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## TOKENIZATION OF REAL-WORLD ASSETS (RWA): A BRIDGE BETWEEN TRADITIONAL FINANCE AND BLOCKCHAIN

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**Abstract.** This article explores the phenomenon of tokenization of real world assets (RWAs) as a key trend in the development of the modern financial ecosystem. The mechanisms of transforming physical and financial assets into digital tokens on the blockchain are analyzed, the advantages and risks of this approach are considered, and up-to-date data on the growth of the RWA market are presented. Research indicates that the market for tokenized assets is demonstrating exponential growth, having reached USD 176 billion in 2024, with projections estimating an increase to USD 16 trillion by 2030 [1,2].

**Key words:** real world assets (RWAs), tokenization, blockchain, decentralized finance (DeFi), digital assets, smart contracts, CBDC, GovTech.

**Introduction.** Tokenization of real world assets (RWAs) is the process of converting physical or financial assets (such as real estate, bonds, or gold) into digital tokens on the blockchain, enabling the creation of a digital representation of a real asset while preserving its economic value.

Each such token represents ownership rights or a share in the underlying asset and can freely circulate within the digital ecosystem. Tokenization enables the transfer of traditional investment instruments into the Web3 infrastructure, providing transparency and automation. RWAs connect two worlds – the classical financial sector and decentralized technologies [3].

This area became especially relevant in 2023–2024, when leading institutional players began actively exploring and implementing tokenization models. Companies such as BlackRock, Franklin Templeton, and Société Générale became pioneers in the field of digital bonds and tokenized funds [4].

Moreover, regulators have begun to establish a legal framework for tokenized assets, recognizing their real value and legal validity.

With the growing interest in RWAs from DeFi platforms such as MakerDAO, Aave, and Ondo Finance, this approach is becoming one of the most promising directions in the development of the financial industry, enabling the convergence of traditional finance (TradFi) and decentralized finance (DeFi).

As a result, new models of collateral, lending, and liquidity based on real world assets have emerged. This opens access to investments for millions of users, including those who previously had no opportunity to participate in equity or debt markets. Financial inclusion is becoming a reality thanks to the ability to invest even small amounts in tokenized real estate, bonds, or commodities.

This also lowers entry barriers for startups, small businesses, and emerging economies that previously found it difficult to attract capital. For investors, RWAs represent a more stable and secure form of investment compared to volatile crypto assets. At the same time, they retain all the advantages of blockchain technology: transparency, automation, and the absence of intermediaries.

The relevance of RWAs research is driven by the rapid growth of interest from institutional investors, major banks, and regulatory bodies. According to data from the Tokenized Asset Coalition, the total value locked in tokenized assets reached USD 176 billion in 2024, representing a 32% increase compared to the previous year [1].

The aim of this article is to provide a comprehensive analysis of the current state of the RWA market, identifying key trends and prospects for the development of tokenization as a tool for transforming the financial landscape.

It is important to understand that RWAs are not a temporary trend but a fundamental direction in the development of digital finance. Through this solution, the real integration of the crypto economy into the global financial system takes place. For banks, funds, and institutional investors, RWAs become the entry point into Web3. For blockchain communities, they represent an opportunity to move beyond speculation and approach practical applications of technology in the economy [5].

**Basic theoretical and practical provision.** The concept of tokenization of real world assets (RWAs) began to be actively discussed within the crypto community starting in 2017, riding the wave of interest in Initial Coin Offerings (ICOs) and the possibilities of smart contracts. The first experiments with tokenization of RWAs took place between 2017 and 2020, when pilot projects emerged in the fields of real estate, art, and commodities. Among the early projects were platforms such as RealT (real estate tokenization in the USA) and Maecenas (art). These initiatives demonstrated that ownership rights could be transferred via blockchain, but also revealed numerous legal and technical limitations. Since 2019, a noticeable shift toward the institutionalization of RWAs has occurred [6].

Financial companies began experimenting with tokenized securities, especially in the bond sector. In 2020, the French bank Société Générale became one of the first to issue a tokenized bond on the Ethereum platform [7].

This became an important precedent for the legitimization of such instruments. In parallel, attempts began within the DeFi environment to use tokenized assets as collateral. MakerDAO, for example, started considering the acceptance of RWAs to back its stablecoin, DAI. This move demonstrated that DeFi can interact with the traditional economy on a profound level. Since 2022, there has been growing interest in the tokenization of government debt – particularly U.S. Treasury bonds. Franklin Templeton and BlackRock have begun developing and testing funds in which shares are represented as tokens. This has turned RWA tokenization from a mere technical experiment into part of the infrastructural solutions on Wall Street [8].

In 2023, BlackRock invested in projects developing tokenized ETFs backed by real assets. This sent a strong signal to the market: RWAs are not only an innovative component but also an institutional one from a strategic perspective.

In 2023, the Centrifuge initiative emerged, combining tokenized invoices, loans, and inventories with DeFi. Projects such as Goldfinch and Maple began providing loans backed by real assets. The term "DeFi 2.0" appeared, referring to integration with the real economy through RWAs. Tokenization became a way to increase liquidity for businesses that had previously faced difficulties in raising capital.

In 2024, the market volume of tokenized bonds and assets exceeded USD 6 billion, according to data from Galaxy Digital. Government regulators began developing frameworks for Security Token Offerings (STOs) and the recognition of digital rights.

2024 became a turning point for the RWA industry. Key development indicators [1, 9, 10, 11]:

- 1. total market volume: USD 176 billion (32% year-over-year growth);
- 2. growth of non-stablecoin assets: 53% in 2024;
- 3. number of RWA tokens: over 185 tokens with a total capitalization of USD 10.62 billion.

The launch of the BlackRock USD Institutional Digital Liquidity Fund (BUIDL) in March 2024 is of particular significance, as it attracted over USD 1 billion in assets under management within a short period, becoming the largest tokenized Treasury bond fund [12].

Initiatives are emerging from central banks and the IMF, viewing RWAs as a component of the future financial infrastructure. The infrastructure for working with tokenized assets has improved, with the emergence of custodial services, auditing, and legal frameworks. Marketplaces for tokenized assets have also begun to appear, such as Ondo Finance, Backed Finance, and OpenEden [13].

Many protocols have begun developing sub-DAOs or subsidiary structures to manage RWA products. Integration with real-world identity has also intensified – through KYC/AML, e-signatures, and notarial protocols. In DeFi, it has become common to see stable yields based on tokenized U.S. Treasuries. RWAs are no longer viewed as a niche topic and are increasingly seen as a strategic bridge between TradFi and Web3. The history of RWA tokenization is a journey from experimental ideas to the infrastructure of a new digital capital.

In evaluating the types of assets eligible for tokenization, the following key categories can be identified:

Real estate: includes residential, commercial properties, and infrastructure assets. Tokenization enables the fractionalization of high-value assets, making them accessible to a wider range of investors.

Digital tokens can represent shares of residential apartments, commercial properties, hotels, or warehouses. This allows investors to purchase a fraction of real estate for a relatively small amount, such as USD 100, making the market more accessible. Projects like RealT and Lofty.ai are already implementing this model, providing monthly rental income to token holders. Another important direction is collateralized commercial real estate, where properties serve as security for token issuance. This creates opportunities for lending to small and medium-sized enterprises.

Financial instruments: Treasury bonds, corporate bonds, loans, and equities. This category shows the most dynamic growth, especially in the segment of U.S. government bonds.

Tokenized bonds are being issued by major institutions such as Franklin Templeton and Société Générale [13,14]. This enables investors to access a faster, more transparent, and more efficient version of traditional securities. Loan tokenization is employed by platforms such as Centrifuge and Goldfinch, where companies gain liquidity and investors receive yields [15].

Commodities: Gold, oil, agricultural products. Tokenization of commodities enables more efficient pricing and trading.

Tokens can represent one ounce of gold or one barrel of oil, as well as volumes of investment-grade wine or whiskey stored in certified warehouses. This allows participation in commodity markets without logistical complications. Examples of such solutions include Paxos Gold (PAXG), Tether Gold (XAUT), and tokens issued by Digix.

**Intellectual property and artworks:** NFT tokenization of works of art, music, patents, and other intellectual property assets.

Many galleries and investors tokenize paintings, sculptures, and collectible items (books, watches, cars, and more). Each token represents a share of ownership or rights to income from future sales. This lowers the entry barrier to elite investment segments and increases liquidity. Platforms such as Maecenas and Particle are opening the contemporary art market to a wider audience.

**Infrastructure assets:** energy facilities, transportation infrastructure, and utilities.

Investors can finance the development of physical supply systems or utility infrastructure. This is particularly relevant for emerging economies and ESG projects. For example, the Energy Web Token project enables tokenization of participation in energy markets [16]. Tokenization of equipment, machinery, and vehicles is also possible, with options for subsequent leasing or resale. There is a growing practice of issuing tokens backed by these assets, transforming them into sources of liquidity for businesses.

Thus, RWA tokenization covers almost the entire spectrum of assets: from securities to energy solutions (such as solar panels) and museum exhibits. This technological flexibility makes the technology relevant and scalable for both institutional and retail investors.

Aspects of the synergy between RWAs, central bank digital currencies (CBDCs), and the development of digital governance solutions (GovTech) require detailed study, but it is impossible to overlook the promising prospects of such interconnection. Potentially, these are the drivers of a revolutionary transformation of the existing public administration architecture.

This represents an opportunity for modernization and, importantly, for overcoming issues such as corruption through the implementation of proper and transparent managerial actions:

- 1. creation of transparent digital registries of state-owned property;
- 2. development of national blockchain infrastructures for managing digital property rights;
- 3. simplification of privatization (or leasing) procedures with increased levels of oversight;
- 4. automation of public procurement and contracts through smart contracts with digital monitoring of execution and compliance with established requirements;
- 5. implementation of eID (digital identity) as a mechanism for verifying ownership rights and participation in governance voting of tokenized assets;
- 6. possibility of involving investors in government-established funds (e.g., tokenized shares in state assets), where CBDCs are used as a means of payment, and the active portion of the portfolio is implemented in the form of RWAs.

It is expected that such a model, combined with an adequate system of public education, will significantly increase public trust in institutional structures and stimulate domestic investments.

Integration of RWA and CBDC solutions into government digital platforms will strengthen the digital sovereignty of the state and have a positive impact on the macroeconomy:

- 1. enhancement of monetary policy through direct digital transfers;
- 2. creation of tokenized "green" ESG bonds and investment mechanisms for sustainable development;
- 3. growth of domestic liquidity and capital accessibility, including with control mechanisms such as "conditional funding," where access to funds is granted only upon strict fulfillment of specific conditions encoded in smart contracts.

To analyze aspects of practical application of RWAs, it is necessary to examine the tokenization mechanism.

Tokenization is the process of converting a real asset into a digital token on the blockchain, while maintaining the legal and economic connection to the original asset.

The tokenization mechanism of RWAs includes the following key stages:

- 1. identification and valuation of the asset: determining the asset's value and legal status;
- 2. creation of a legal structure: establishing a Special Purpose Vehicle (SPV) to ensure the legal connection between a token and an asset;
  - 3. token issuance: creation of digital tokens using smart contracts;
  - 4. blockchain registration: recording ownership rights in the distributed ledger;
  - 5. trading and management: enabling a secondary market and managing the asset.

The key participants in the ecosystem are:

- 1. custodians: ensure the secure storage of assets and their digital representations. They play a critical role in maintaining trust in tokenized assets;
- 2. oracles: provide reliable information about asset prices and conditions in the external world for smart contracts;
- 3. tokenization platforms: Centrifuge, Mantra, Ondo Finance, Tokeny, Securitize provide the technological infrastructure for the creation and management of tokenized assets.

Tokens are issued on the selected blockchain platform – which may be Ethereum, Polygon, or Avalanche.

Tokens are encoded in a smart contract with conditions for ownership, transfer, and yield distribution. Each step is verified by ecosystem participants such as custodians (asset holders), oracles

(data providers), legal partners, and smart contract developers. Investors purchase tokens through the platform, gaining access to the real asset in digital form.

Smart contracts are essential for secure operations: they automatically distribute income, block transactions if conditions are not met, and record ownership rights. Oracles connect data from the external world – such as prices, revenues, and collateral status – and transmit it to the blockchain. For example, if a token represents real estate, an oracle may provide information about the property's value based on appraiser data [17].

All of this ensures transparency, automation, and trust throughout the process. Platforms such as Centrifuge employ decentralized procedures to connect real assets to DeFi. Ondo Finance focuses on the tokenization of bonds and corporate instruments, collaborating with institutional investors [18].

The tokenization process requires compliance with regulatory requirements, especially when issuing security tokens. Mechanisms such as whitelists and trading restrictions for non-qualified investors may be applied. The legal framework can vary by jurisdiction – MiCA is actively developing in Europe, while SEC regulations apply in the United States. It is important that token holders have clear rights, including redemption, income, or voting rights [19].

Overall, the tokenization mechanism is a coordinated interplay of technology, law, and finance. It paves the way for the creation of a global, 24/7, barrier-free investment space. More advanced formats are to be expected, including fractional tokenization with flexible governance, automatic asset inheritance, and multi-chain accounting.

The current practical application of RWAs significantly changes how people invest in, buy, sell, and manage assets. One of the key advantages is ownership fragmentation, meaning the ability to divide an expensive asset into small digital shares. For example, if a house is valued at USD 500,000, it can be divided into 5,000 tokens worth USD 100 each: anyone can become a "fractional investor." This opens the door to real estate, art, or securities markets for students, freelancers, and residents of countries with limited investment access.

Tokens enable peer-to-peer buying and selling of assets directly between participants, without banks, brokers, or notaries. Smart contracts automatically execute transaction conditions: transfers, income distribution, and ownership transfers. This reduces costs and speeds up operations – transactions that previously took weeks now take minutes.

Successful practical examples include implemented projects that fully leverage the advantages of technologies embedded in RWAs:

- 1. a platform where one can purchase a share of luxury real estate for USD 100 and receive rental income. All documents are stored on the blockchain, and rental payments are made automatically once a month;
- 2. implementation of factoring functionality using tokenization of accounts receivable: small businesses issue tokens backed by unpaid invoices and receive liquidity from investors. Investors, in turn, earn interest when the client pays the invoice.

Such models are applied in agriculture (tokens for future harvests), energy (solar panels), equipment (leased machinery), and even education (prepaid courses).

For companies, this is a way to raise capital faster without traditional lending. For investors, it opens access to new types of income previously unavailable.

Tokenization is useful for asset management—for example, through DAO infrastructure, where token holders vote on building repairs, rent changes, and other important decisions. This makes investments not only more accessible but also more democratic. The system is transparent: everything is visible on the blockchain—who bought what, who voted on what, and when payments will be made.

Blockchain also simplifies auditing and regulatory compliance. Regulators can track the movement of funds and shares in real time, reducing the risks of money laundering and fraud.

Equally important is that tokens are easy to transfer or sell on the secondary market. If you have invested in a tokenized asset, you are not obligated to hold it for years—you can sell your share at any time.

Mass adoption of tokenization also promotes financial inclusion – meaning that more people in developing countries will gain access to global financial markets.

Even educational institutions can issue tokens backed by future income streams or tuition payments, forming a type of informational "social card" about students. A pilot project is being actively implemented at V. N. Karazin Kharkiv National University, and similar initiatives are underway in South Korea (company Letitu), with positive outcomes expected. In African countries, startups are emerging where farmers tokenize their harvests, and students can purchase "education tokens" that pay off after gaining employment.

Thus, RWA tokenization is not just a trend but a powerful tool for transforming the entire economic model—from traditional investments to crowdfunding, microfinancing, and social entrepreneurship.

All of the above allows for a systematic analysis of the potential risks associated with the technology under study.

One of the main advantages of real asset tokenization is increased liquidity. Thus, tokenization of traditionally illiquid assets provides:

- 1. ownership fragmentation: the ability to purchase shares in high-value assets;
- 2. 24/7 trading: global markets without time restrictions;
- 3. reduced spreads: more efficient price discovery.

Lowering entry barriers: this aspect can be characterized as a form of investment democratization:

- 1. minimum investments: the ability to invest from USD 100 in real estate;
- 2. geographic accessibility: investments in assets worldwide;
- 3. simplified procedures: automation through smart contracts.

Thanks to fragmentation, people can invest even with USD 10 or USD 100, without waiting to accumulate large capital. This is especially important for young people, students, and residents of developing countries. Investing becomes not a luxury but a real opportunity for everyone.

Transparency of RWAs is a significant step forward compared to the traditional system and can be considered a factor of operational efficiency:

- 1. transparency: all information is available in the distributed ledger;
- 2. cost reduction: elimination of intermediaries in various processes;
- 3. transaction speed: instant transactions instead of multi-day procedures.

All data on assets, transactions, and rights are recorded on the blockchain and accessible at any time. This helps prevent double sales, fraud, and "dark zones" in reporting. Platforms can publish ownership registries, yield schedules, and payment timetables – all verifiable.

Additionally, tokenized assets can interact with DeFi protocols. For example, a real estate token can be used as collateral in DeFi to obtain a loan or participate in yield farming. This makes assets more flexible: you not only own them but can also leverage them within the digital economy.

The possibility of passive income arises: many platforms allow staking of RWA tokens to earn interest income, akin to the concept of traditional deposit placements. This can include rent, dividends, interest on debt tokens, etc. Thus, tokens transform a passive asset (for example, a building) into working capital.

Finally, interoperability is a key feature. Tokens can be used across different blockchains (via bridges), in various applications, and are easily integrated into the DeFi ecosystem. This opens up new use cases – from automated refinancing to insurance of tokenized assets.

Despite its clear advantages, the market for tokenized RWAs faces a number of serious challenges – risks. One of the key issues is regulatory uncertainty.

The main regulatory challenges include:

- 1. uncertainty of legal status: differences in regulatory approaches across jurisdictions;
- 2. compliance requirements: the need to adhere to financial regulations;
- 3. taxation: challenges in determining the tax status of tokenized assets.

In many countries, there is no clear legislation defining the status of RWA tokens, especially when they represent shares in physical assets. The lack of a unified legal framework limits scalability and deters institutional investors.

One of the most significant risks is the risk of legal recognition (or non-recognition) of ownership. In some jurisdictions, a token representing real estate or a bond is not considered valid proof of ownership. This can lead to problems in court or in disputes between parties. There is currently no synchronization between on-chain data and offline property registries [20].

Technical vulnerabilities also pose a significant threat; such risks include:

- 1. smart contract security: risks of hacking attacks and coding errors;
- 2. dependence on oracles: issues with the reliability of external data;
- 3. scalability: limitations of blockchain throughput.

Smart contracts governing tokens may contain bugs or be vulnerable to hacks. There have been cases in DeFi history where hackers exploited vulnerabilities to steal hundreds of millions of dollars. Additionally, there are risks of infrastructure failures, especially when using new or unstable blockchains.

Operational risks should also be highlighted:

- 1. custodial risks: issues related to the storage and management of assets;
- 2. over-collateralization: the need for excessive collateral backing;
- 3. secondary market liquidity: risks of low trading activity.

Some platforms use over-collateralization (e.g., collateral at 150%), which reduces capital efficiency. Others hold real assets through custodial intermediaries, who must be trusted – thus, some decentralization is lost. If a custodian turns out to be dishonest or is subjected to sanctions, token holders may lose access to the underlying collateral.

It is also important to consider the insufficient liquidity of some tokens, especially in "young" projects. An investor may not find a buyer when wanting to exit a position. This is particularly critical in cases of force majeure – liquidity may vanish precisely when it is needed most.

Finally, insufficient platform transparency (e.g., hidden terms, unaudited reserves) can lead to a loss of trust. That is why choosing the right infrastructure and conducting thorough project audits are crucial steps before investing in RWAs.

Tokenization of RWAs holds immense potential to transform the global financial system. One of the key development directions will be integration with central bank digital currencies (CBDCs). This will link traditional financial systems with blockchain infrastructure, ensuring more reliable settlements and regulatory compliance. For example, using e-CNY or the digital euro for transactions involving tokenized bonds will enhance trust in RWAs.

According to a report by Boston Consulting Group, the market volume of tokenized assets could grow from USD 3 billion in 2023 to USD 16 trillion by 2030 [2]. This growth is driven by interest from banks, investment funds, and technology startups, as well as increased transparency of blockchain solutions. Tokenization helps to "digitize" traditional instruments and make them accessible to a global audience. This creates the foundation for a new financial architecture – fast, open, and accessible.

Special attention is given to sustainable financing. The tokenization of "green" bonds, investments in climate projects, and environmental infrastructure is already being tested in the EU and the UAE. Platforms such as Flowcarbon and Toucan Protocol enable real-time tracking of the origin and movement of environmental assets. Thus, blockchain can enhance efficiency and transparency in addressing climate risks [13].

Developing countries can also reap significant benefits. Through DeFi and tokenized instruments, access to capital can be provided to those previously excluded from the traditional banking sector. For example, a farmer in Africa can pledge future harvests as digital assets and receive financing. This promotes financial inclusion and supports the development of the local economy.

In the long term, RWAs could serve as a bridge between digital and traditional finance, replacing some outdated infrastructures. The development of digital identities, property rights, and smart contracts will strengthen blockchain's role as the foundation of global financial accounting. Institutional players such as BlackRock, JPMorgan, and HSBC are already launching pilot projects, signaling a large-scale transformation. Thus, asset tokenization is not just a trend but a fundamental shift in how we perceive money, ownership, and investments.

**Conclusion.** Tokenization of real world assets (RWAs) represents a paradigmatic shift in the financial industry, creating a bridge between traditional and decentralized finance. Analysis of the current market status shows that RWAs are moving from the experimental stage to large-scale commercial application:

- 1. growth scale: the tokenized assets market demonstrates sustained exponential growth, reaching USD 176 billion in 2024;
- 2. institutional adoption: involvement of major financial institutions, such as BlackRock, confirms the technology's maturity and the market's readiness for widespread implementation;
- 3. technological readiness: the development of blockchain infrastructure and smart contracts provides a reliable foundation for the tokenization of various asset types.

Thanks to RWAs, investors gain access to new asset classes previously available only to major players. For example, purchasing a share in luxury real estate or government bonds has become possible even with a small capital.

This paves the way for the democratization of finance – where everyone can participate in global investment flows. Additionally, tokenization makes traditional assets more liquid and transparent. Data on transactions, ownership rights, and fund movements are recorded on the blockchain and are immutable. This enhances trust from both private investors and institutional players.

However, the potential of RWAs can only be realized through coordinated efforts among technologists, legal experts, and governments. It is essential to establish a unified regulatory framework, recognize tokens as property rights, and implement standards for digital identification. Many countries have already begun this process: legal frameworks for tokenized assets are being developed in the UAE, Singapore, and the EU. The success of RWAs depends not only on technology but also on the ability to adapt legislation and transform financial habits.

It is important to understand that RWAs are not merely a trend but a new infrastructure of the global economy. They enable faster settlements, reduced costs, and expanded investment horizons. Companies will be able to raise capital more quickly and cheaply, while users can interact with assets without intermediaries. The emergence of hybrid platforms combining DeFi and CeFi will mark the next stage of development.

The technology has already proven its viability; now, scaling is necessary. In the coming years, we will see an increasing number of real-world cases – from tokenization of real estate to issuance of digital bonds by governments. At the same time, it is crucial to maintain a balance between innovation and investor protection. This requires transparent regulations, auditing, cybersecurity, and educational initiatives.

RWA have already begun reshaping the market structure. Traditional banks are becoming not only consumers but also integrators of blockchain solutions. New financial players are building services at the intersection of Web3, FinTech, and traditional capital. These processes are forming a new era of finance, where blockchain ceases to be a buzzword and becomes a fundamental part of the infrastructure.

Synergy between RWA, CBDC, and GovTech will enable, in essence, a revolutionary transformation in the form of a transition from fragmented digital initiatives to a comprehensive digital governance system, within which:

1. government assets gain liquidity and high transparency;

- 2. budgets become programmable and controllable;
- 3. citizens of the state gain access to investments in public assets, as well as to mechanisms for managing them.

For the further development of the RWA ecosystem, constructive dialogue between technology companies, traditional financial institutions, legal experts, and regulators is essential. Only by establishing clear legal frameworks and technological standards can the tokenization of RWAs fully realize its potential to transform the global financial system.

The future of RWA lies in creating a hybrid financial ecosystem where traditional assets gain the advantages of blockchain technology, and decentralized finance is enriched by real economic value. This opens new opportunities for investors, issuers, and the entire financial industry, fostering the development of a more efficient, accessible, and transparent financial market as well as a government governance model (GovTech).

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