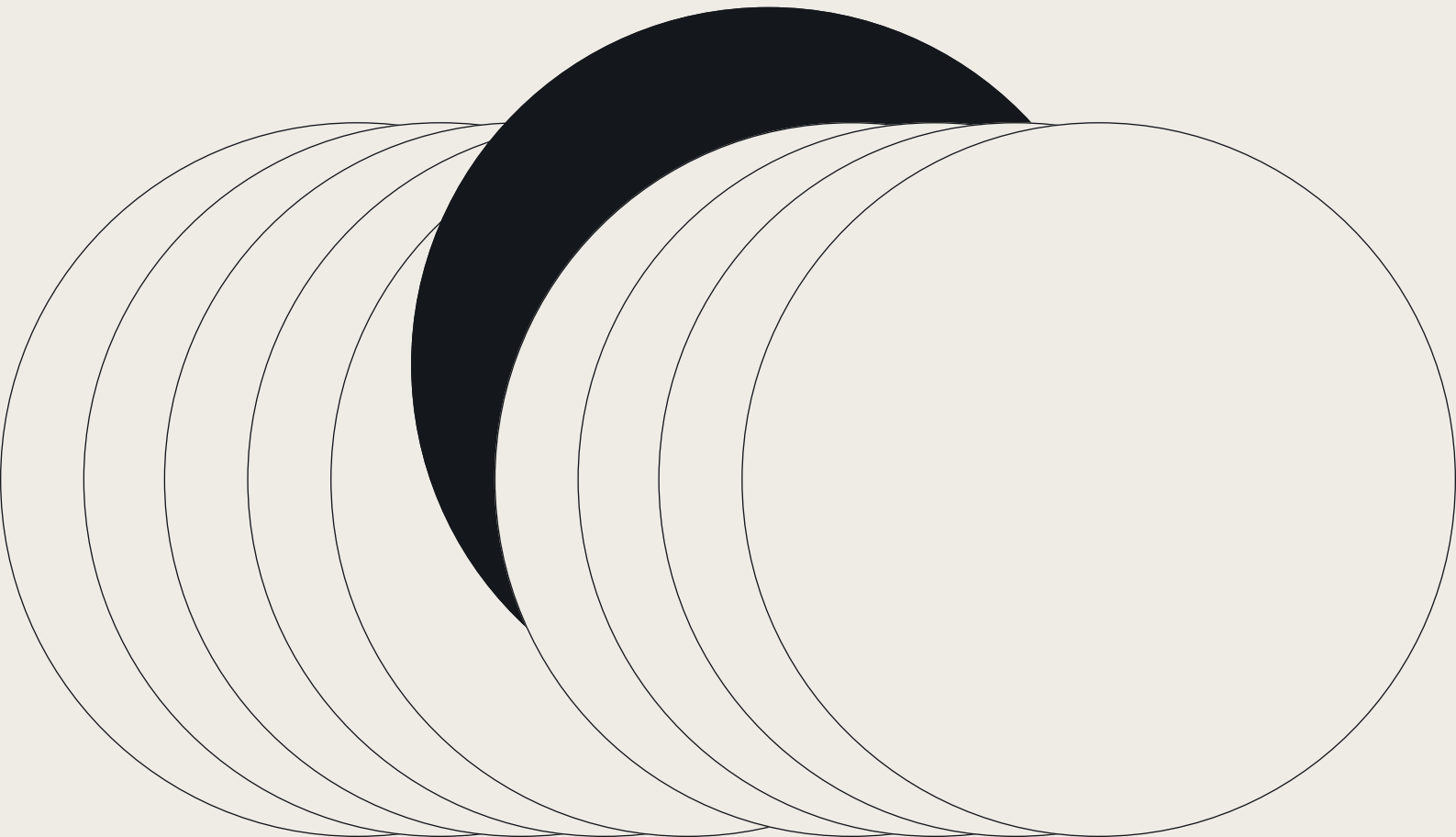
Throughout this piece, we introduce and break down the Spectrum of Tokenization framework, providing examples of different models of tokenization and highlighting key differences between each model. Additionally, we highlight the opportunities and risks that asset owners, investors, and service providers may face as they interact with different tokenization models across the Spectrum.

Our aim with this report is to provide our partners and the industry a more standardized way to analyze tokenized asset products.

Adam Lawrence
Co-Founder, CEO

adam@rwa.xyz

Introduction



At RWA.xyz, we have seen a wave of tokenization initiatives undertaken by startups, financial service incumbents, and regulatory bodies over the past few years. Accompanying this movement has been a myriad of publications on the topic of tokenization.

Thought pieces on blogs, coverage from news outlets, and crypto banter on X (lovingly referred to as "Crypto Twitter") have focused broadly on the potential opportunities of tokenization. Within these broad excerpts, the tokenization process is largely abstracted, with authors simply referring to assets as either tokenized or not tokenized.

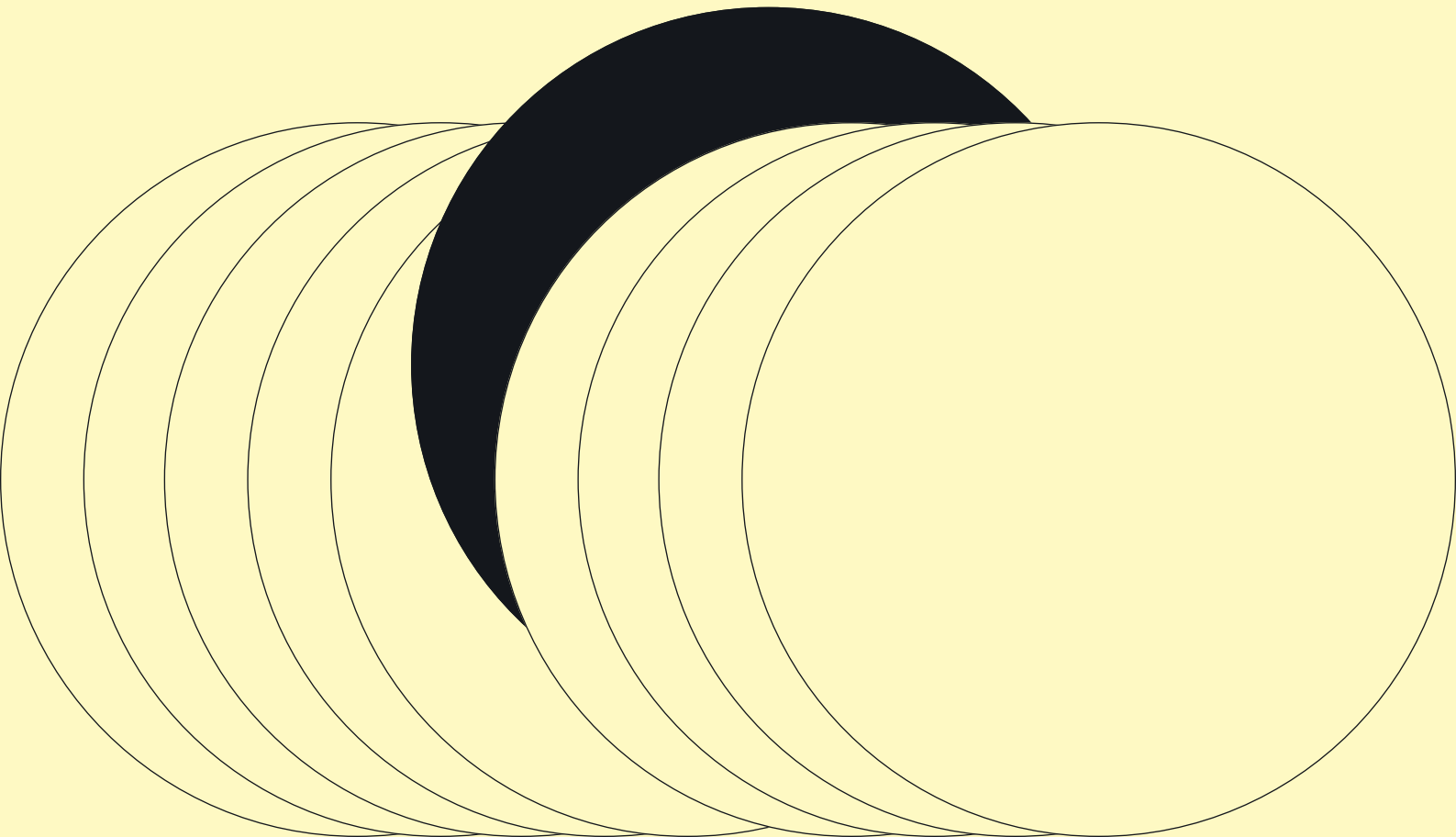
In contrast, research publications from industry associations, banks, and technology providers have narrowly focused on how tokenization could affect their (or their customers') respective industries.[1] Within these publications, the tokenization process is described so narrowly and in detail that they tend to limit accessibility for less specialized audiences.

To evolve from *theoretical discourse* to *tangible products*, all ecosystem stakeholders must be on the same page.[2] Our discourse should strike the delicate balance of being specific enough to retain details about the tokenization of assets while remaining broad enough to create a common dialogue that's inclusive of cryptocurrency enthusiasts and traditional financial (TradFi) participants alike.

1 Industry associations include ISLA and BIS; banks include Bank of America and Citibank; and technology providers include Digital Assets Holdings and Bitbond, amongst others.

2 History shows us that standardizing industry vernacular not only prevents misunderstandings but also catalyzes innovation:
1. American National Standards Institute (ANSI) establishing the "C standard," leading to proliferation of the C programming language;
2. International Civil Aviation Organization (ICAO) establishing November Alpha Tango Oscar (NATO) Phonetic Alphabet, which has become the primary means of coordination amongst aircrafts in the sky; and
3. International Accounting Standards Board (IASB) guidelines for preparing and presenting financial statements, leading to financial clarity and reduced opportunities for fraud.

The Spectrum of Tokenization



In an effort to foster a common dialogue, we have created the Spectrum of Tokenization, (or the Spectrum,) a novel framework that characterizes asset tokenization.

Figure A: The Spectrum of Tokenization

	Offchain Conventional	>>>	Hybrid Digitally Enabled	>>>	Onchain Digitally Native
	Model 1	Model 2	Model 3	Model 4	Model 5
	Status Quo	Onchain Representation	Onchain Integration	Onchain Enforcement	Fully Onchain
Ownership	Assets are represented and enforced offchain	Assets are represented onchain but enforced offchain	Assets are represented onchain but enforced offchain	Assets are represented and enforced onchain	Assets are digitally native and enforced onchain
Value Transfer	Value is exchanged between counterparties offchain	Value is exchanged between counterparties offchain	Value is exchanged between counterparties using both offchain and onchain means	Value is exchanged between counterparties using both offchain and onchain means	Value is exchanged between counterparties onchain

Source: RWA.xyz

We believe that assets should not be binarily defined as *tokenized* or *not tokenized*. Instead, we offer a more nuanced approach, arguing that financial relationships can be digitized in several ways, ranging from conventional (i.e., entirely offchain) to digitally native (i.e., fully onchain).[3]

At the same time, we avoid over-complication by omitting financial relationship nuances (e.g., asset class, industry, jurisdiction, etc.), instead, electing to highlight common threads between different tokenization structures today. By doing so, we are left with five different tokenization models, which we delineate based on the model's unique way of handling asset ownership and value transfer.

3 "Onchain" refers to activities, data, or processes that occur within a blockchain or are directly recorded on a blockchain. In juxtaposition, "offchain" refers to any activities, data or processes that occur off a blockchain, typically on databases and other conventional means of coordination.

We believe that most financial relationships and thus assets will be poised to transition from conventional to onchain means; however, certain relationships may not feasibly reach a Fully Onchain dynamic due to specific frictions along the Spectrum.

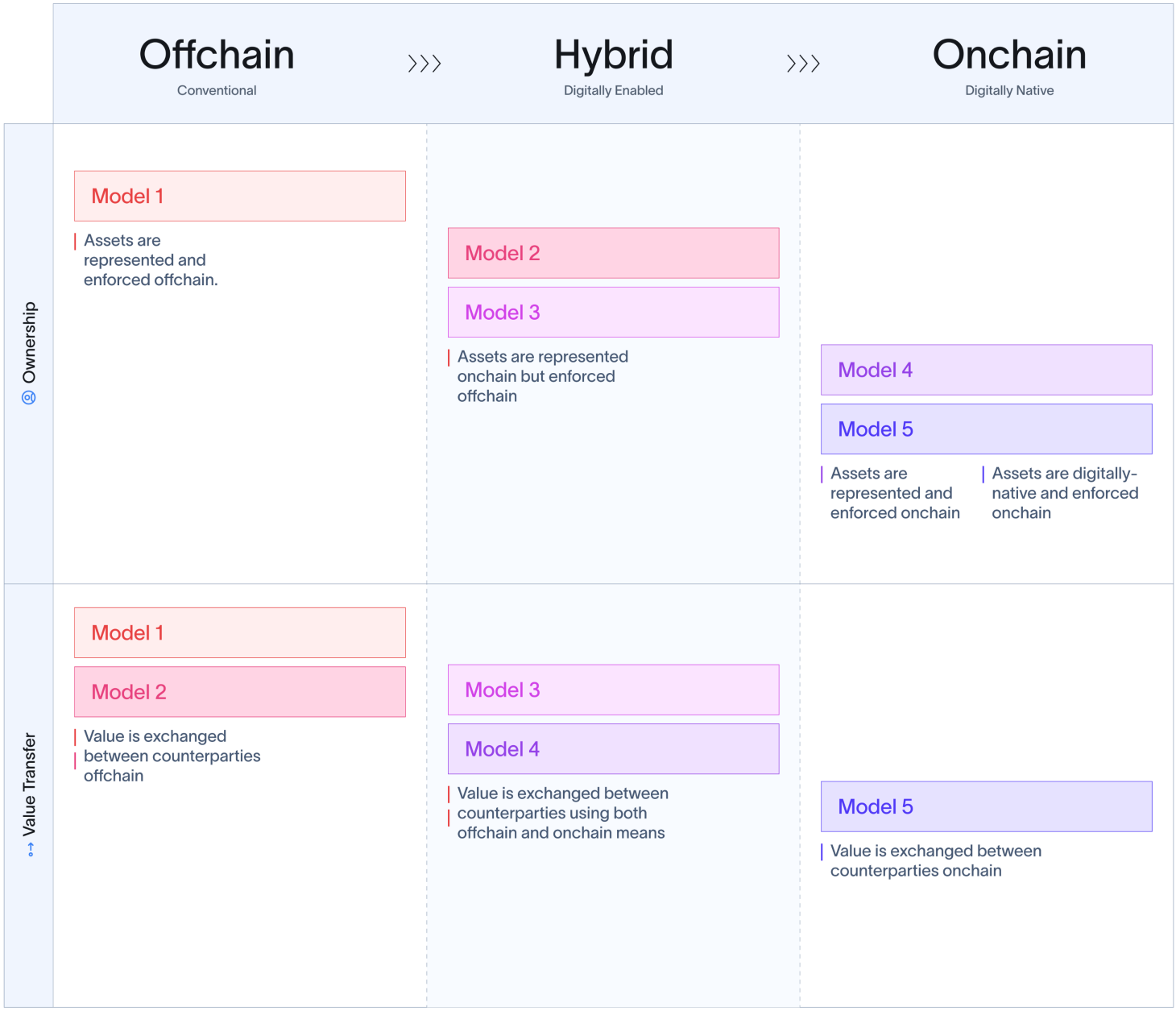
For example, the only difference between Model 3 and Model 4, is regulatory and legal in nature. In Model 3, asset ownership rights are upheld exclusively through traditional, offchain means. In contrast, in Model 4, asset ownership rights are enforced according to the possession of a bearer token, which embeds or otherwise provides offchain recourse for possession of the token. Regulatory appreciation of tokens as bearer assets represents the most significant step toward digitally enabled financial markets. However, moving from Model 3 to Model 4 is a non-trivial feat, as regulatory shifts tend to happen much slower than technology or commerce.

Considering the inevitable frictions that come with transitioning to digitally enabled markets, we anticipate that participants will remain cautiously optimistic about blockchain technology, and experiment and implement without dismantling legacy processes and systems.[4]

In the following sections, we present examples detailing each aspect of the Spectrum. Additionally, we discuss how market participants, including asset owners, investors, and service providers, may be affected by the deployment of different tokenization models in financial markets.

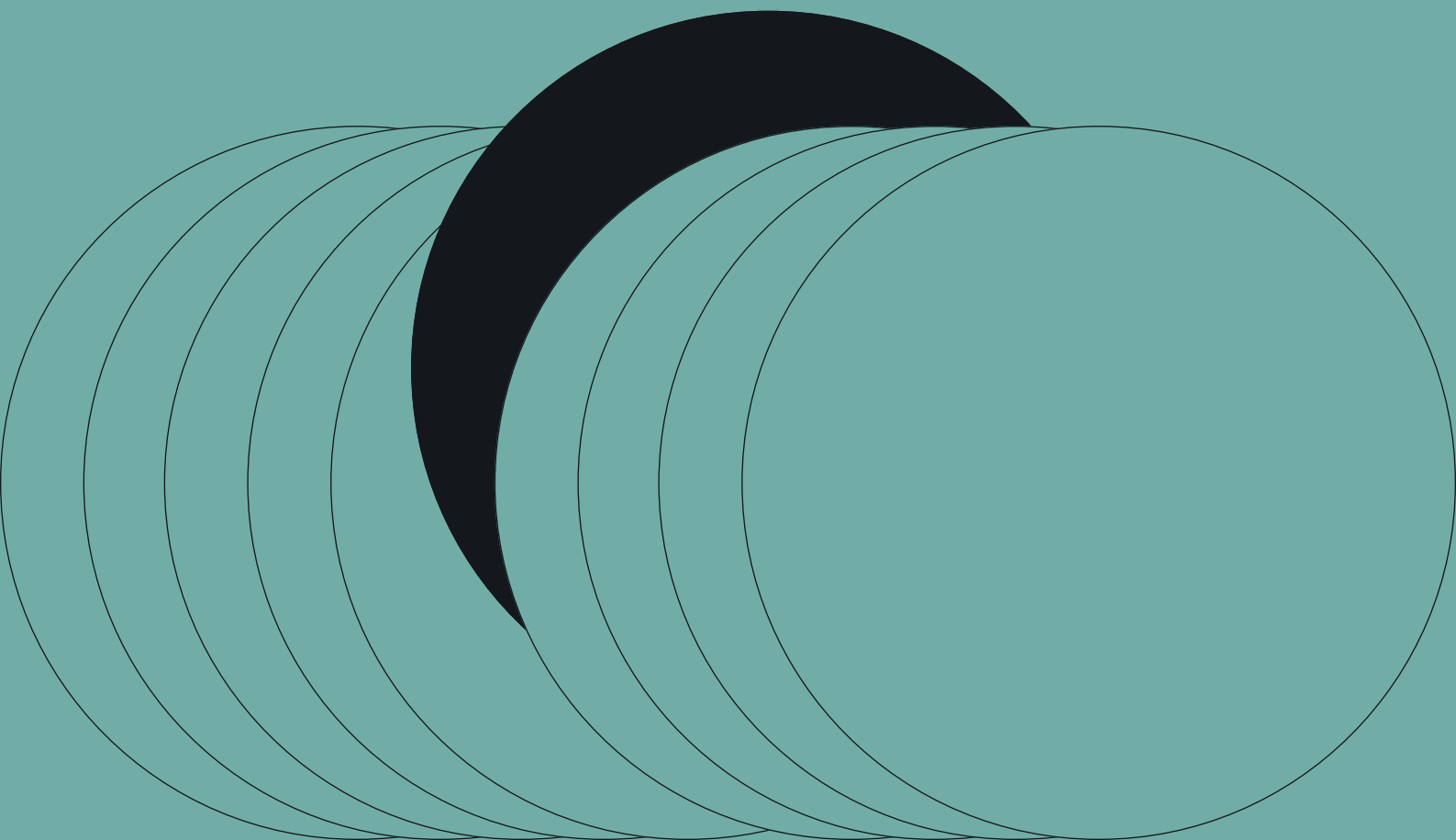
4 The ongoing operations of Iron Mountain generated $4.3B over 2022 in its 'Global Records & Information Management' (Global RIM) or essentially, its file-keeping business. This is only one case study of how legacy processes and systems will continue to be relied upon, and thus will likely be resilient against disruption.

Figure B: Visual Aid for the Spectrum of Tokenization

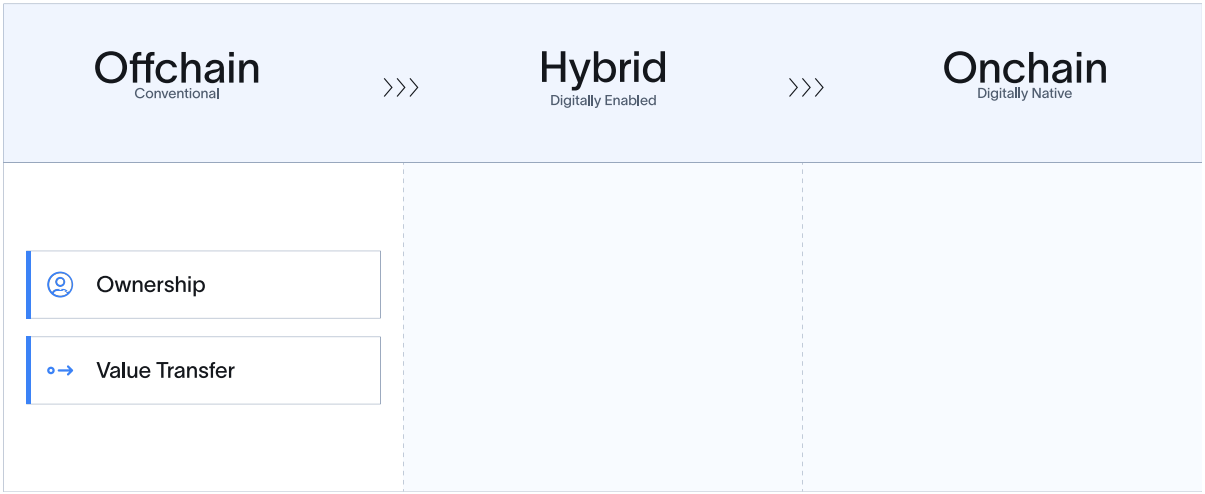


Source: RWA.xyz

Spectrum Models & Examples



Model 1: Status Quo



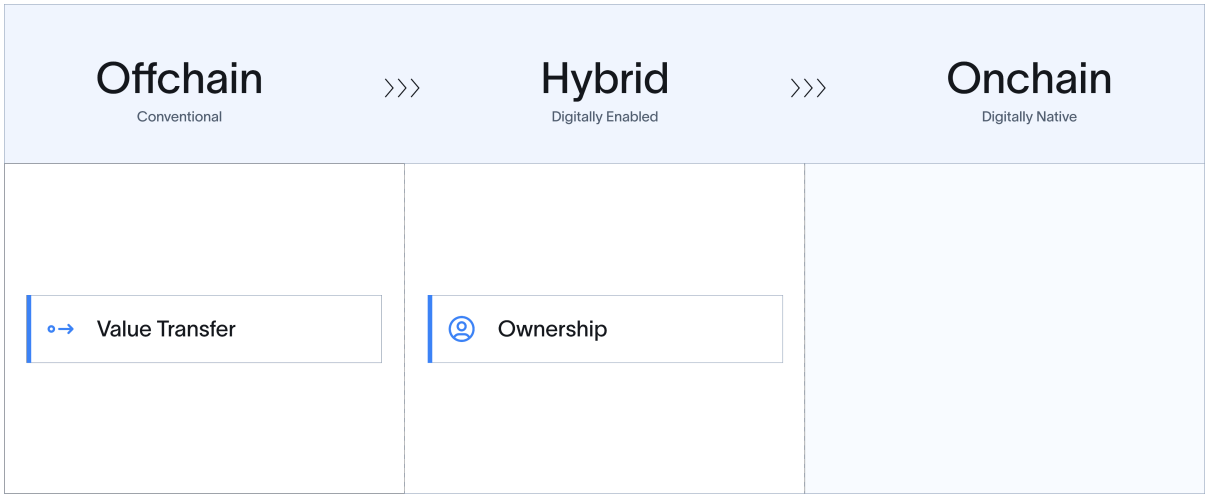
Source: RWA.xyz

Representative Transaction - An investor purchases Apple Inc. Common Stock ($AAPL) directly from Apple Inc. via the NASDAQ stock exchange.

Ownership - Assets are held offchain in stockholder brokerage and custody accounts. Ownership rights over $AAPL shares are represented by traditional, offchain means.

Value Transfer - Apple Inc. sells stock and in exchange receives fiat from investors. Investors then become stockholders and receive dividend payments in fiat.

Model 2: Onchain Representation



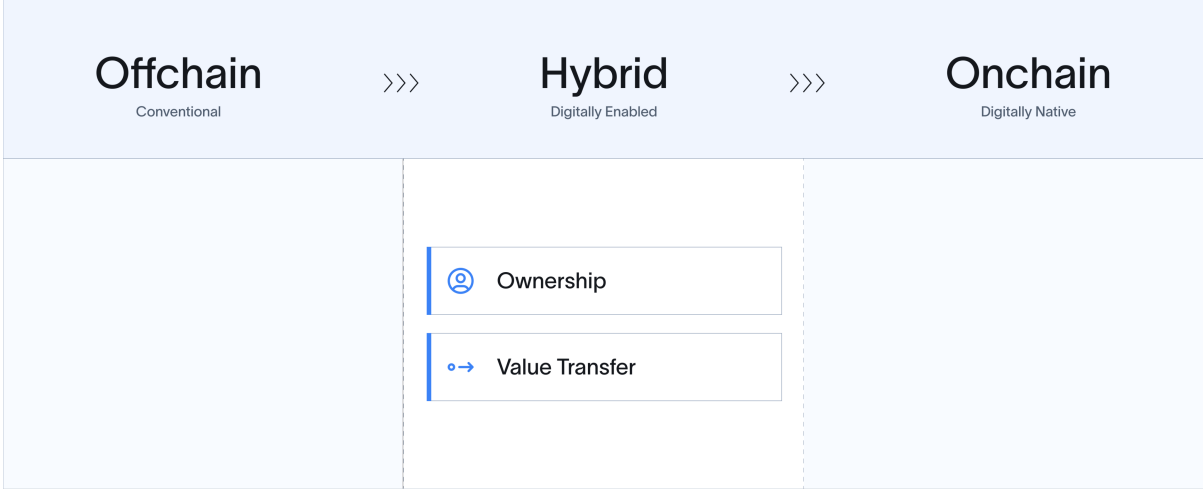
Source: RWA.xyz

Representative Transaction - An investor purchases shares of the Franklin OnChain U.S. Government Money Fund ($FOBXX) on Benji, Franklin Templeton's mobile application for tokenized investment products.

Ownership - $FOBXX is represented onchain as the token $BENJI, as evidenced on PolygonScan. Notwithstanding, $FOBXX features traditional service providers, including a transfer agent, which interacts with the blockchain on an investor's behalf. For example, the prospectus for $FOBXX states the "transfer agent maintains controls to correct errors or unauthorized transactions on any blockchain utilized by its proprietary blockchain-integrated system." Ownership rights over $FOBXX shares are represented by traditional, offchain means.

Value Transfer - Value transfer is offchain, as investors subscribe and redeem $FOBXX fund shares in fiat.

Model 3: Onchain Integration



Source: RWA.xyz

Representative Transaction - An investor deposits $USDC to the New Silver Series 2 "senior" ($NS2DRP) pool (the New Silver Pool) via the Centrifuge App (formerly known as Tinlake), a decentralized, blockchain-based application. On the opposite side of the transaction is the pool issuer, NS Pool LLC (the special purpose vehicle, or SPV), which is owned and managed by New Silver Lending LLC (New Silver). New Silver is a real-estate bridge lender that pre-funds loan originations from its balance sheet and effectively reimburses itself through liquidity in the New Silver Pool to fund future loan originations.

Ownership - New Silver sells assets (i.e., real-estate bridge loan receivables) into the SPV, which tokenizes the receivables as ERC-721 tokens.[5] These tokenized receivables refer to the offchain receivables, thus representing the collateral for $NS2DROP (i.e., New Silver Pool) token holders. While smart contracts[6] may be used to execute aspects of the transaction, asset ownership rights are still fully developed, managed, and represented by traditional, offchain means.

5 It is technically a non-fungible token (NFT) on Centrifuge Chain.

6 A "smart contract" is a self-executing, code-based agreement that automatically enforces and facilitates the terms of a contract on a blockchain, ensuring trust and transparency in various transactions.

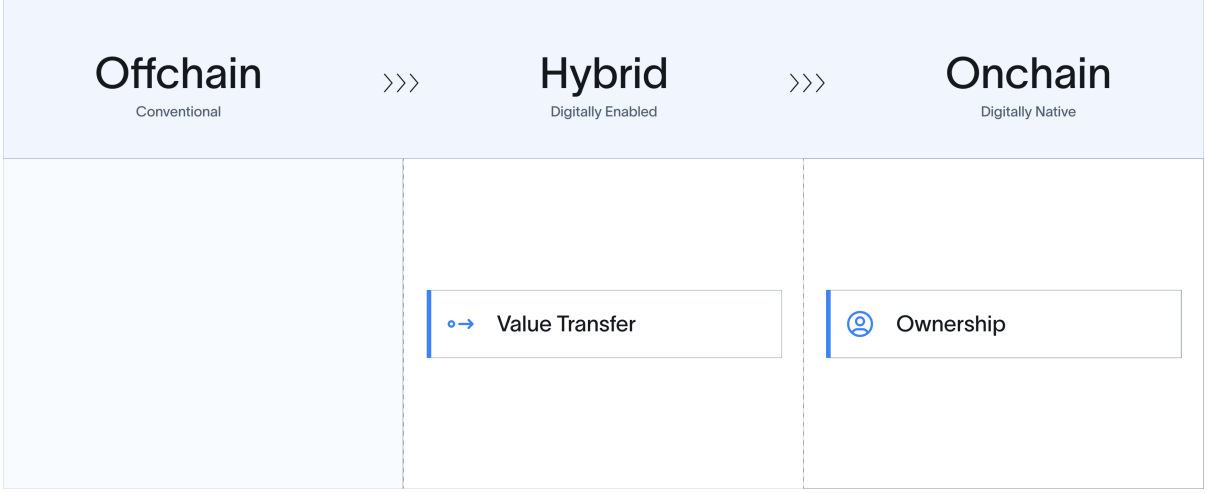
Model 3: Onchain Integration continued

- **Value Transfer** - At the time of deposit, the investor receives $NS2DROP tokens, which are proportionally representative of its contribution to the New Silver Pool "senior" tranche.[7] By sending the tokenized receivables to the pool smart contracts, the SPV effectively pledges its receivables as collateral for a credit line, enabling it to draw the $USDC from the New Silver Pool. The SPV then proceeds to convert $USDC to USD and wire the USD to New Silver, effectively reimbursing New Silver for pre-funding the origination of the loan. Income (i.e., interest and principle) generated from the receivables is deposited directly into the SPV, which then converts the USD-denominated income into $USDC and sends it to the New Silver Pool smart contracts. Investors can then redeem their investment by interacting with the New Silver Pool smart contracts.[8] Value is transferred both offchain and onchain in this model of the framework.

7 There is also a New Silver Series 2 Junior ($NS2TIN) pool, which we omit for the purposes of this example.

8 ERC-721 tokens are periodically updated to reflect receivable paydowns or revaluations, if applicable.

Model 4: Onchain Enforcement



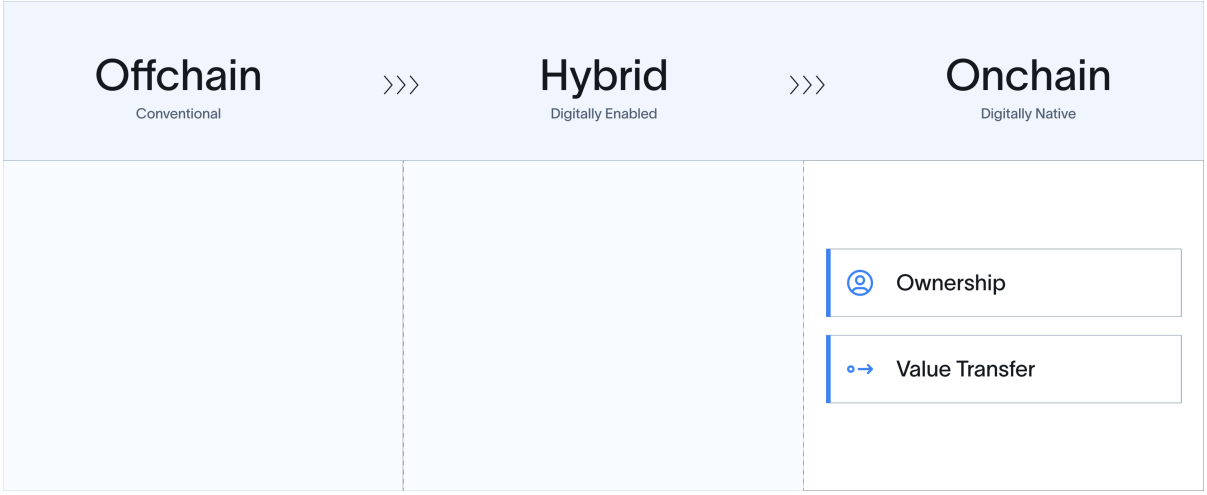
Source: RWA.xyz

To avoid redundancy, all aspects of the Onchain Enforcement model are identical to the Onchain Integration model, *except* that in Model 4, there is an assumption that the jurisdictions in which transactions occur expressly grant token holders all rights that would be granted to holders of traditional, offchain agreements. **In other words, Model 4 uniquely implies token holders have recourse to the natively offchain assets.**

In tokenized asset markets today, there are vastly more examples of Model 3 transactions as compared to Model 4 transactions. This is because Model 4 transactions are dependent on regulatory jurisdictions that recognize and enforce the ownership rights of bearer tokens on the same level as they do traditional, offchain agreements.

However, there are examples of Model 4 transactions emerging in "crypto-friendly" jurisdictions, of which there are few at the time of writing. For example, Anemoy offers sophisticated, private, non-U.S. investors access to U.S. Treasury Bill yields through a regulator-approved fund structure. In this example, local law permits for tokenization of fund shares, such that investors hold tokens instead of fund shares with the same rights.

Model 5: Fully Onchain



Source: RWA.xyz

Representative Transaction - An investor contributes $wETH to a Uniswap liquidity pool on the Uniswap App, a decentralized, blockchain-based application, which a borrower uses to access liquidity.

Ownership - The investor is a liquidity provider, or LP (not to be confused with a limited partner). In exchange for their contribution to the pool, the investor receives an LP token. The LP token, held in the investor's digital wallet, represents its pro-rata share of all assets in the pool. As such, ownership of the underlying asset is controlled and enforced onchain.

Value Transfer - Investors deposit $wETH into the pool in exchange for LP tokens by interacting with smart contracts through the Uniswap App. As previously mentioned, LP tokens represent an investor's pro-rata share of all assets in the liquidity pool. Borrowers from the liquidity pool pay transaction fees into the liquidity pool when they use pool liquidity. These transaction fees represent the revenue of the pool, which is automatically distributed pro-rata to the LP token holders.

How the Spectrum Affects Market Participants

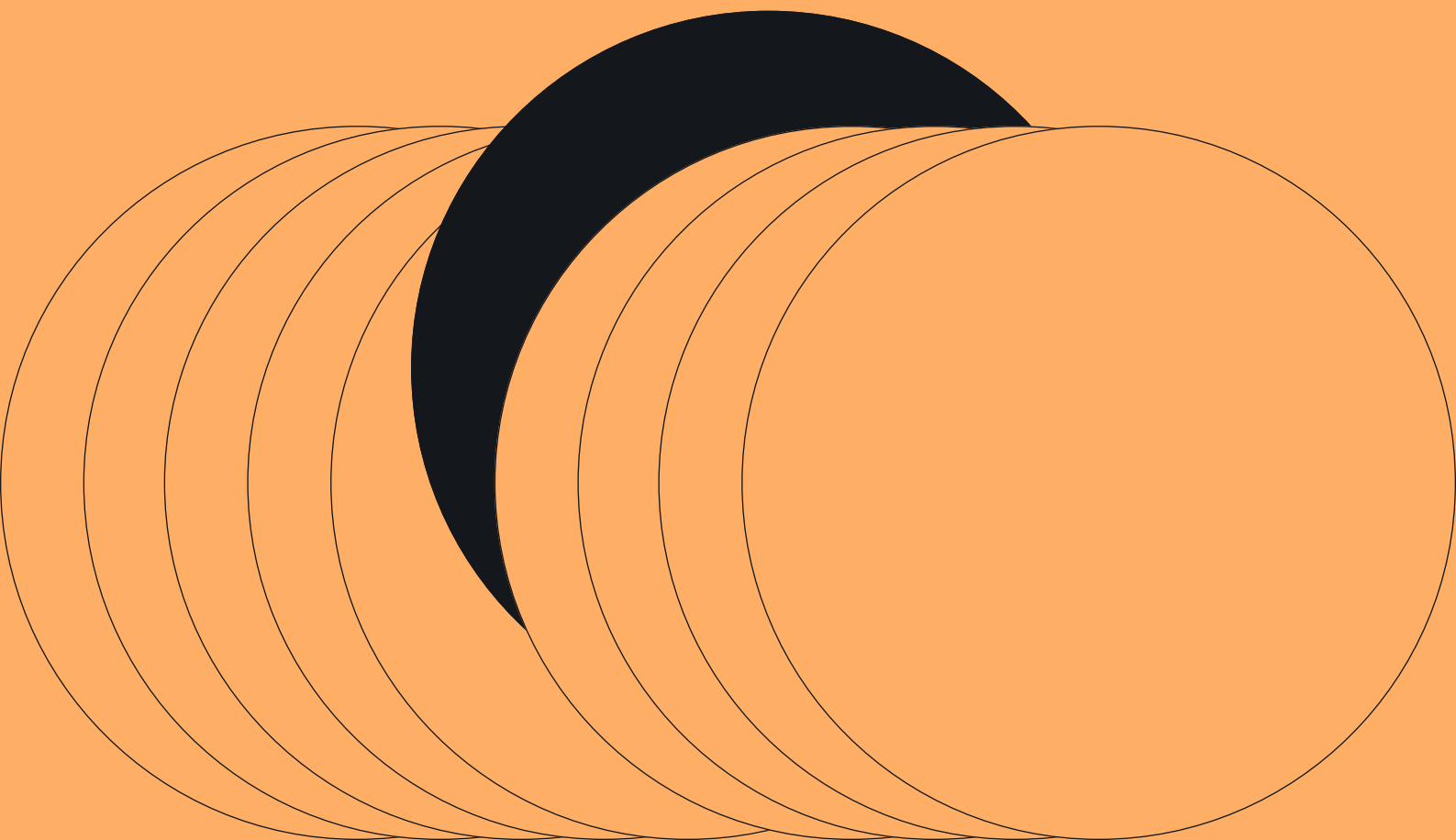


Figure C: Implications of the Spectrum on Market Participants

		Transparency of public blockchains	New or expanded market potential	Managing financial relationships via smart contracts	Digital asset regulation
Asset Owners	Opportunities	Highlights financial health	Access to alternative sources of liquidity	Reduced operating costs	Clarity
	Risks	Heighted scrutiny of holdings	Lack of liquidity or natural buyers of assets	Novel, idiosyncratic technological and operational risks	Discouragement
Investors	Opportunities	Reduced information asymmetry	Enabled or augmented access to investment opportunities	Reduced operating costs	Clarity
	Risks	May expose competitive advantages	Inefficiencies relating to new markets	Novel, idiosyncratic technological and operational risks	Discouragement
Service Providers	Opportunities	Increased demand for new roles and services	Increased demand for new roles and services	Increased demand for new roles and services	Clarity
	Risks	Disintermediation of existing functions	Disintermediation of existing functions	Disintermediation of existing functions	Discouragement

Source: RWA.xyz

Asset Owners

From an asset owner's perspective, moving along the Spectrum towards more digitally enabled models results in:

Increased transparency and exposure relating to onchain custody

The Onchain Enforcement and Fully Onchain models require that assets are enforced onchain. For asset owners, this requirement implies that asset characteristics and performance will be able to be fully and transparently monitored, at all times. On one hand, this may serve as a testament to the financial health of an asset owner. On the other hand, it may subject the asset owner to continuous scrutiny. Asset owners will therefore need to have sufficient operational and technical know-how to manage their completely onchain, and potentially non-custodial asset holdings.

Access to alternative sources of liquidity

In the Status Quo and Onchain Representation models, value transfer occurs offchain, implying asset owners use traditional banking infrastructure and service providers. As such, these asset owners must comply with existing regulations.

In the Onchain Integration and Onchain Enforcement models, value transfer occurs both offchain and onchain. Accordingly, asset owners must use traditional banking infrastructure and service providers, in addition to having onchain capabilities. Asset owners operating in these two models will need to comply with existing financial regulations and emerging regulations with respect to digital assets.[9]

In a Fully Onchain environment, value transfer occurs onchain, subjecting asset owners to predominantly emerging regulations with respect to digital assets.

Unifying the Onchain Integration, Onchain Enforcement, and Fully Onchain models is the use of tokens (e.g., $ETH, $BTC, stablecoins) in the transfer of value, which may allow asset owners to bypass unfavorable means of exchange and local currency dynamics.

Reduced intermediation costs, *but* exposure to novel, idiosyncratic risks

By moving towards digitally enabled tokenization models, smart contracts become a material factor in financial relationships. This represents an evolution from transactions today, which are characterized and enforced via offchain agreements.

Accordingly, asset owners may be able to reduce transaction costs through the use of smart contracts as both a complement and a substitute for traditional legal services.

By moving to smart contract-enforced financial relationships, an asset owner is vulnerable to the novel risks posed by using smart contract logic, including hacks, bugs, and lack of regulatory clarity.

9 This is where platforms facilitating blockchain-enabled marketplaces for offchain private credit assets (commonly referred to as real-world assets, or RWAs within the crypto community) emerged, including Centrifuge, Credix, and Goldfinch, amongst others. The value proposition for asset owners has been new liquidity sources, whereas the value proposition for investors, that is, namely crypto-native capital sources has been blockchain-enabled portfolio diversification beyond volatile cryptoassets and low-yielding stablecoins.

Investors

From an investor's perspective, moving towards digitally enabled models of the Spectrum may offer:

Enabled or augmented access to opportunities

Investors benefit from increased accessibility as they look for opportunities closer to the digitally native side of the Spectrum. One example is that the continued development of blockchain technology will yield novel assets that exist solely as a result of the technology itself.[10]

Further, tokenization enables the fractionalization of assets in a flexible and programmable manner, which may lower an investor's barrier to entry for capital-intensive or capital-restrictive asset classes.[11] [12] Building upon the prior point, tokenization has the potential to reduce transaction costs and thus the types of assets that can be securitized and offered to investors.[13]

Additionally, tokenized assets present investors the opportunity to engage in a 24/7/365 trading environment with relatively instantaneous settlement, clearing, and delivery.[14]

Lastly, traditional financial products, in almost all cases, incorporate some form of "permissioning" (e.g., know-your-client (KYC), anti-money laundering (AML), geo-blocks[15], wallet whitelist verification, investor accreditation checks, minimum wallet balance requirements, etc.), which may limit certain investors from accessing a particular financial product.

10 While we are in the early days of this potential reality, we observe promising projects emerging with respect to onchain intellectual property (IP) rights (e.g., Trips).

11 While it should be recognized that assets can be fractionalized in conventional models, smart contracts and the lack of conventional baggage (e.g., "round lots" in foreign exchange markets, whole-number stock splits, etc.) allows for fractionalization to be much more easily and efficiently done via a blockchain.

12 For example, RealT's fractionalized real estate products have allowed retail investors to surpass liquidity barriers and gain exposure to the real estate market for the first time.

14 Digitally enabled tokenization models are "relatively instantaneous" as opposed to "instantaneous" given traditional (e.g., time-for-delivery coordination) and idiosyncratic (e.g., block finaliztion rate) timing limitations.

15 A geo-block is a security mechanism used by cryptocurrency exchanges, applications and services which limits access to products offered by those constituencies based on user jurisdiction.

Moving towards the digitally native side of the Spectrum offers the potential for permissionless financial products, in which financial relationships can occur between parties without disclosing identity, geography, financial health, or other considerations found in traditional financial relationships.[16]

Decreased information asymmetry

Reporting standards across financial relationships vary greatly, irrespective of the use of a blockchain. There are differences in how information is collected, organized, and disseminated to investors for almost every transaction type.

Transaction activity for public blockchains can be monitored via a blockchain scanner, representing a potential improvement in Models 2 – 5, relative to the Status Quo. While monitoring value transfer between wallets and smart contracts is superior to lacking said information, it may offer a limited perspective, as smart contracts may simply complement traditional agreements.

Onchain data with respect to Onchain Representation and Onchain Integration models are almost certain to be lacking full transparency. Alongside the Status Quo, these models rely on periodic reporting versus real-time, and are often developed manually or with limited technology.

The Onchain Integration model, deployed by many tokenization infrastructure protocols, has attempted to reduce information asymmetry through onchain reporting.[17] However, monitoring and reporting for this model has been imperfect to date, leading to low levels of transparency into the underlying assets of investments.[18]

16 For example, primary issuance of Ondo's T-bill product is permissioned, yet secondary market liquidity is permissionless on Flux.

17 For example, Centrifuge onchain NFT monitoring mechanism.

18 MakerDAO is an example of an onchain capital source that has invested in tokenized offchain assets. At times, (particularly within the transition to Endgame) the MakerDAO community has expressed frustrations due to a lack of transparency and financial reporting.

The Fully Onchain model is the most resilient against cumbersome processes and offers higher relative transparency than other models. The Onchain Enforcement model should exhibit similar characteristics, but in practice is likely to be less robust than a Fully Onchain setup. The Onchain Enforcement and Fully Onchain tokenization models have the potential to meaningfully reduce information asymmetry for investors, as asset ownership in these models is enforced onchain.This enables investors to conduct real-time audits of assets.

It should be recognized that while reduced information asymmetry may offer asset pricing transparency for investors, it may also stomp out a competitive advantage.

Increased regulatory, technological, and operational risks

More conventional financial relationships may be less vulnerable to regulatory, technological, and operational uncertainty than those that are digitally enabled. This dynamic will certainly evolve with time.

Service Providers

From a service provider's perspective, moving along the Spectrum towards more digitally enabled models yields:

New roles and service offerings

Tokenization will foster demand for novel services such as smart contract legal experts, digital asset custodians, onchain treasury managers, blockchain financial reporting & monitoring providers, etc.

Existing service providers will be required to evolve into new roles if they want to capture opportunities relating to tokenized finance.

New service providers will emerge to meet the demand for digitally enabled products that require specialized skills and knowledge.[19]

The potential for operational streamlining

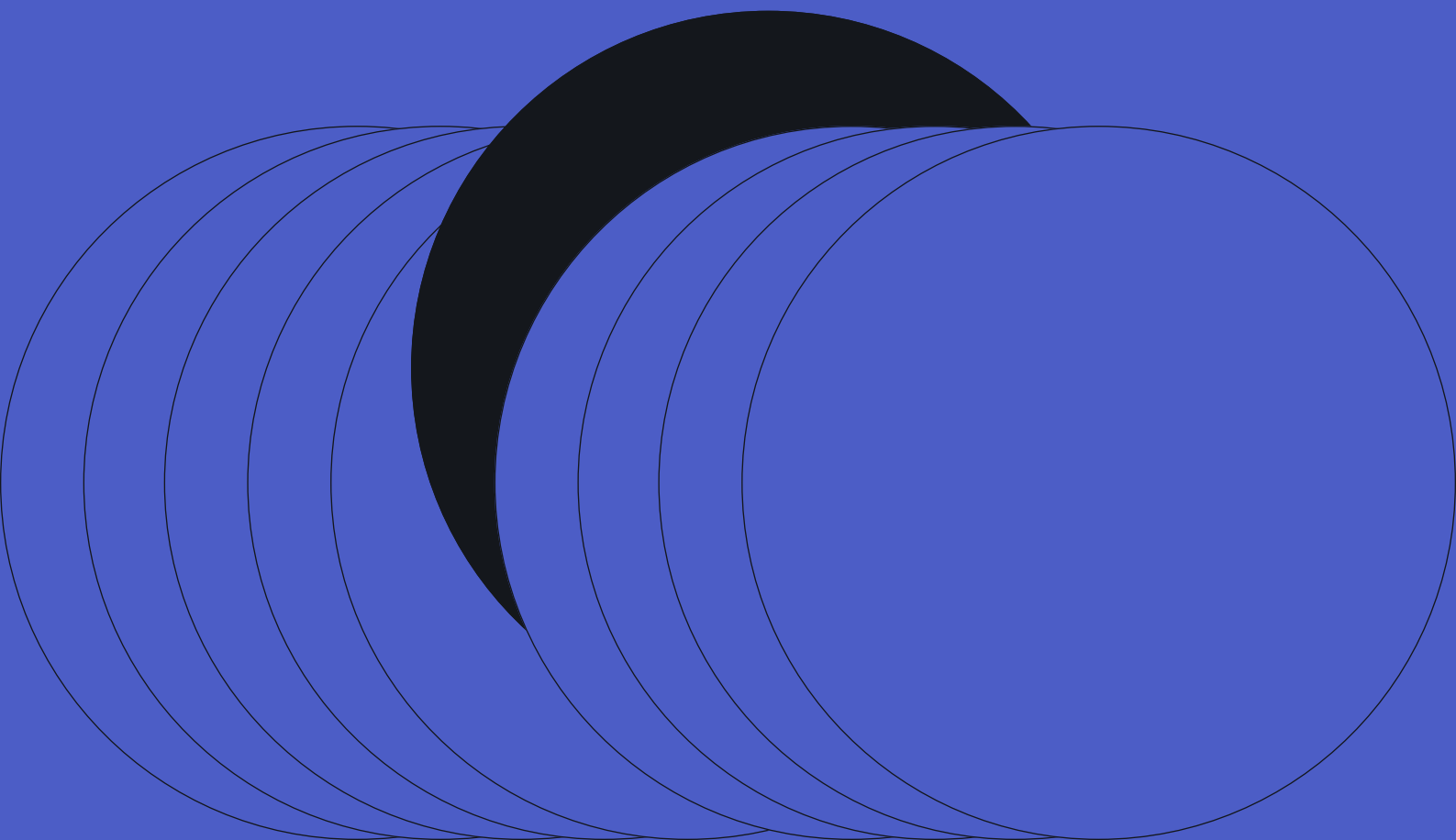
The Status Quo and Onchain Representation models entail coordination amongst disparate counterparties and data sources. Generally speaking, novel or esoteric assets and transaction types require a significant investment of resources from service providers, typically more so than for well-understood assets or transaction types.

The Onchain Integration, Onchain Enforcement, and Fully Onchain models allow service providers to streamline transaction data via a blockchain, thus increasing overall efficiency. It is unclear if service providers can position themselves to take advantage of the potential for blockchain technology to boost top-line growth and improve margins. Incumbent service providers are also at risk of disintermediation by way of tokenization.[20]

19 For example, decentralized autonomous organization (DAO) treasury managers are predominantly services-based businesses that support crypto treasuries with respect to their capital allocation (e.g., Steakhouse Financial, Swiss Asset DAO, and Karpatkey).

20 For example, Figure uses blockchains to reduce costs relating to home loan origination.

Concluding Remarks



As blockchain technology and associated services evolve, we foresee ongoing experimentation in tokenized asset finance. With time, we will see new examples upon every degree of the Spectrum, offset by attrition in protocols and products failing to find a foothold in the market.

The Spectrum was developed with sustainability in mind. Ambitiously, we intend that all existing and future financial relationships can be categorized via the Spectrum.

We would like to thank Charlotte Dodds for editing this piece. Additionally, we want to acknowledge Johnny Reinsch, Martin Quensel, Alfred Macdaniel, Vincent Jow, and others who wished to remain anonymous for their material contributions to this work.

Please reach out at team@rwa.xyz with any feedback that may enhance the Spectrum framework or its use! Any substantial changes will warrant an updated framework publication.

Authors

This report is a collaborative effort by the RWA.xyz research team and its advisors.

Collin Erickson

collin@anemoy.io

LinkedIn

**affiliated with one or more parties referenced in the document*

Mac Naggar

mac@rwa.xyz

LinkedIn

Jack Chong

jack@rwa.xyz

LinkedIn

Resources

Institutions, asset managers, and researchers use the RWA.xyz Platform to analyze tokenized assets.

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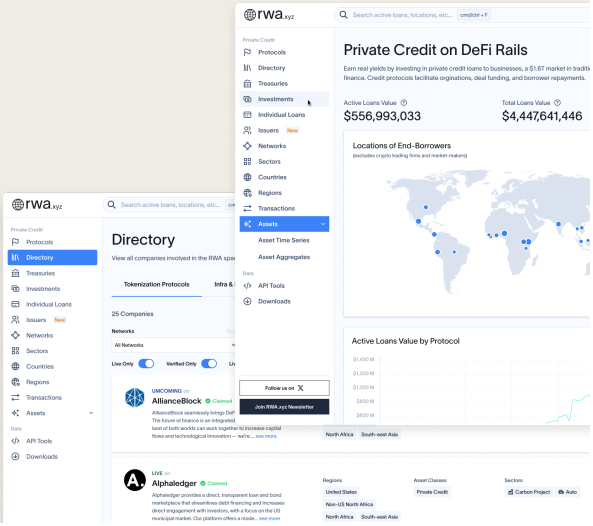

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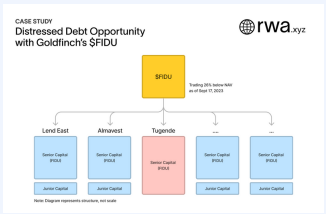

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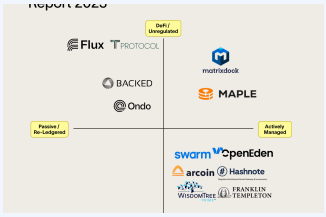

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