

21.co

The State of Tokenization



2023

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01 Executive Summary

Executive Summary

The convergence between crypto and traditional asset classes, including fiat currencies, equities, government bonds, and real estate, is experiencing an unprecedented growth. Our thesis is clearer than ever, namely, blockchains are becoming the backend infrastructure for every asset class with use cases beyond our imagination in the future. Tokenization couldn't be possible until the emergence of the Bitcoin blockchain and hereafter Ethereum introducing a global computing platform for smart contracts that led to a cambrian explosion of different variations of blockchains and distributed ledger technologies.

Tokenization is one of the fastest-growing use cases and now with our real-time [dashboards](#) anyone can follow the evolution (see the following section).

Total Assets
\$118.6B

The value of tokenized assets across public blockchains amounts to \$118.57 billion. Ethereum accounts for over 58% or \$69.16 billion of all tokenized assets and has the most vibrant ecosystem, with more than 6 million daily active users and almost 6,000 monthly active developers. Ethereum optimizes for security and decentralization, with over **800,000 validators**, while other blockchains compete on speed and scalability. Tron comes second with over **\$45 billion** of tokenized assets, while Solana comes third with the fastest **settlement time of 0.4 seconds**.

Asset Classes
9

Digital dollars or USD stablecoins are the first successful tokenization implementation, representing ~10% of crypto's total market value and ~97% of all tokenized assets. Other asset classes amounting to 9 in total, including **U.S. treasuries**, have seen significant growth this year (>450%) on the back of decades-high interest rates. However, outside USD stablecoins, most of the tokenization solutions today are still not globally accessible due to regulatory restrictions and socioeconomic circumstances, including low Internet penetration rates in emerging regions.

Crypto Users
431M

There are about 431 million crypto users or about ~5.36% of the world population. The level of crypto adoption today is equivalent to internet adoption in **2000** when the number of internet users amounted to 361 million or 5.91% of the world population at the time. The countries with the highest percentage of crypto ownership tend to have a **high internet and banking penetration rate**. Today, **holders of tokenized assets account for a little more than 10% of the estimated 431 million crypto owners, or roughly 47 million people.**

2030 Opportunity
\$3.5T-\$10T

Tokenization is likely to scale into a multi-trillion-dollar opportunity by 2030 We estimate that the market value for tokenized assets will be between **\$3.5 trillion** in the bear-case scenario and **\$10 trillion** in the bull case by **2030**. The market value is derived from the estimated penetration rate of the total addressable market across various asset classes, including non-financial corporate debt, real estate funds, private equity, securities collateral, trade finance, and public debt securities.

21.co Real-Time Dashboards

Anyone can now monitor the evolution of tokenization in real-time with our [21.co dashboard](#) tracking the global landscape, as well as asset-specific dashboards for commodities, real estate, equities, and more.



Government Securities



Equities, Corporate Bonds, and Private Funds



Commodities



Real Estate



Fiat-Collateralized Stablecoins



Asset-Based Finance



21.co Research Team Edit

21.co is the parent company of 21shares, the world's largest crypto ETP issuer
Our Research Page: <https://21shares.com/insights>

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Team members



4,351 stars ★

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41 dashboards

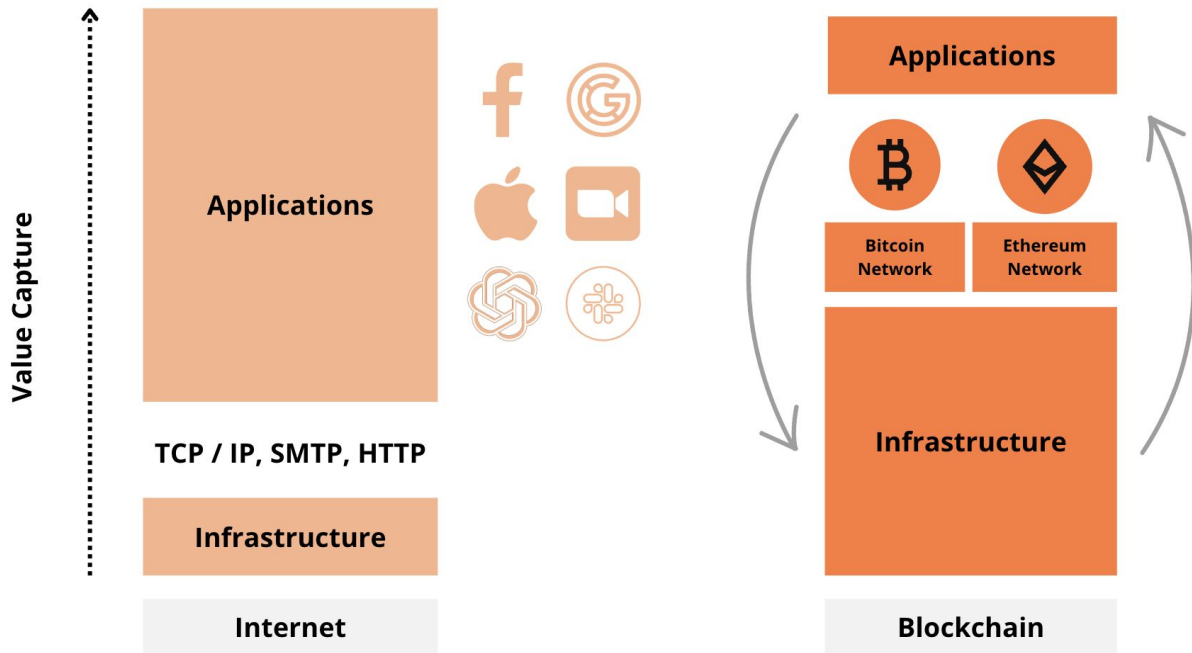
7 people

02 Blockchains and Distributed Ledger Technologies (DLTs)

Crypto's Positive Feedback Loop

- Decentralized blockchains are financially sustained by the underlying native token coordinating stakeholders to secure the network and validate transactions. For the first time in history, protocols like Ethereum or Bitcoin can have a direct investment, unlike TCP/IP or SMTP.
 - Miners and Validators** receive a stream of native tokens in return for confirming transactions and securing the network.
 - Users** must pay a fee denominated in the native token whenever they transact on the network. Thus, these tokens are analogous to digital commodities like oil.
 - As the network expands in use cases and more applications come to life, the native token captures more demand and value, similar to how the U.S. dollar benefits from the economic prowess of the United States and global trades.

Figure 1: Positive feedback loop between crypto as an investable asset and crypto as a usable global computing platform at the base layer.



Source: 21.co.

Public Blockchains: Where is Tokenization Built?

Ethereum and **Tron** have the lion's share of tokenized assets as of October 2023, primarily due to the amount of stablecoins issued on each network. Ethereum accounts for over **58%** or **\$69.16 billion** of all tokenized assets (**\$118.57 billion**) and has the most vibrant ecosystem, with more than **6 million daily active users** and almost **6,000 monthly active developers**. Table 1 also shows that Ethereum optimizes for security and decentralization, with over **800k validators**, while the rest compete on speed and scalability. Tron comes in second place with over **\$45 billion** of tokenized assets, while Solana takes third with the fastest **settlement time of 0.4 seconds**.

Table 1: Comparison of Public Blockchains in the Tokenization Landscape

Blockchain	Tokenized Assets (Millions of \$)	Market Share (%)	Settlement Time (Average in Seconds)	Transaction Cost (Average in \$)	Daily Active Users (30D MA)	Monthly Active Developers (As of June 2023)	Total Validators
Ethereum	\$69,160	58.33%	12	\$1.97	6,323,307	5,946	<u>844,108</u>
Tron	\$45,760	38.59%	3	\$0.23	1,538,461	67	<u>27</u>
Solana	\$1,510	1.27%	0.4	\$0.0002	<u>219,700</u>	1,475	<u>1,988</u>
Avalanche	\$1,210	1.02%	2	\$0.06	580,983	308	<u>1,296</u>
Stellar	\$422	0.36%	<u>4</u>	\$0.00001	106,397	97	<u>42</u>
Base (Coinbase)	\$159	0.13%	2	\$0.08	907,538	N/A	1 sequencer*
Algorand	\$140	0.12%	<u>3.3</u>	\$0.0001	<u>29,846</u>	180	<u>998</u>
Polygon	\$127	0.11%	2.2	\$0.02	4,578,588	837	100
Gnosis	\$86	0.07%	6.13	\$0.004	160,981	169	147,743
TOTAL	\$118,574	100.00%	3.3 (Median)	\$0.02	14,445,801	9,079	1,147 (Median)

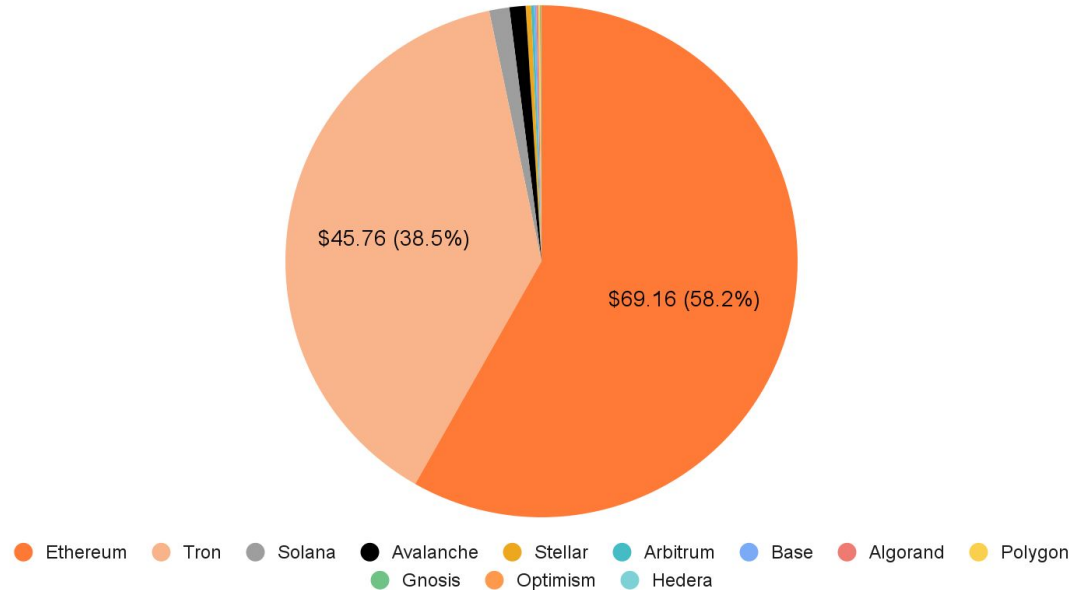
** Sequencer: The equivalent of validators that submits data on Ethereum. They receive data on the scaling network, then pass information along to Ethereum, which ultimately gets confirmed by the validators on the main network

Public Blockchains: Market Share

- **Ethereum remains the digital asset industry's financial hub**, with over 50% of all tokenized fiat currencies, including U.S. dollars, also called stablecoins (~\$65 billion), deployed on the network.
- Due to its **credible neutrality**, Ethereum is poised to be the network of choice for tokenization.

Figure 2: Market Share of Public Blockchains

Market Share of Tokenized Asset Value by Blockchain Network (Billions of \$)














Source: 21.co, DeFi Llama

Tokenization Examples: Public Blockchains and Private DLTs

Table 2 gives some examples of the evolution of the tokenization landscape. While **this financial innovation's first and most successful implementation was fiat-backed stablecoins, use cases have expanded over time**, with prominent entities like the European Investment Bank issuing bonds on a private distributed ledger technology (DLT).

Table 2: Tokenization examples by issuer, asset type, and platform (non-exhaustive list)

Issuer	Asset	AUM	Category	Platform	Platform Type	First Issued
Tether 	Tokenized currency	\$41B	Fiat-backed stablecoin	Ethereum + <u>9</u> blockchains	Public	Oct 2014
Circle 	Tokenized currency	\$24B	Fiat-backed stablecoin	Ethereum + <u>14</u> Blockchains	Public	Sep 2018
Paxos 	Tokenized gold	\$464M	Commodity	Ethereum	Public	Sep 2019
Franklin Templeton 	U.S. government money fund	\$307M	Government Security	Stellar	Public	<u>April 2021</u>
Centrifuge 	NFTs representing off-chain collateral	\$250M	Asset-Based Finance	Ethereum, Centrifuge Chain	Public	<u>May 2020</u>
Ondo Finance 	Tokenized ETFs	\$175M	Government Security	Polygon	Public	<u>Jan 2023</u>
EIB 	Tokenized government bond	€100M	Government Security	GS DAP	Private	<u>Jan 2023</u>
Siemens 	Tokenized corporate bond	€60M	Corporate Bond	Polygon	Public	<u>Feb 2023</u>
RealT 	Tokenized shares in LLC	\$52M	Real Estate	Ethereum	Public	<u>May 2019</u>
EIB 	Tokenized government bond	£50M	Government Security	HSBC Orion	Private	<u>Nov 2022</u>
Aktionariat 	Tokenized stock	\$27M	Private Equity	Ethereum	Public	Jan 2021

Sources: 21.co, Federal Reserve, DeFi Llama Tether Limited, Circle, Paxos, RealT, Centrifuge, Aktionariat, Franklin Templeton, European Investment Bank, Ondo Finance, Siemens

Strengths & Weaknesses: Public Blockchains vs. Permissioned DLTs

Public blockchains like Ethereum provide a globally- accessible platform with superior battle-tested technology versus distributed ledgers. DLTs benefit from a stringent end-to-end KYC and AML process and deeply concentrated liquidity within the traditional finance ecosystem. However, tokenization will help blockchains access traditional finance deep liquidity.

Table 3: Comparison of Public Blockchains versus Permissioned Distributed Ledgers

Features	Blockchains (e.g., Ethereum)	Distributed Ledgers
Technological Maturity	High (++)	Medium (+-)
Interoperability (with other systems)	Medium (+-)	Low (- -)
Deep Liquidity	Medium (+-)	High (++)
User Privacy	Medium (+-)	High (++)
Global Accessibility	High (++)	Low (- -)
Decentralization	High (++)	Low (- -)



















Source: 21.co

03 Tokenized Assets

Tokenization By The Numbers

Stablecoins are the original tokenized asset and have reached product-market fit, with almost 97% (\$69.13 billion) of the tokenization market share across Ethereum-compatible networks, followed by commodities like tokenized gold and government securities, such as tokenized U.S. Treasuries. It is important to note that fiat-collateralized stablecoins are a digital representation of fiat currency, like the U.S. dollar. The issuers of these products (e.g., Circle and Tether) maintain an off-chain reserve of the target asset, primarily in the form of short-term U.S. T-Bills and cash, with ratios dependent on the issuer's asset-liability management.

Table 4: Tokenization by Types of Assets across Selected Blockchains (Ethereum, Avalanche, Stellar, Arbitrum, Base, Polygon, Gnosis, Optimism)

Summary Table of Tokenization: By Type of Assets									
Fiat-Collateralized Stablecoins Include Tokenization of Cash and Treasury Bills									
Ranking	Type	Market Cap	Market Share	1D Change	1W Change	1M Change	1Q Change	1H Change	1Y Change
1	Fiat-Collateralized Stablecoins	 \$69.13b	 96.95%	0	0.6%	-1.2%	-4.6%	-9.5%	-29.8%
2	Commodities	 \$928.26m	 1.30%	0.1%	1.7%	-2.6%	-4.6%	-10.0%	0.5%
3	Government Securities	 \$675.18m	 0.95%	0	0.5%	6.2%	13.7%	63.3%	182564.8%
4	Asset-Based Finance	 \$355.58m	 0.50%	0	0.6%	3.3%	8.7%	19.9%	71.5%
5	Real-Estate	 \$123.42m	 0.17%	0	-46.1%	-32.8%	47.3%	62.8%	119.2%
6	Corporate Bonds	 \$63.71m	 0.09%	0	0	0	0	0	
7	Private Equities	 \$21.51m	 0.03%	0	0.1%	0.4%	0.7%	2.5%	22.6%
8	Equities	 \$5.17m	 0.01%	0	0	0.3%	17.7%	584.7%	
9	Private Funds	 \$3.48m	 0.00%	0	0	-76.6%	57.5%	804.5%	

9 rows Search...

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Source: 21.co, Dune Analytics. This table only considers blockchains available on Dune Analytics. Data as of October 10, 2023

Tokenized Government Securities

Tokenized U.S. Treasuries have witnessed a remarkable growth of over **450% this year**, with a total of **\$650 million in assets**. The rise of on-chain U.S. treasuries can be attributed to the **prevailing high-interest-rate environment**. Issuers include crypto natives such as Ondo and Backed Finance, alongside well-established traditional finance players like Franklin Templeton.

Figure 3: Treasury Product Market Cap by Protocol

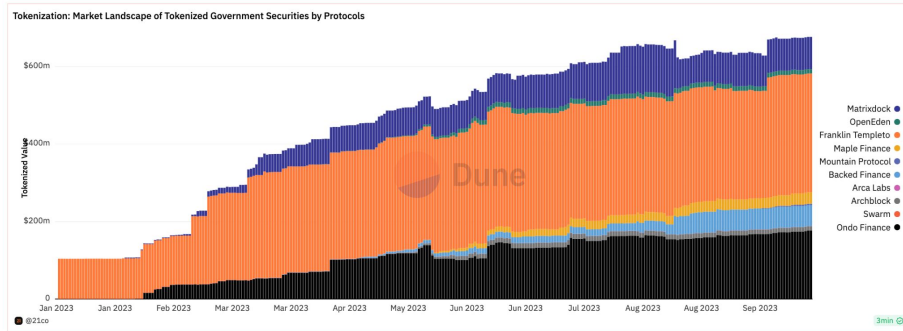
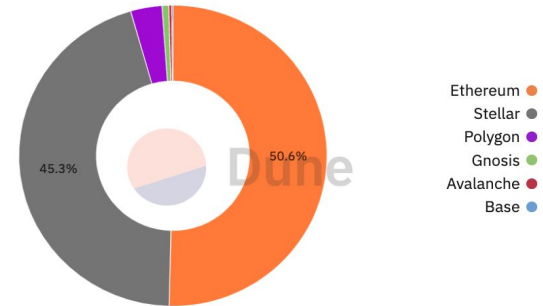


Figure 4: Treasury Cap by Network

Tokenized Government Securities Breakdown by Blockchain

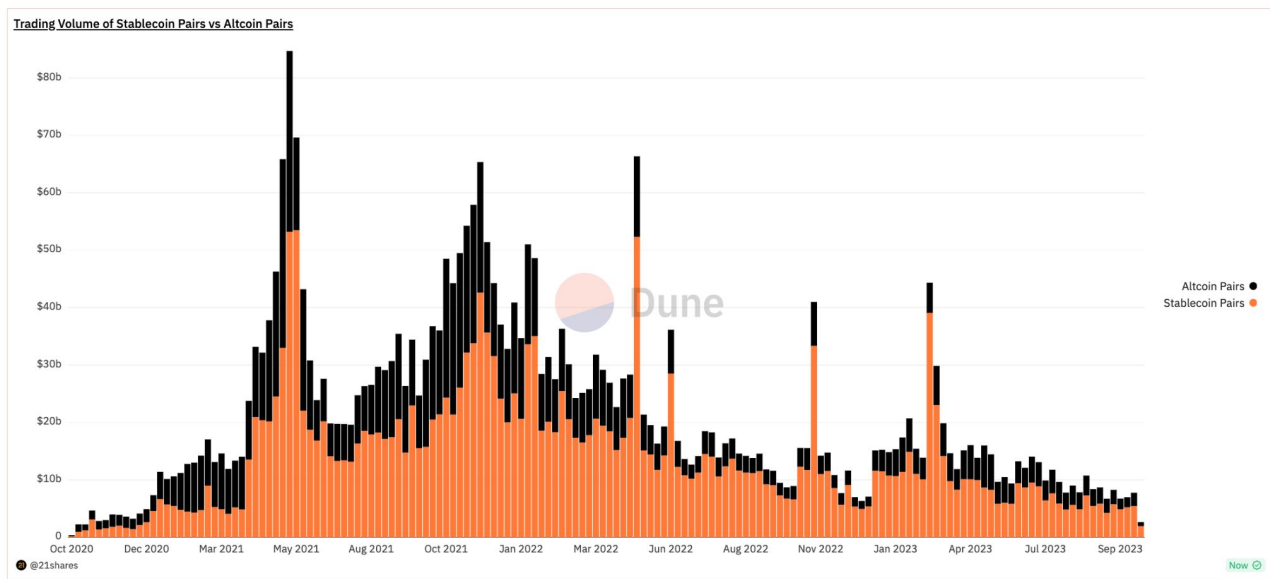


04 Trading Venues

Trading Venues: Stablecoins

Tokenized assets continue to be dispersed across a variety of trading venues and channels. The prevailing absence of a unified trading platform for these assets can largely be ascribed to **regulatory ambiguities and inadequate shared infrastructure**. As previously alluded to, stablecoins represent the predominant force in the tokenization market. Stablecoins are widely accessible and actively traded on both centralized and decentralized exchanges. Notably, Figure 5 illustrates the **widespread adoption of stablecoin pairs, constituting 70% of the total volume on decentralized exchanges**. In contrast, in early 2020, the majority (60%) of the volume was dominated by Altcoin pairs (e.g., BTC/ETH), down to 30% as of 2023.

Figure 5: Trading Volume of Stablecoin Pairs vs Altcoin Pairs on Decentralized Exchanges



Trading Venues: Tokenized Funds

When examining tokenized funds, while it's apparent that there are venues to trade these tokenized assets in a decentralized manner, the predominant choice among issuers is to adopt **segregated platforms** or applications, primarily to meet **stringent regulatory requirements**. While **these platforms harness the power of public blockchain technology, accessibility remains confined by the requisite onboarding process involving KYC/AML (Know Your Customer/Anti-Money Laundering) procedures or geographical limitations**. Although this may appear counterintuitive to the ethos of crypto, given the current limited accessibility, this issue is likely to be resolved through technological and regulatory advancements. Moreover, it also aligns with **our thesis that innovation primarily occurs in the backend infrastructure, exemplified by the utilization of a public blockchain for settlements**. Although we weren't able to obtain precise user numbers, we leveraged web traffic statistics as a means to assess user engagement.

Table 5: List of venues for tokenized funds and private credits (non-exhaustive list)

Venue	Network	Type	KYC/AML	Geography	Monthly Unique Web Visitors (Jul - Sep 23 Average)	AuM/ Active Loans
Centrifuge	Ethereum	Private Credit	Yes	U.S. persons must be verified "accredited investor". All 15 countries sanctioned by the U.S. are excluded (e.g., Cuba, North Korea, Iran).	33,823	\$ 244M
Ondo Finance	Ethereum, Polygon	Treasuries	Yes	Only available to accredited investors and qualified purchasers, as stipulated by U.S. laws.	30,070	\$ 188M
Maple	Ethereum, Solana	Private Credit	Yes	Only available to institutional and individual accredited investors	11,146	\$ 129M
Matrixdock	Ethereum	Treasuries	Yes	Only available to institutional and individual accredited investors	<5,000	\$ 81M
Backed Finance	Ethereum	Treasuries	Yes	Only available for " qualified investors ," and not available in the U.S. or U.K.	<5,000	\$ 47M
WisdomTree Prime	Stellar	Treasuries	Yes	Only available in a limited number of U.S. states.	<5,000	\$ 11M
OpenEden	Ethereum	Treasuries	Yes	Only available to accredited investors and professional investors	6,182	\$ 11M
Securitize	Ethereum, Polygon, Avalanche	Private Credit, Private Equity	Yes	Retail investors can participate in primary market offerings, depending on the type of offering. Several countries have been excluded based on regulatory requirements.	37,398	\$ 3.5M*

05 Investor Demographics

Where are we today in terms of adoption?

- There were about **431 million crypto users** globally at the beginning of 2023, representing **~5.36%** of the world population.
- For the methodology, Triple-A utilized the following metrics to obtain the most encompassing and accurate set of statistics:
 - a. **Country Weighted Scoring:** ownership data by country is derived from Chainalysis' 2022 "Geography of Cryptocurrency Report."
 - b. **Global Weighted Scoring:** based on 15 surveys and reports from leading institutions like the University of Cambridge, Statista, and Gallup.
 - c. **Outlier Research:** To ensure accuracy, more in-depth research and data sampling were conducted for China and India due to their large population size.
 - d. **Primary Data Collection:** Conducted across selected countries by Triple-A.

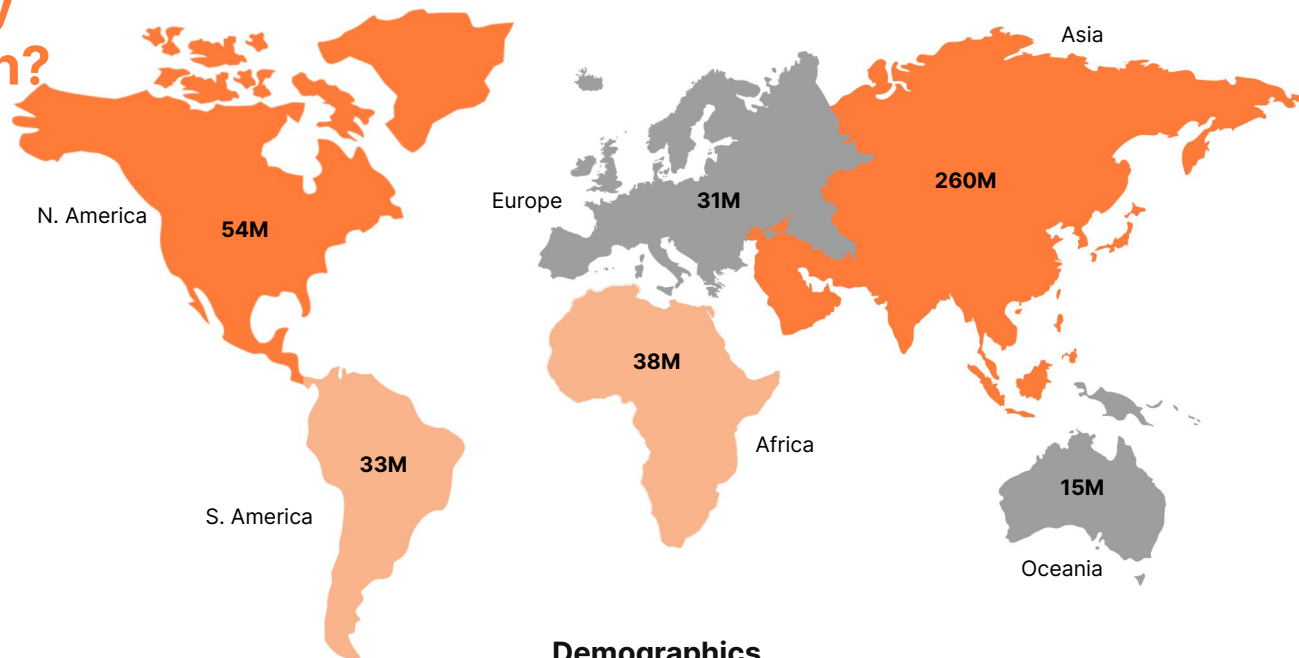


Figure 6: Crypto Demographics

Demographics



Male



Female

US\$25,000

Annual income of the average crypto owner



Bachelor's degree or higher

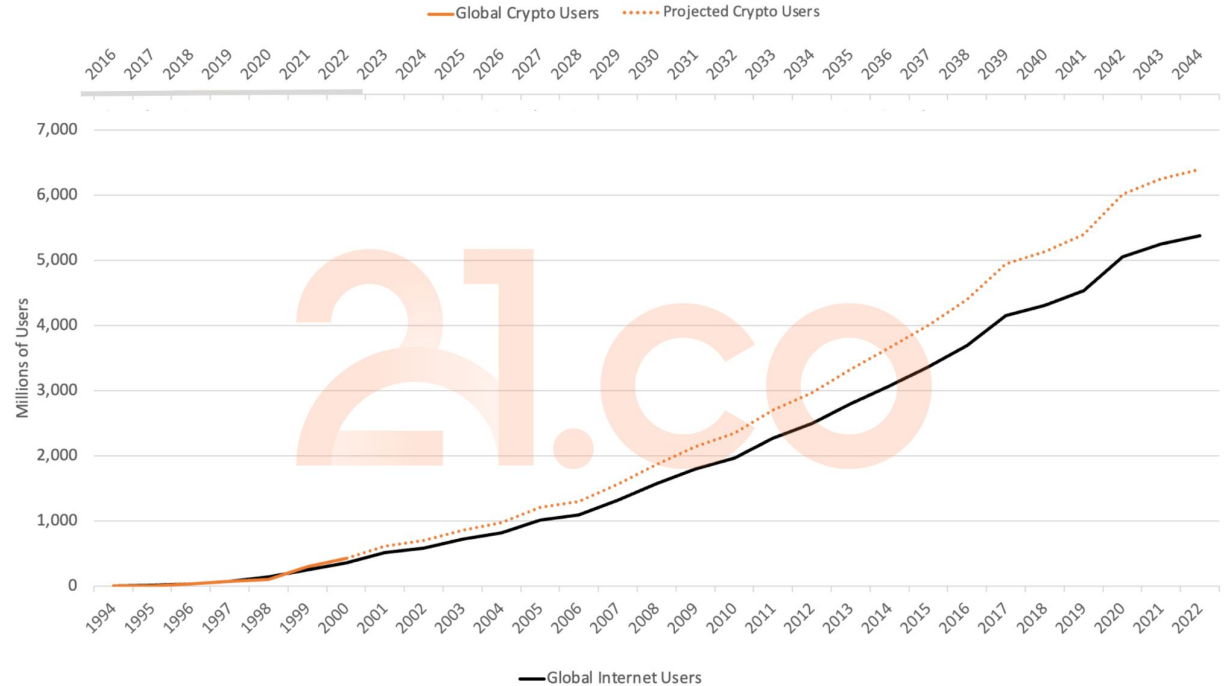


Aged under 34

S-Curve: Crypto vs. Internet Adoption

- The level of crypto adoption today is equivalent to internet adoption in **2000**.
- From 2016-2022, the **CAGR for the number of crypto owners has outpaced that of internet users** from 1994-2000 (~89% vs. ~65%)
- The forecast for the number of crypto owners for the next 22 years is based on a CAGR of 12.45%, the same CAGR of the number of internet users from 2000 to 2022.

Figure 7: S-Curve, Crypto vs. Internet Adoption

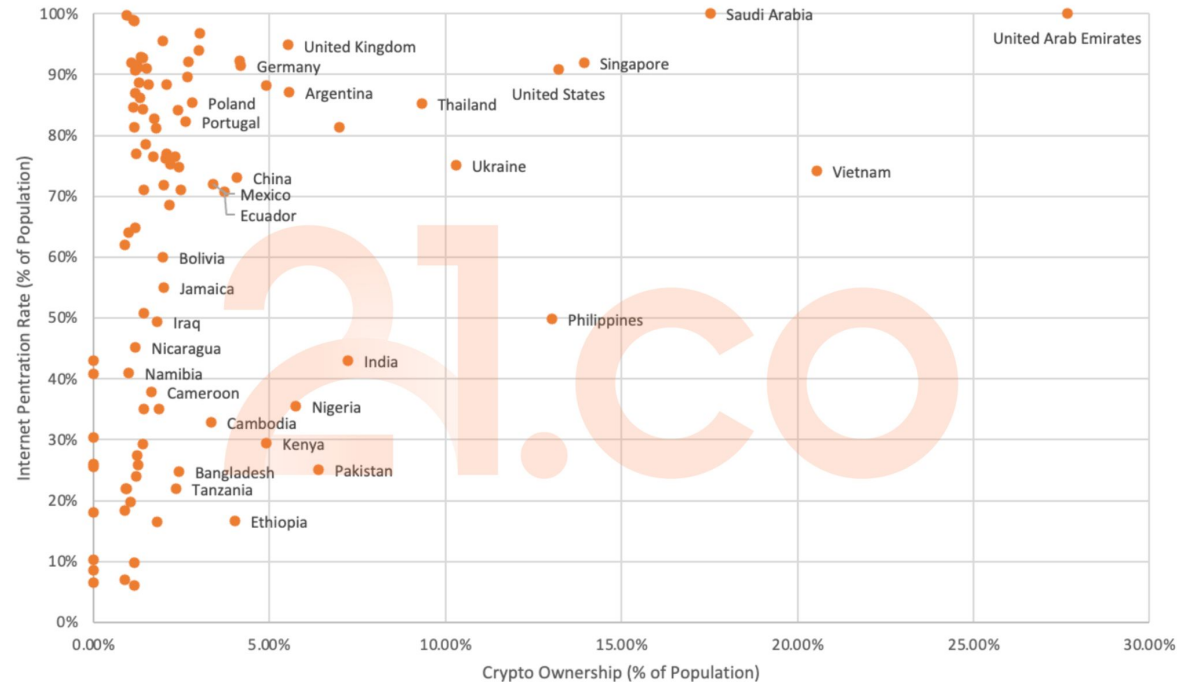


Source: 21.co, [Internet World Stats](#), [Statista](#). 1994 and 2016 are the first dates for which we have reliable public data on the number of internet and crypto users, respectively.

Crypto Ownership vs. Internet Penetration Rate

- Public **blockchains** are **permissionless**, meaning anyone can create a free wallet and transact with tokenized assets. **The only requirement is to have an Internet connection.**
- As shown in Figure 8, the countries with the highest percentage of crypto ownership tend to have a high Internet penetration rate, with the notable exception of the Philippines.
- The low internet penetration rate in emerging economies, such as South Asia and Sub-Saharan Africa, limits crypto adoption.

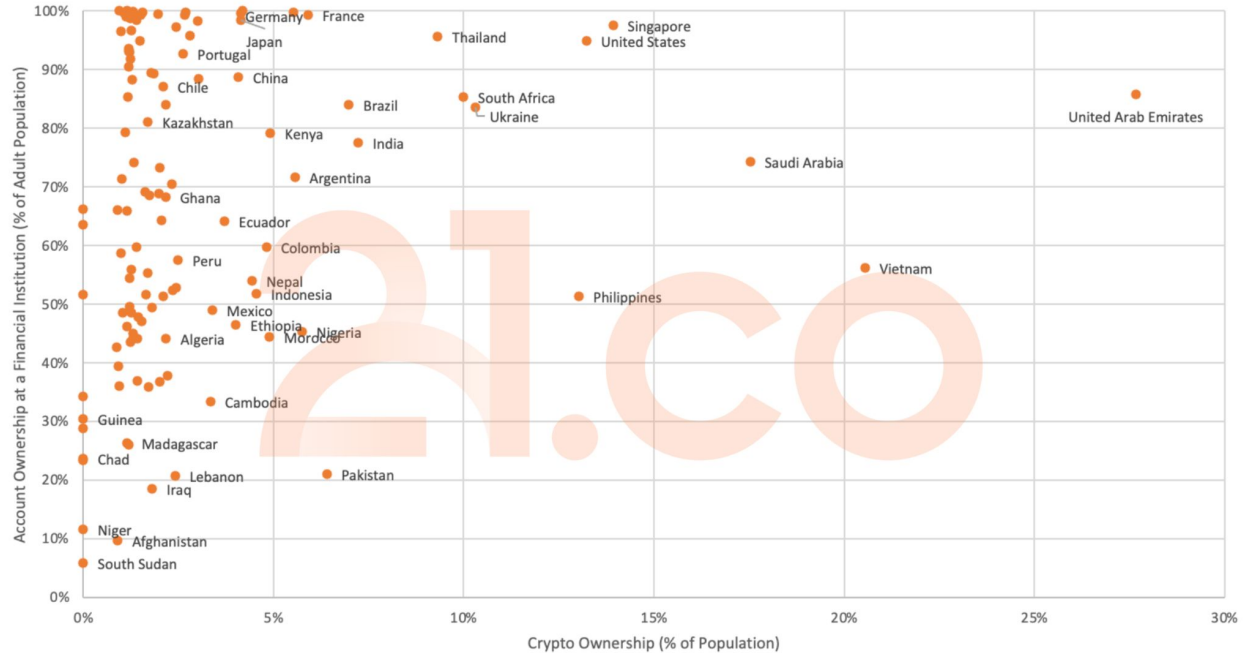
Figure 8: Crypto Ownership vs. Internet Penetration Rate (% of Population)



Crypto Ownership vs. Banking Penetration Rate

- Decentralized Finance (DeFi) promises to provide access to financial services to the **~\$1.4 billion adults who are still unbanked**, according to the World Bank.
- However, Figure 9 suggests that the countries with the highest crypto adoption tend to have higher banking penetration rates, with some notable exceptions, like Vietnam and the Philippines.

Figure 9: Crypto Ownership vs. Banking Penetration Rate (% of Population)



Source: 21.co, [Triple-A](#), World Bank (Account ownership at a financial institution or with a mobile-money-service provider, % of population ages 15+). 120 countries were included in the sample based on the data available for both metrics.

Developers, A Leading Indicator of Value Creation

- Developers and entrepreneurs are the first adopters of blockchain technology and an early indicator of potential value creation. Namely, they develop the end-consumer services and products or build upon the backend.
- There were **21,338 monthly active developers** as of June 2023, a **~2x** increase from January 2020 and **~20x** from January 2015.
- Despite the exponential growth, crypto developers only represent **~0.1%** of all the developers worldwide ([27.7M](#))

Figure 10: Crypto Monthly Active Developers



Source: [Electric Capital](#), Data as of June 2023.

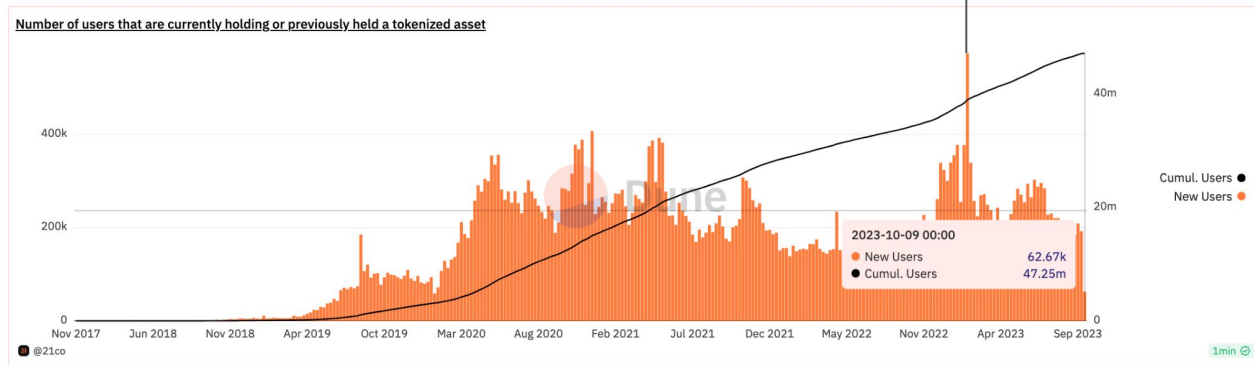
Tokenization Users

In a 2022 survey by [BNY Mellon](#) to institutional investors, including asset owners (e.g., pension funds), asset managers, and hedge funds (excluding crypto-specific funds or alternative fund managers), **97% agreed that “tokenization will revolutionize asset management” and be “good for the industry.”**

- There are about **47 million holders** of tokenized assets as of October 2023. We should note that **99% of this figure is due to stablecoins**; the other use cases are still experimental in scale.
- Tokenized assets represent about **10% of crypto's total market cap**, only behind BTC and ETH, showing that stablecoins have achieved product-market fit.

Figure 11: Holders of Tokenized Assets over Time

During the **banking crisis in March 2023**, we saw a significant uptick in new holders of tokenized assets. This was likely due to users buying USDC and other fiat-backed stablecoins as they momentarily lost their pegs to take advantage of the arbitrage opportunity.

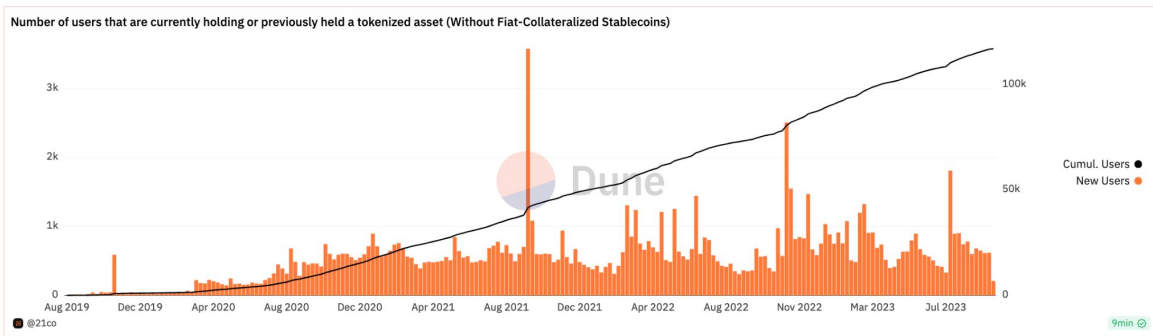


Source: 21.co. This table only covers blockchains available on Dune (Ethereum, Avalanche, Arbitrum, Base, Polygon, Gnosis, Optimism), which represent about 60% of total tokenized assets.

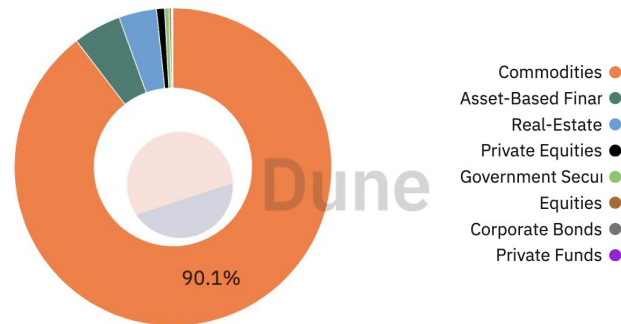
Tokenization Users

Excluding stablecoins, there are about 116k holders of tokenized assets as of October 2023. The most prominent use case outside of stablecoins is tokenized commodities, with ~105k cumulative users, followed by asset-based finance (5.6k), private equity (~800), and government securities (~400).

Figure 12: Holders of Tokenized Assets over Time (Excluding Stablecoins)

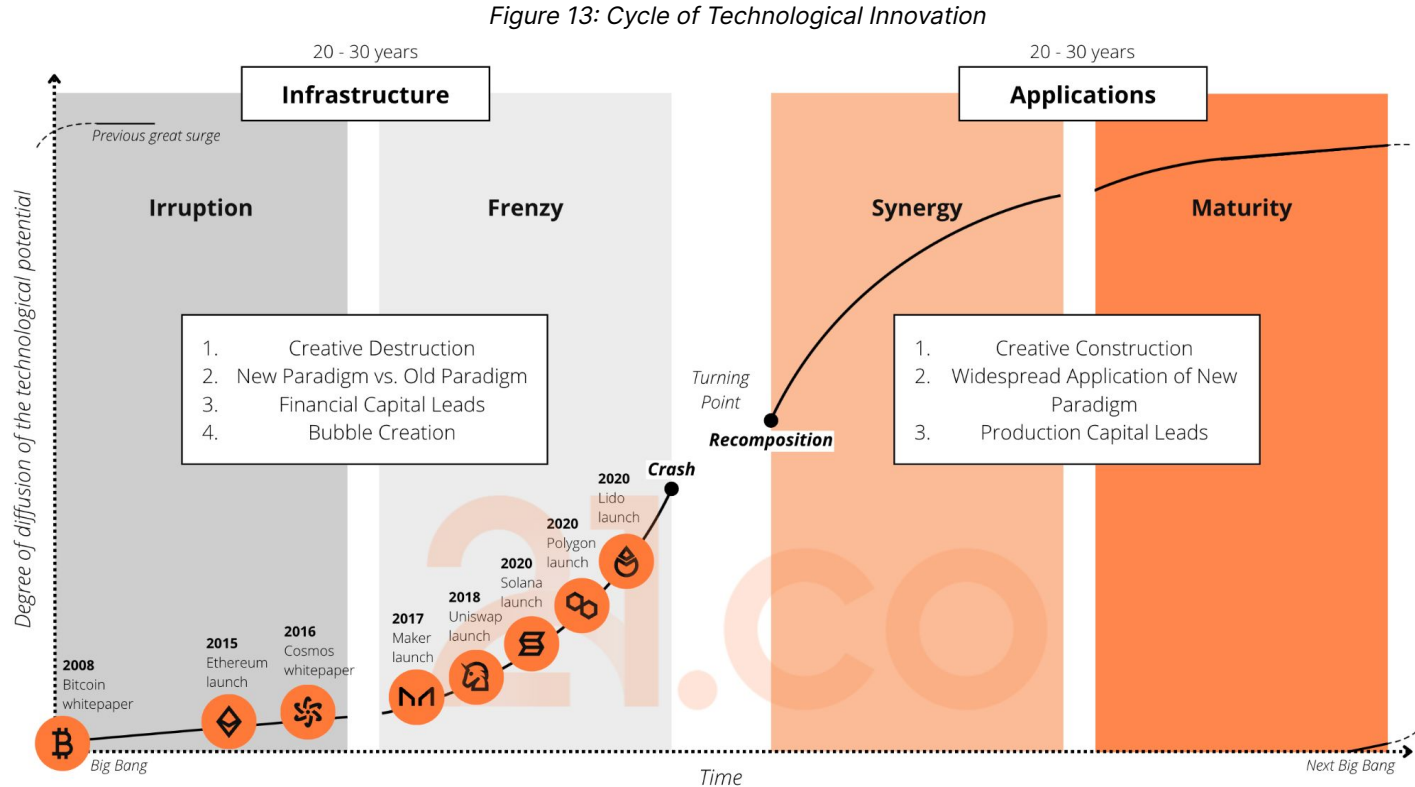


Number of Cumulative Users that have held Tokenized Assets - by Type of Asset



Pivotal Moment for Crypto Adoption

- Blockchains, analogous to the internet protocols, will become more invisible on the backend, where innovation will focus more on consumer-facing applications.
- Based on Carlota Perez's framework, **crypto is transitioning from frenzy to synergy**.
- Through this transition, crypto will increasingly integrate with existing financial software and bring real-world assets (RWAs) on-chain via tokenization.



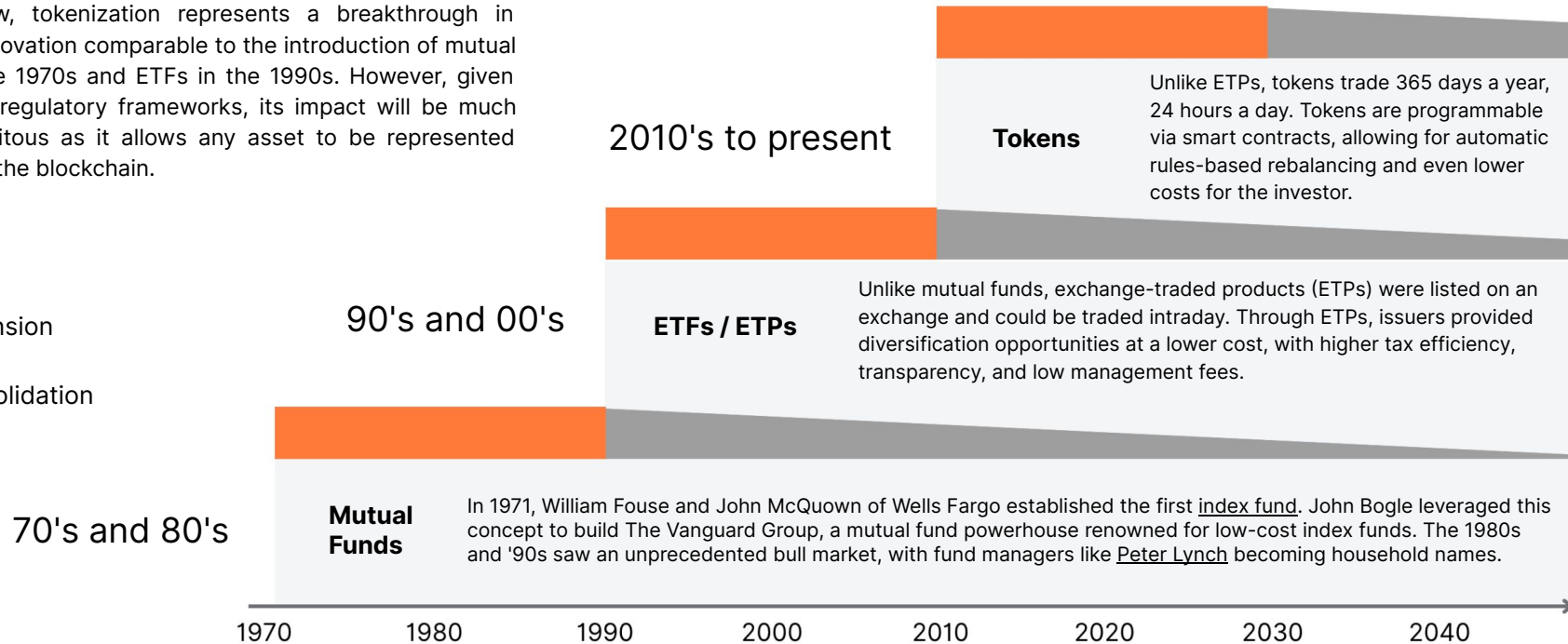
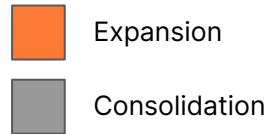
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Total Addressable Market (TAM)

The Evolution of Financial Products: We're in the Tokenization Era

Figure 14: The Evolution of Financial Products, from Mutual Funds to Tokens

In our view, tokenization represents a breakthrough in financial innovation comparable to the introduction of mutual funds in the 1970s and ETFs in the 1990s. However, given the proper regulatory frameworks, its impact will be much more ubiquitous as it allows any asset to be represented digitally on the blockchain.



Tokenization: A Multi-Trillion-Dollar Market

We estimate that the market value for tokenized assets will be between **\$3.5 trillion** in a bear-case scenario and **\$10 trillion** in a bull-case scenario by **2030**. For the base case, we assume that tokenization will capture about ~10% of the net assets of regulated open-end funds worldwide, which was ~\$70 trillion at the end of Q2 2023. For the bull case, the CAGR is comparable to the one we have observed historically for the growth of crypto owners. The bear case is ~0.5x the base case.

Figure 15: Tokenization Market Sizing

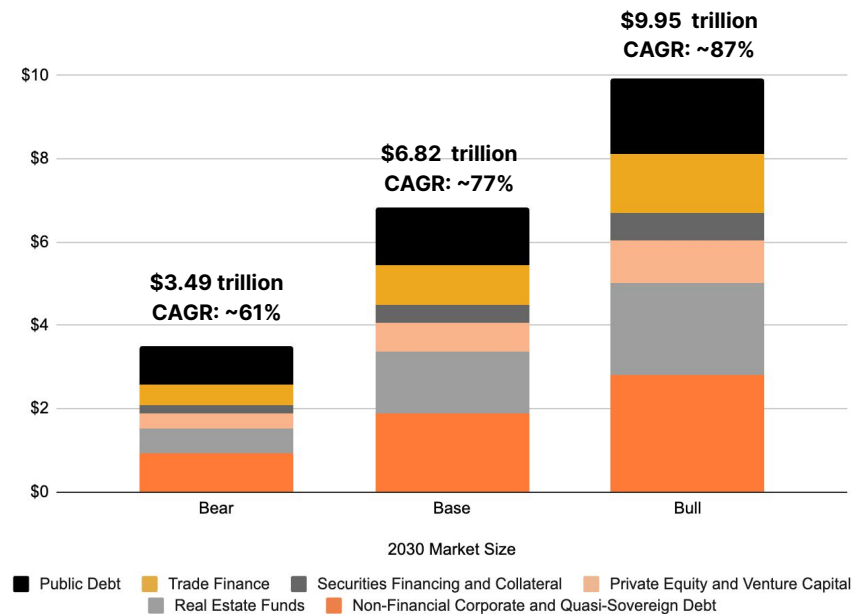


Figure 16: Market Sizing Assumptions

Industry – Total Addressable Market	Penetration Rate		
	Bear	Base	Bull
Non-Financial Corporate and Quasi-Sovereign Debt	0.5%	1%	1.5%
Real Estate Funds	3%	7.5%	11%
Private Equity / Venture Capital	5%	10%	15%
Securities Financing and Collateral	0.5%	1%	1.5%
Trade Finance	4%	8%	12%
Public Debt	1%	1.5%	2%

Why Would a Traditional Business or Investor Want to Bring their Assets On-Chain?

Table 6: Benefits of Tokenization

Benefits	Description
Liquidity	Simplified architecture for liquidity provision and end-user access.
Accessibility	Global and/or expanded accessibility.
Settlement Efficiency	Faster settlement, reduced operational and intermediating costs via automated execution.
Transparency	Tamper-proof record of ownership that is publicly accessible, with stakeholders having a clear understanding of how tokenized assets are managed and governed.
Composability	Tokenized assets can be used across other services built in the same blockchain network. For instance, a user can use a tokenized security as collateral in a lending marketplace, or provide liquidity on a decentralized exchange.
Interoperability	Seamless transfer of assets and data across different blockchains if, for example, two banks decide to use Ethereum on the one hand and Polygon on the other.

07 Challenges & Regulations

Tokenization Challenges

There are **five main challenges** that must be addressed for tokenization to scale by orders of magnitude from where it is today (see next slides for more details).



Legal and Regulatory Compliance



Standardized Laws and Regulations



Collaboration between Multiple Stakeholders



Valuation and Audit Implications



Security and Scalability

Source: 21.co

Challenges

Table 7: Tokenization Challenges and Limitations

Challenge	Description	Potential Solution
Legal and regulatory compliance	<p>Tokenization needs a legal framework for the transfer of ownership. In other words, how do we ensure that a token transfer means transferring the ownership of the underlying asset?</p> <p>I.e., Market participants holding or trading tokens (e.g., VASP) are subject to AML/KYC regulations and must ensure the identity of their clients.</p>	<ul style="list-style-type: none"> - Decentralized Digital Identity, utilizing ZK* technology, automates the secure sharing of personal and financial information while preserving privacy and linking ownership to a real identity. Not only does it streamline and simplify KYC/AML procedures, but it also offers a comprehensive solution to identity management. - Legislation to address the gap between physical and digital twins, such as Article 7(1) of the Liechtenstein Token Act, where token transfer equates to rights transfer.
Valuation and audit implications	<p>How do we enforce a proper price discovery mechanism that allows the token to trade close to the “intrinsic” or nominal value of different tokenized assets?</p> <p>And how do we ensure stringent collateralization standards when institutions hold crypto?</p>	<ul style="list-style-type: none"> - Acknowledging a set of token standards, then using oracle data-feed solutions run by oversight bodies (personal nodes) to query the value of assets in question from the real world. - Example: ERC 2258 splitting custodial and beneficial ownership, ERC 3643 bringing more control for post-issuance operations, like guaranteeing ownership as tokens are linked with on-chain identity - Leveraging Chainlink’s Proof-of-Reserves, combined with traditional audits, to ensure real-time compliance and satisfy high-collateralization requirements.

Source: 21.co

*ZK: Zero Knowledge Proof Technology allowing the owner to prove underlying data is true without revealing its content.

Challenges

Table 7: Tokenization Challenges and Limitations

Challenge	Description	Potential Solution
Standardized laws and regulations	How can tokenized securities spanning across multiple jurisdictions operate in a globally compliant manner?	While certain conditions apply broadly (e.g., securing legal ownership, AML provisions, existence of a marketplace, qualification of the token), local jurisdictions must still be accounted for effective compliance assurance. <ul style="list-style-type: none"> - A common taxonomy for digital assets, like 21Shares' Global Crypto Classification Standard (GCCS), used in conjunction with existing risk-management frameworks that can then be tailored for blockchain-based securities. - That said, collaboration between token issuers, regulators, service providers, and investors is necessary for effective regulation.
Security & Scalability	Public blockchains must demonstrate resilience against cyber-security attacks and scale to the demands of the global financial system.	Artificial Intelligence (AI) models to analyze historical data for identifying patterns of vulnerability, combined with regulated sandbox environments that allow for experimentation with novel securitized implementations such as the European Blockchain Regulatory Sandbox .**
Collaboration between the multiple key stakeholders	There is a need for a standard for bringing assets on-chain to minimize human intervention and make things as scalable as possible.	Interoperability solutions connecting traditional and blockchain native platforms like Chainlink CCIP connecting banks and public blockchains, demonstrated by Chainlink and ANZ pilot trial.*

Source: 21.co

* <https://pages.chain.link/hubfs/e/anz-ccip-cross-chain-tokenized-asset-settlement-case-study.pdf>

** <https://digital-strategy.ec.europa.eu/en/news/launch-european-blockchain-regulatory-sandbox>

Regulations

Table 8: Regulatory Frameworks

Jurisdiction	Framework	Objective
Switzerland *	Federal Act on the Adaptation of Federal Law to Developments in Distributed Ledger Technology (DLT bill)	Introduces a new category of ledger-based securities in the Code of Obligations; allows for the issuance, listing, and trading of ledger-based securities through DLT trading facilities; offers clarity for transfer of rights on a blockchain.
Luxembourg*	Blockchain III Law	Enables book-entry securities issued and held through DLT to be subject to financial collateral arrangements and implements important concepts in Luxembourg law to accompany the Pilot Regime.
Germany*	Future Financing Act / Electronic Securities Act (eWpG)**	Enables blockchain-based security issuance.
UK	Second Digital Securities Sandbox , established under Financial Services and Markets Act 2023	Progressively enables digital securities to be traded, with FCA overseeing. Expected to go live by Q1 of 2024.
Singapore	Proposed framework, yet to be implemented	Discusses governing standards and best practices related to market infrastructure, which can be applied to the digital asset ecosystem.

Source: 21.co, Federal Assembly of the Swiss Federation, CSSF, Tokeny, Deloitte, UK Government, Monetary Authority of Singapore (MAS)

EU DLT Regime: Pilot regime for digital assets and a regulatory sandbox that certain member states began implementing like Luxembourg.

(*) Caveat with Switzerland, Germany and Luxembourg is that securities can only be listed on a trading venue if they are recorded in a book entry form on a central securities depository
 (**) The Electronic Securities Act (eWpG), which came into force in 2021, has only allowed bearer bonds and investment fund units to be securitized in electronic securities so far, but not shares in stock corporations. This is now to be changed, thus taking a decisive step toward digitalizing the capital market. In the future, registered and bearer shares can also be issued as electronic shares.

08 Conclusion

Conclusion

While use cases like stablecoins illustrate the potential of tokenization, we are still in the experimental phase of this innovation. As the digital asset space matures, it will converge with the traditional financial system and become more ubiquitous, analogous to how the Internet has increasingly become an essential part of our daily lives over the past 30 years. Today, holders of tokenized assets already represent more than 10% of the estimated 431 million crypto owners. We expect crypto to seamlessly integrate with existing financial software and build bridges into the physical world, enabling tokenization to grow into a multi-trillion-dollar industry impacting billions of people worldwide.

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