

DEEDX

WHITE PAPER

ACCESS PROPERTY FROM ANYWHERE ,
ANYTIME .

A PROJECT BY CODING LEGENDS



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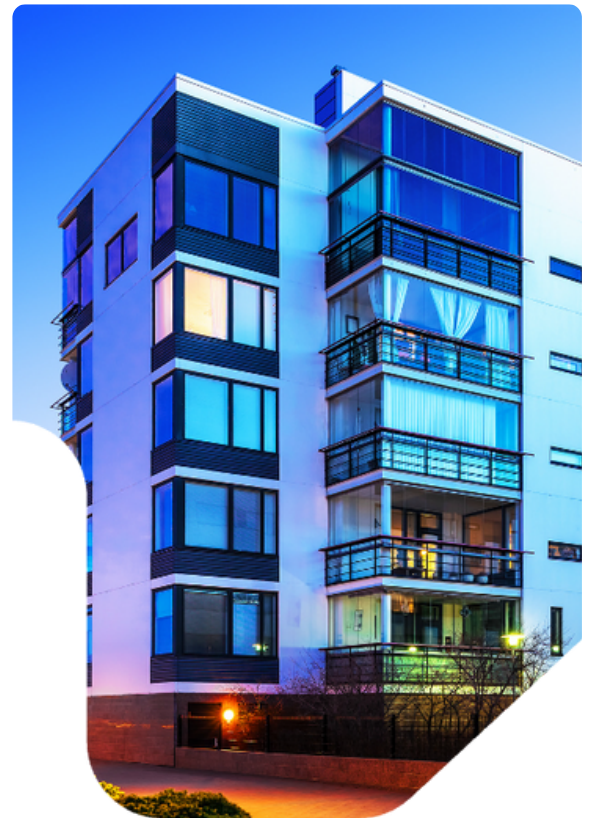
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EXECUTIVE SUMMARY

DeedX represents a groundbreaking advancement in the real estate sector by integrating blockchain technology into various aspects of property transactions. This white paper provides a comprehensive overview of the DeedX ecosystem, designed to revolutionize real estate processes through enhanced security, efficiency, and transparency. Key components of the DeedX platform include:

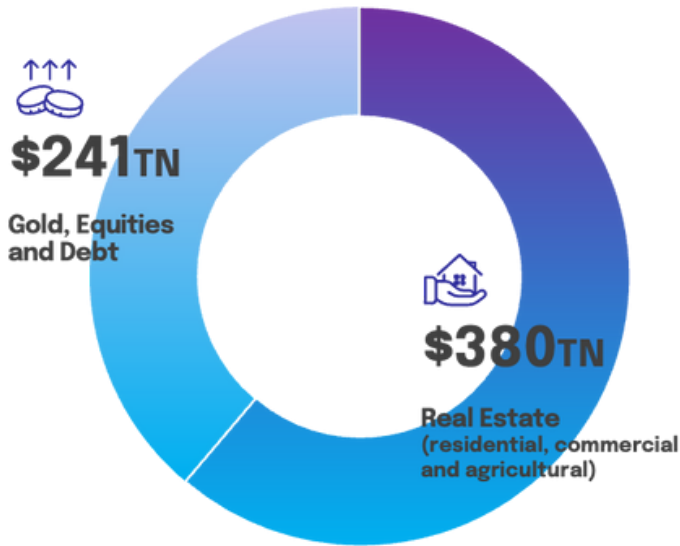
- **Government Portal:** Facilitates real-time monitoring, automates taxation, and integrates with Clean ID and KYV systems, ensuring transparent and compliant transactions.
- **Legal Portal:** Streamlines legal processes with features like property deed verification, digital smart contracts, and a marketplace for legal services.
- **Real Estate Agent Portal:** Empowers agents with tools for property listing, transaction management, and compliance through an escrow system and KYC process.
- **Bank Portal:** Bridges traditional and digital finance by allowing banks to mint stable tokens and supports mortgage lending and deed locking.
- **DeedX Wallet:** A user-friendly gateway for real estate investments, supporting multiple cryptocurrencies and facilitating asset swaps and fractionalized property investments.
- **GridX:** Specialized in fractionalized real estate investments, offering investors the opportunity to purchase property fractions represented as digital tokens



By leveraging blockchain technology, DeedX ensures immutability, transparency, and efficiency in real estate transactions. This innovative approach not only enhances the efficiency and transparency of real estate transactions but also builds trust among all stakeholders involved.

THE OPPORTUNITY

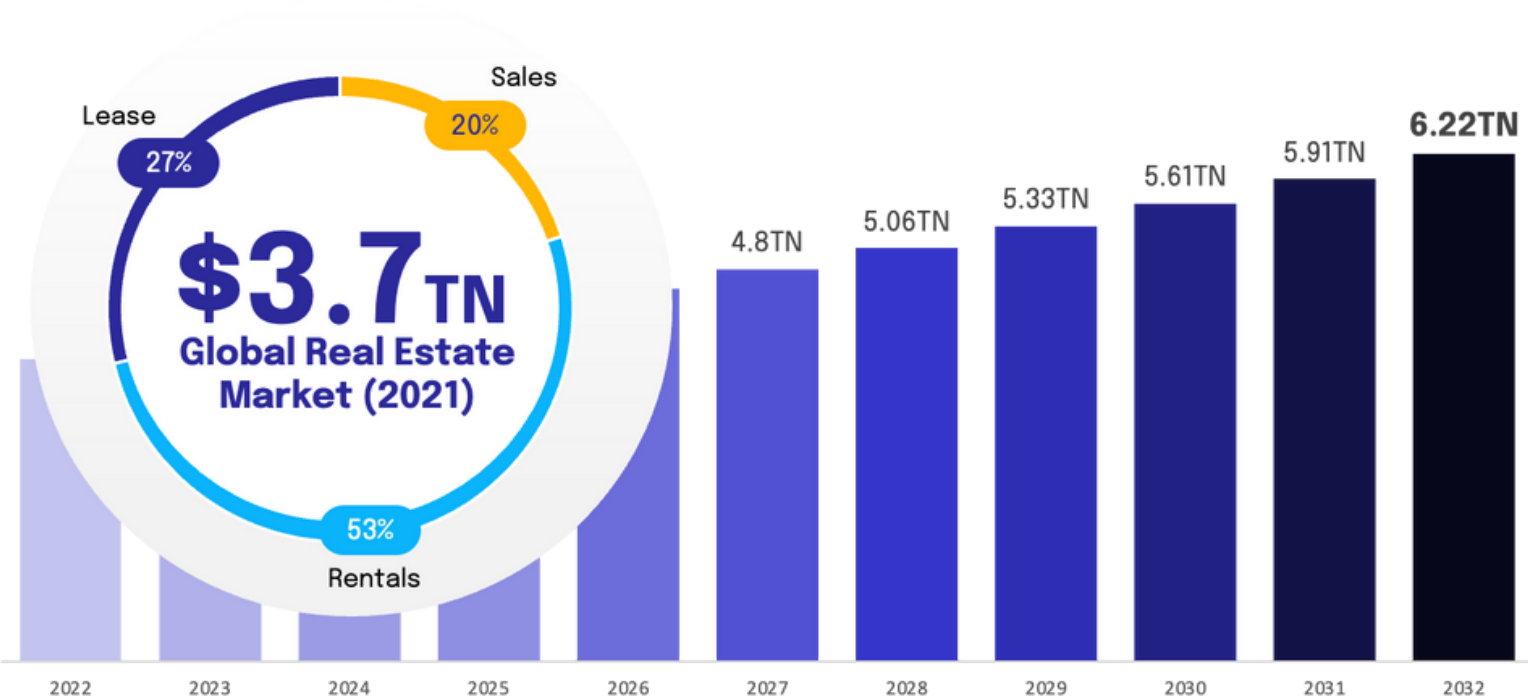
Real Estate property remains the biggest store of global wealth...



< 50%
of the world population
do not own the property
they inhabit

Market Size

Global real estate market to grow by 70% over the next 10 years



INTRODUCTION

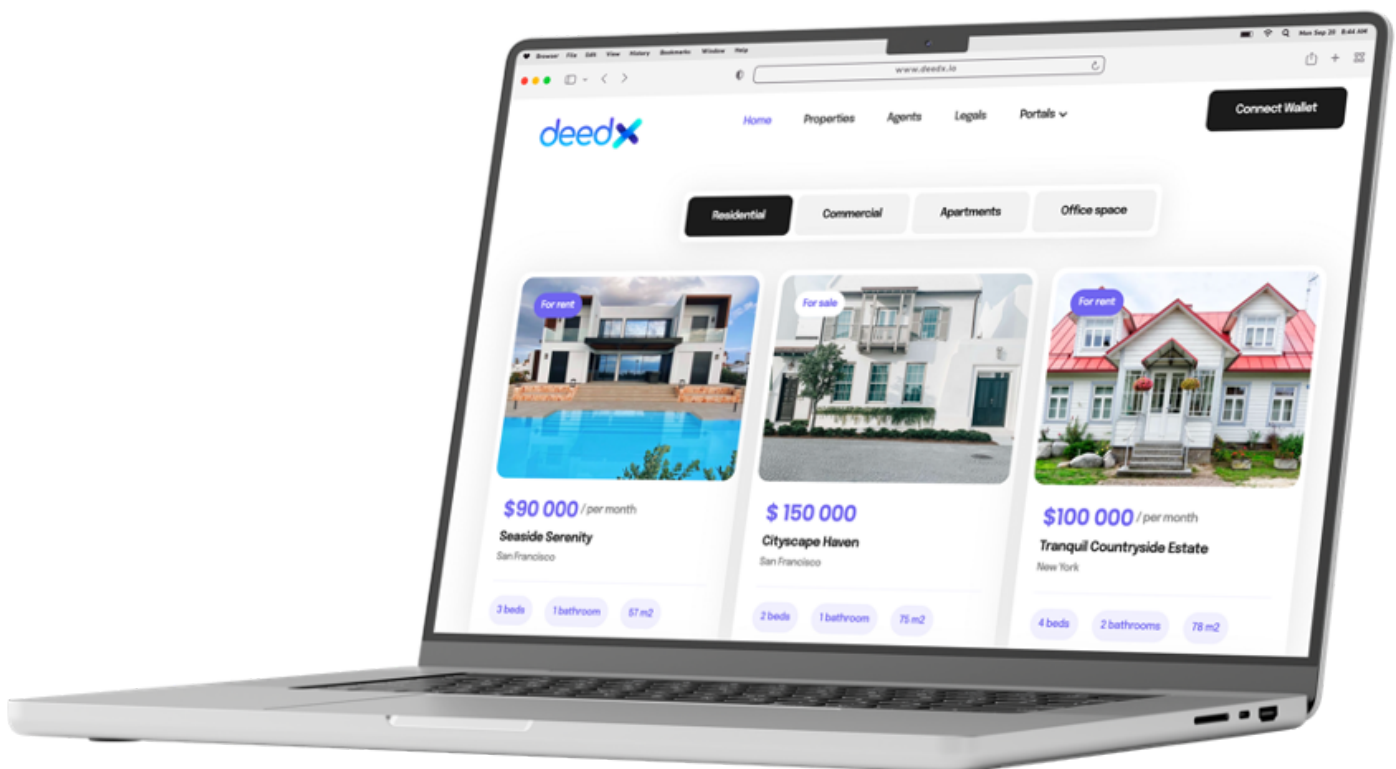
Background and Purpose

The real estate industry, characterized by complex transactions and diverse stakeholders, demands an evolution in its operational mechanisms. DeedX emerges as a solution, harnessing the power of blockchain to simplify and secure real estate transactions. This white paper delves into the intricacies of the DeedX platform, elucidating its components and their impact on the real estate market.

DEEDX PLATFORM OVERVIEW

A Comprehensive Blockchain Ecosystem for Real-Estate and Investments

DeedX is an integrated platform that combines various portals and a sophisticated wallet system to cater to the needs of the real estate market. At its core, blockchain technology ensures immutability, transparency, and efficiency, making DeedX a trailblazer in the industry.



SAFETY AND SECURITY OF LAND TITLES AND DEEDS ON BLOCKCHAIN

The Importance and Efficacy of Decentralized Document Storage

Introduction

In the evolving landscape of real estate transactions, the advent of blockchain technology has introduced a transformative approach to managing land titles and deeds. This section of the whitepaper delves into the significance of storing land titles and deeds on a blockchain network, with a specific focus on the Polygon blockchain, and elucidates why decentralized storage of such documents represents a best practice in the realm of real estate.

Cryptographic Immutability in Blockchain

Hash Function Algorithms

- **Secure Hash Algorithm (SHA-256):** Blockchain employs SHA-256, a cryptographic hash function that converts document data into a 256-bit (32-byte) hash value. Mathematically, it's defined as $H: \{0,1\}^* \rightarrow \{0,1\}^{256}$, where $\{0,1\}^*$ represents the set of all binary strings (document data) and $\{0,1\}^{256}$ is the set of 256-bit strings (hash values).
- **Merkle Tree Structure:** A Merkle Tree is a binary tree where each leaf node represents the hash of a block of data (document) and each non-leaf node is a hash of its child nodes. Mathematically, for a Merkle Tree with n leaf nodes, $M_i = H(D_i)$ for $i=1,2,\dots,n$ where D_i is the document data block and M_i is the Merkle hash.

Polygon's Layer 2 Scaling Solutions

- **Plasma Framework:** The Plasma framework, implemented in Polygon, utilizes Merkle Trees to create "child" blockchains off the main Ethereum chain. Each child chain can be represented by C_i where i indicates the chain index, and the root of each C_i is stored on the main chain.
- **zk-SNARKs Implementation:** zk-SNARKs provide a way to verify knowledge of a secret without revealing the secret. Mathematically, it's a proof construction where Prover can prove to Verifier that $V(x,w) = 1$ for a statement x and a witness w , without revealing w . Here, V is a polynomial-time verification algorithm.

MODELS IN DECENTRALIZED STORAGE

Distributed Ledger and Consensus Algorithms

- **Blockchain Ledger Representation:** The blockchain ledger can be represented as a growing list of blocks, $L = [B_1, B_2, \dots, B_n]$, where each block B_i contains a set of transactions and the hash of the previous block B_{i-1} , ensuring a cryptographic link.
- **Consensus Mechanism Modeling:** For Proof of Stake (PoS), the probability of a node being chosen to validate a block is proportional to its stake. Mathematically, if $P(v)$ is the probability of a node v being chosen and $S(v)$ is the stake of v , then $P(v) \propto S(v)$.

Byzantine Fault Tolerance (BFT)

- **BFT Algorithms:** In a network of n nodes, to tolerate f Byzantine nodes, BFT algorithms ensure consensus if $n \geq 3f + 1$. The system remains functional and reaches consensus as long as the number of malicious nodes doesn't exceed a third of the network

Security Protocols in Polygon Network

Advanced Encryption Standard (AES) and Public Key Infrastructure (PKI)

- **AES Encryption:** AES encrypts document data using symmetric key cryptography. Mathematically, for a key K and plaintext P , the encryption function is $E_K(P) = C$, where C is the ciphertext. The decryption function is $D_K(C) = P$.
- **PKI Algorithms:** PKI uses asymmetric cryptography. For a public key Pu and private key Pr , if $E_{Pu}(M) = C$, then $D_{Pr}(C) = M$ and vice versa, ensuring secure communication and identity verification.

The cryptographic foundations of blockchain technology, especially as applied in the Polygon network, provide a robust and secure framework for managing real estate documentation. The intricate use of hash functions, Merkle Trees, consensus algorithms, and encryption standards underlines the technical prowess of blockchain in ensuring the security, integrity, and reliability of land titles and deeds.

Through the application of these advanced mathematical models and cryptographic protocols, the real estate sector stands to benefit significantly from enhanced security, transparency, and efficiency in document management. The Polygon network, with its Layer 2 solutions and sophisticated cryptographic implementations, further amplifies these benefits, positioning itself as a frontrunner in the blockchain-based transformation of real estate documentation.

MECHANISM OF TRACEABILITY IN BLOCKCHAIN

Immutable Ledger and Transaction Linkage

- **Block Linkage in Blockchain:** Each block in a blockchain contains a set of transactions along with the hash of the previous block. Mathematically, if B_i represents the i^{th} block, it contains $\text{hash}(B_{i-1})$, creating a continuous link. This linkage forms a chain that provides a complete history of all transactions.

Cryptographic Hash Functions

- **Hash Function Role:** Hash functions transform input data (transaction details) into a fixed-size hash value. For any transaction T , $\text{hash}(T)$ produces a unique output, ensuring that any change in T results in a completely different hash, making alterations easily detectable.

Merkle Trees for Efficient Data Verification

- **Merkle Tree Structure:** In blockchain, transactions within a block are organized in a Merkle Tree, where each leaf is a hash of individual transaction data. The root of the tree, a single hash, effectively represents the summary of all transactions in the block.

IMPORTANCE OF TRACEABILITY IN OWNERSHIP RECORDS

Verification of Ownership History

- **Chain of Ownership:** The blockchain's immutable ledger allows for tracing the complete history of a property's ownership. Each transaction related to a property adds a new block to the chain, creating a sequential record of ownership transfers.

Fraud Prevention and Data Integrity

- **Tamper-Evident Ledger:** The cryptographic nature of blockchain makes it nearly impossible to alter transaction data retrospectively. This integrity is crucial in preventing fraud and disputes over property ownership.

Transparency and Trust in Transactions

- **Public Verification:** Blockchain's transparent ledger allows all parties to verify the history and current state of ownership records. This openness fosters trust among participants in real estate transactions.

Regulatory Compliance and Auditability

- **Ease of Audit:** The clear and chronological order of transactions on a blockchain simplifies the process of auditing property records for regulatory compliance, making it an efficient tool for legal and financial scrutiny.

Traceability in blockchain is a cornerstone feature that revolutionizes how property ownership records are maintained and verified. Its implementation in real estate transactions brings an unprecedented level of security, transparency, and efficiency. The ability to trace every transaction, coupled with the immutable and tamper-evident nature of blockchain, ensures that property ownership records are accurate, reliable, and readily verifiable. This advancement not only enhances the trustworthiness of real estate transactions but also aligns seamlessly with regulatory and legal frameworks, setting a new standard in property documentation and management.

CURRENT PROBLEM

The real estate market faces a critical challenge marked by a severe lack of transparency, leading to fraud and disputes. This issue is exacerbated by outdated and inefficient processes, resulting in sluggish transactions. Exorbitant transaction costs further hinder market accessibility, especially for lower-income groups, amid a growing scarcity of affordable housing. The sector is also plagued by complex legalities, data fragmentation, and limited liquidity, making real estate transactions cumbersome and slow. Despite the urgent need for environmental sustainability and technological innovation, the industry lags in adopting these crucial changes. Additionally, the market's susceptibility to economic cycles adds to its unpredictability, impacting stakeholders at all levels. These deep-rooted issues underscore the urgent need for transformative solutions in the real estate domain.

Complex processes discourage real estate transactions



Lack of transparency
on ownership and legal validity

Overreliance
on disinvested stakeholders.

Reactive and slow
verification process

HOW DEEDX SOLVES

DeedX is revolutionizing the real estate sector with its innovative blockchain-powered platform, designed to bring unprecedented transparency, security, and efficiency to property transactions. By integrating blockchain technology, DeedX ensures that every transaction is transparent and secure, significantly reducing the potential for fraud and disputes.

The platform uniquely unifies all key stakeholders in the real estate market, including government bodies, legal professionals, buyers, sellers, and financial institutions, into a cohesive and user-friendly ecosystem. This integration streamlines interactions and transactions, making real estate processes more efficient and accessible.

A key innovation of DeedX is the introduction of fractional ownership through the GridX portal, democratizing real estate investment by allowing investors to purchase fractional shares in properties. This lowers the investment barrier, making it feasible for a wider audience to participate in the real estate market.

CREATING AN INTEGRATED, TRANSPARENT AND UNIFIED PROPERTY LISTING AND ENGAGEMENT EXPERIENCE



Saves time and effort
by pre-verifying property deeds

Ability to own property from anywhere
with blockchain-secured digitized deeds

Transparent and secure transactions
with an integrated wallet using stablecoins

Increased listing credibility
with independent verification options

Access to a global audience
with crypto-powered transactions

Hassle-free and faster transactions
with access to fiat money and crypto funds

DEEDX FLOW

Connecting global stakeholders to listings ensuring secure, swift, and transparent transactions



SELLING PROPERTY ON DEEDX

Agent Verification and Property Listing

- **Verification Function (V(a)):** Each agent a undergoes a rigorous verification process, ensuring the authenticity and reliability of agents on the platform.
- **Property Minting Function (M(p)):** Properties p are minted on the blockchain, creating immutable digital representations (T) that enhance security and transparency.

Transaction Management

- **Commission Structure (C(p, a)):** A predefined commission model is algorithmically calculated for every property-agent combination, ensuring fair and transparent compensation.
- **Escrow Account Function (E(p)):** Sale proceeds are securely held in an escrow account until all conditions of the transaction are met, guaranteeing the protection of funds.

Compliance with Government and Legal Standards

- **Government (G_c) and Legal (L_c) Compliance Checks:** Integration with government and legal portals ensures that each transaction adheres to regulatory standards and legal requirements.

RENTING PROPERTY ON DEEDX

Rental Agreement Processing

- **Rental Agreement Function (R_f):** Digital contracts outline terms including property p, tenant t, duration d, and security s, ensuring clarity and legal integrity.

Payment Management

- **Rental Payment Function (Pay):** This function facilitates the transfer of rental payments, maintaining a transparent and efficient process for both tenants and landlords.

Security Deposits

- **Renter Pays Security Deposit to Landlord:** The renter initiates the process by paying the security deposit to the landlord.
- **Deposit Transferred to DeedX Wallet:** The security deposit is then transferred from the landlord to DeedX's wallet, where it is locked for a predetermined period (e.g., 1 year).
- **Landlord Uses Deposit as Collateral with DeedX:** The landlord can use the locked contract as collateral to receive a cash amount (80% of the deposit value) from DeedX. This is contingent upon the landlord's agreement to resettle the full amount within the agreed period.
- **DeedX Invests in Fixed Deposit with a Bank:** DeedX, holding the deposit, chooses a bank offering the best interest rate and makes a fixed deposit. The interest earned from this deposit serves as revenue for DeedX.
- **End of Period Settlement:** Once the agreed period ends, the process concludes with the settlement of all accounts. The renter's security deposit is handled as per the agreement, considering any interest or deductions as applicable.

BUYING PROPERTY ON DEEDX

Purchase Process and Mortgage Financing

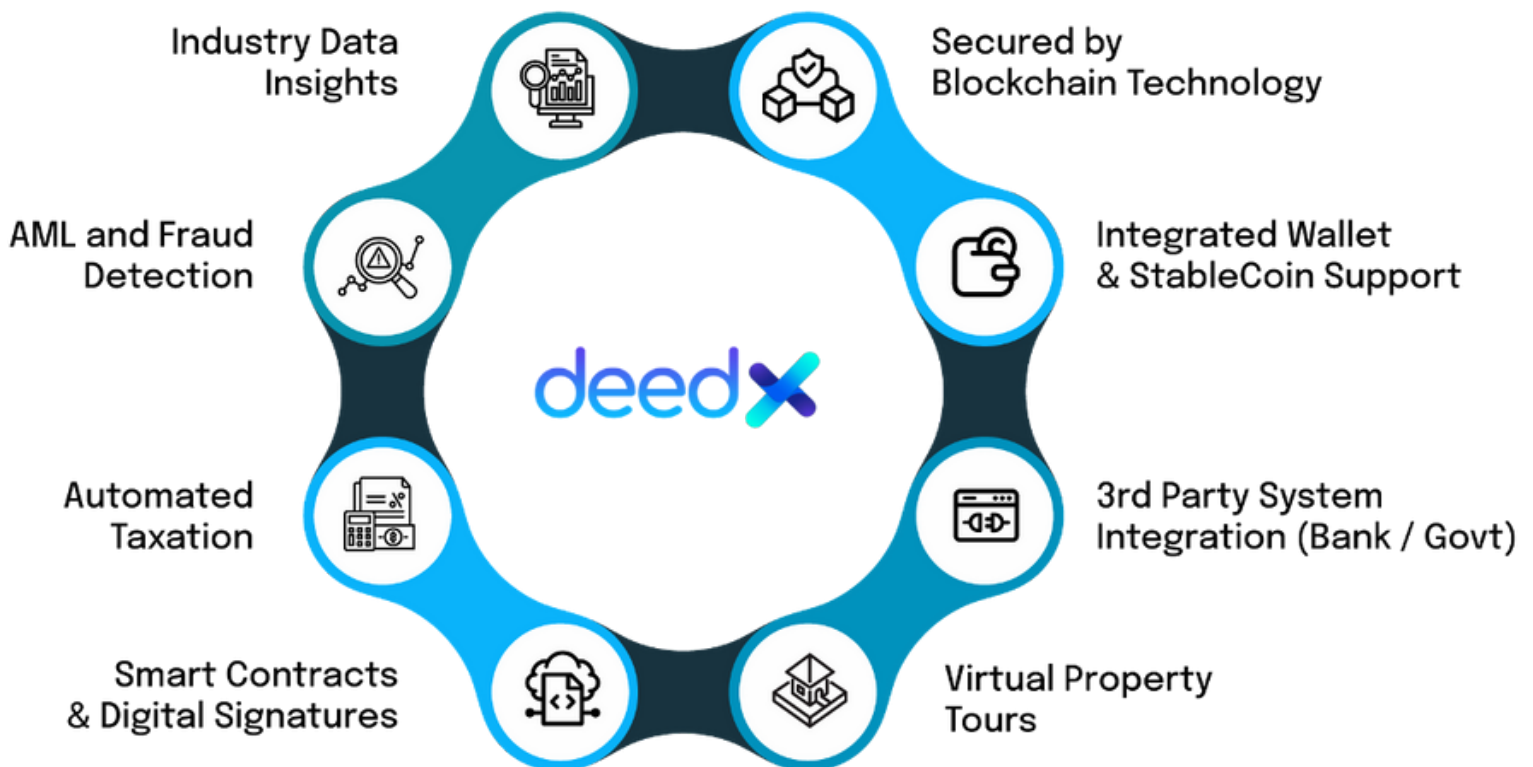
- **Purchase Function (Pu):** Maps buyers B and properties P to the transaction price, offering a clear and straightforward purchase pathway.
- **Mortgage Function (M_f):** For buyers requiring financing, this function connects them with mortgage options, seamlessly integrating with the bank portal.

Escrow and Ownership Transfer

- **Escrow Management (E(p, b)):** Buyer's funds are held securely in escrow, reinforcing trust in the transaction process.
- **Ownership Transfer (O_t):** Ensures the legal transfer of property ownership post-transaction, backed by blockchain technology for added security.
- **DeedX Wallet Functions (W_f):** Central to all transactions, the DeedX Wallet handles and tracks payments, commissions, and escrow funds.
- **Portal Integration Functions (I_b, I_l, I_g):** Seamlessly interact with banking, legal, and government portals, ensuring compliance and streamlined processes.

DEEDX COMPONENTS

DeedX stands as a revolutionary integration of blockchain technology into the real estate sector, fundamentally transforming property transaction processes. At its core, the DeedX ecosystem comprises multiple interconnected portals designed to streamline, secure, and bring transparency to various aspects of real estate dealings. The Government Portal focuses on ensuring transparent, compliant transactions and real-time monitoring, while the Legal Portal streamlines property deed verification and facilitates digital smart contracts. For real estate agents, DeedX provides a comprehensive portal with tools for listing properties, managing transactions, and ensuring compliance through KYC procedures. The Bank Portal bridges the gap between traditional and digital finance, allowing seamless transactions in real estate. Additionally, the DeedX Wallet offers a user-friendly interface for managing digital and traditional assets, supporting diverse cryptocurrencies and enabling asset swaps. Another innovative component, GridX, focuses on fractionalized real estate investments, allowing investors to own property shares as digital tokens. Each component of DeedX synergistically works to enhance the efficiency, security, and transparency of real estate transactions, making the platform a beacon of innovation in the sector.



DEEDX ECOSYSTEM

GOVERNMENT PORTAL

Enhancing Transparency and Compliance

The Government Portal is a key component of DeedX, designed to facilitate real-time monitoring of transactions, automate taxation processes, and integrate with Clean ID and KYV systems. This portal ensures that all real estate transactions are transparent and compliant with regulatory standards.

Purpose and Functionality of the Government Portal

Integration with Clean ID and KYV (Know Your Vendor) Systems:

- The Government Portal utilizes Clean ID technology, ensuring that all participants in the real estate market are verified and trustworthy. This integration facilitates the KYV process on the blockchain, ensuring that all parties in a transaction, including renters, landlords, and agents, are authenticated.

Real-Time Monitoring of Rental Agreements and Deed Transfers:

- The portal provides government authorities with real-time access to rental agreements and property deed transfers. This feature ensures that all transactions are transparent and compliant with regulations, reducing the risk of fraudulent activities.

Automated Taxation System:

- By integrating with the DeedX wallet system, the portal enables the automation of tax calculations and collections. This system simplifies the taxation process for both the government and the stakeholders, ensuring accuracy and timeliness in tax payments.

Data Privacy and User Notification:

- A unique aspect of the Government Portal is its commitment to user privacy. Whenever a government entity accesses a user's profile or transaction details, the system automatically notifies the user. This transparency ensures that users are aware of government scrutiny, fostering a trust-based relationship between the government and the citizens.

Building a Corruption-Free Ecosystem:

- The overarching goal of the Government Portal is to create a corruption-free real estate environment. By ensuring transparency and accountability in every transaction, the portal plays a crucial role in building a fair and equitable market for all stakeholders.

Advanced Analytics for Policy Making:

- The portal is equipped with advanced analytics tools that enable government authorities to analyze real estate trends and patterns. This data-driven approach aids in informed policy making, ensuring that regulations evolve with the changing dynamics of the real estate market.

Enhancing Public Trust:

- By providing a clear and transparent view of real estate transactions, the Government Portal enhances public trust in the system. This transparency is crucial in building confidence among investors, renters, and other market participants.

In summary, the Government Portal of DeedX represents a technologically advanced, secure, and user-centric approach to real estate governance. Its integration with blockchain technology not only ensures the integrity of transactions but also paves the way for a more efficient, transparent, and corruption-free real estate market.

Legal Portal

Streamlining Legal Processes in Real Estate

The Legal Portal on DeedX serves as a hub for verifying property deeds and creating digital smart contracts. It offers comprehensive agreement templates and a rating system for lawyers, ensuring authenticity and legal integrity in property transactions.

Functionality and Features of the Legal Portal

Verification and Authentication of Property Deeds

The Legal Portal enables lawyers to meticulously review and verify property titles and documents. This process ensures that all listings on the DeedX platform are authentic and free from scams or forgeries. Once a lawyer approves a deed, DeedX verifies and approves the listing, maintaining the platform's integrity.

Facilitation of Digital Smart Contracts

The portal simplifies the process of drafting and executing digital smart contracts. When a buyer and seller agree on terms, they can use the Legal Portal to find a qualified lawyer based on their specific area and requirements. These lawyers assist in drafting digital smart contracts, which can be completed and signed directly on the platform. This feature is essential for both property sales and rental agreements.

Comprehensive Agreement Templates

DeedX offers a wide selection of agreement formats, catering to various transaction types. This variety enables stakeholders to quickly find and agree on a suitable contract format, significantly speeding up the transaction process.

Lawyer Rating System: The portal incorporates a rating system for lawyers, based on their performance and completion of work. This system ensures quality service and accountability, as lawyers are incentivized to maintain high standards to attract more clients.

Marketplace for Legal Services

The Legal Portal functions as a marketplace, allowing lawyers to offer their services and earn additional income. This feature not only benefits the lawyers but also provides users with a range of legal service options.

Rigorous Lawyer Verification Process: To maintain high standards, DeedX conducts a thorough verification process for lawyers wishing to join the platform. This includes Clean ID verification and an interview process to assess their qualifications and expertise.

Integration with Blockchain Technology

The use of blockchain technology in the Legal Portal ensures the security and immutability of contracts and legal documents. This technology also facilitates transparency and traceability in legal transactions.

- **Enhanced User Experience:** The Legal Portal is designed to be user-friendly, allowing easy navigation and access to legal services. This enhances the overall user experience, making legal processes less daunting and more accessible.

In summary, the Legal Portal of DeedX is a technologically advanced, secure, and efficient platform that revolutionizes the way legal aspects of real estate transactions are handled. It ensures legal compliance, authenticity, and ease of transaction, making it a vital component of the DeedX ecosystem.

Real Estate Agent Portal

Empowering Agents with Advanced Tools

This portal enables real estate agents to list properties, manage transactions through an escrow system, and ensure compliance through a KYC process. It also features an automated commission structure and a royalty system for property owners.

Functionality and Features of the Real Estate Agent Portal

Ownership Verification Process:

- A critical function of the portal is to verify the ownership of properties listed for sale. Real estate agents are required to conduct thorough property verification, ensuring that the titles are linked to the original owner. This process is facilitated by DeedX, which approves the titles after verification, thereby maintaining the integrity of the listings.

On-Chain Property Listings:

- Agents can list properties on the blockchain, providing a secure and transparent record of the listing. This feature ensures that all property information is immutable and easily verifiable.

Comprehensive Property Management Tools:

- The portal offers agents a suite of tools for effective property management. This includes the ability to upload property photos, create marketing materials, and manage listings, providing a one-stop solution for all their sales needs.

Automated Commission Structure:

- For every property minted on the blockchain, the commission percentage for the agent is predefined and immutable. This ensures transparency in transactions, as the commission is automatically transferred to the agent's wallet upon the sale of the property, while the remainder of the funds goes to the owner.

Royalty System for Owners and Agents:

- The platform allows property owners to set up a royalty system. This innovative feature means that owners, and optionally agents, can receive a percentage of future sales, creating a continuous revenue stream.

Enhanced Marketing Capabilities:

- The portal provides advanced marketing tools that enable agents to effectively showcase properties. This includes virtual tours, high-quality image galleries, and targeted marketing strategies.

Blockchain-Enabled Transparency:

- By leveraging blockchain technology, the portal ensures that all transactions are transparent and secure. This technology also facilitates the traceability of property ownership and sales history.

User-Friendly Interface:

- The design of the portal focuses on usability, making it easy for agents to navigate and manage their listings, even for those with limited technical expertise.

Integration with Legal and Government Portals:

- The Real Estate Agent Portal is seamlessly integrated with the Legal and Government Portals of DeedX, ensuring compliance with legal requirements and streamlined processing of transactions.

In summary, the Real Estate Agent Portal on the DeedX platform represents a groundbreaking approach to property sales and management. It combines technological innovation with practical tools to enhance the efficiency and effectiveness of real estate agents, while ensuring the security and authenticity of property transactions.

Advanced Transaction Process in the Real Estate Agent Portal

Listing Properties on Behalf of Owners:

- Real estate agents have the capability to list properties on the DeedX platform on behalf of the owners. This process involves a thorough verification of property details and ownership to ensure authenticity.

Escrow System for Secure Transactions:

- When a sale occurs, the payment from the buyer is held in an escrow account managed by the DeedX platform. This escrow system acts as a secure intermediary, ensuring that funds are only released when all conditions of the sale are met.

KYC Process During Transactions:

- A key component of the transaction process is the Know Your Customer (KYC) procedure. DeedX conducts a rigorous KYC check during the sales process to verify the identities of all parties involved, particularly focusing on the property owner and the buyer.

Release of Funds to Verified Owner's Wallet:

- The funds held in escrow are released only to the verified wallet of the property owner. This wallet must match the owner details as per the title of the deed. This mechanism ensures that the proceeds from the sale are securely transferred to the rightful owner.

Blockchain-Enabled Verification:

- The use of blockchain technology in this process ensures that the verification of ownership and the transfer of funds are transparent, secure, and immutable. This technology also facilitates the traceability of the entire transaction process.

Automated Compliance Checks:

- The platform automatically performs compliance checks in line with real estate regulations and legal requirements. This includes verifying the legality of the property sale and ensuring that all contractual obligations are fulfilled.

Integration with Legal and Government Portals:

- Seamless integration with the Legal and Government Portals ensures that all transactions comply with legal standards and government regulations, further enhancing the security and legitimacy of the transaction.
- User Notification and Transparency: Throughout the transaction process, all parties are kept informed with timely notifications. This transparency builds trust and ensures that all stakeholders are aware of the transaction status.

How Real Estate Agents Get Involved on the DeedX Platform

- **Agent Registration and Verification:**
 - Agents must first register on the DeedX platform.
 - They undergo a rigorous verification process, including identity checks and professional credentials validation, to ensure they are legitimate and qualified.
- **Listing a Property:**
 - **Owner Verification:** Before listing a property, agents are responsible for verifying the ownership. This involves checking property documents and matching them with government records.
 - **Minting the Property on Blockchain:** Once ownership is verified, agents mint the property on the blockchain. This process creates a digital representation of the property deed, linked to the real owner's identity.
- **Ensuring Authentic Ownership Transfer:**
 - **Smart Contracts for Transactions:** When a property is sold, a smart contract is created, stipulating the terms of the sale and ensuring that funds are transferred only upon fulfillment of these terms.
 - **Escrow System:** Payments for property sales are held in an escrow account within the DeedX platform. Funds are only released to the owner after all conditions in the smart contract are met.
- **Safeguarding Against Fraudulent Listings:**
 - **Cross-Verification of Property Details:** The platform employs cross-verification mechanisms, where property details are checked against multiple databases to prevent fraudulent listings.
 - **Flagging and Reporting Mechanisms:** Agents and users can flag suspicious listings, which are then reviewed by DeedX's compliance team.
 - **Continuous Monitoring:** The platform continuously monitors transactions and listings for any unusual activity, using algorithms to detect potential fraud.
- **Agent's Role in Transactions:**
 - Agents facilitate the sale process, from listing to finalizing the sale.
 - They assist in drafting and executing smart contracts, ensuring that all legal and regulatory requirements are met.
 - Agents provide guidance to both buyers and sellers throughout the transaction process.
- **Commission and Payments:**
 - Agents receive their commission directly through the DeedX platform, as stipulated in the smart contract.
 - The commission structure is transparent, and the payment process is automated upon the successful completion of a sale.
- **After-Sale Services:**
 - Agents may offer additional services post-sale, such as property management or advisory services, through the DeedX platform.

Real estate agents play a vital role in the DeedX ecosystem. They act as facilitators and validators, ensuring that property listings are legitimate, transactions are secure, and ownership transfers are authentic. The platform's use of blockchain technology, smart contracts, and an escrow system provides a robust framework to prevent fraud and ensure that the rightful property owners receive their funds securely. This system not only enhances the efficiency and transparency of real estate transactions but also builds trust among all parties involved, with legal and regulatory standards. This approach safeguards the interests of all parties involved, from property owners to buyers, while empowering real estate agents to conduct transactions with confidence and integrity.



Real Estate

Bank Portal

Bridging Traditional and Digital Finance

The Bank Portal integrates traditional banking with blockchain technology. It allows banks to mint their own stable tokens, facilitating smooth on-ramp and off-ramp transactions. The portal also supports mortgage lending and deed locking, enhancing the financial aspects of real estate transactions.

Functionality and Features of the Bank Portal

Integration with DeedX and Wallets:

- Banks connected to DeedX can seamlessly interact with the platform and its wallet system. This integration allows for efficient management of transactions related to real estate.

Minting of Bank-Specific Stable Tokens:

- Participating banks can mint their own stable tokens on the blockchain, pegged to their reserve assets. For example, a token like 'ComBank Token' would represent a stable value equivalent to fiat currency held by the bank.

Facilitating Off-Ramp and On-Ramp Transactions:

- Off-Ramp (Fiat to Token): Buyers looking to purchase property with cash can deposit funds into their DeedX account at the bank. The bank then credits an equivalent amount of their stable token to the buyer's DeedX wallet. These tokens can be used for property transactions on the DeedX platform.
- On-Ramp (Token to Fiat): After a property transaction, the buyer or seller can return to the bank to 'burn' the tokens in exchange for fiat currency. This process ensures a smooth transition between digital and traditional currencies.

Mortgage Lending and Deed Locking:

- Banks can offer mortgage services through the portal. When a mortgage is issued, the corresponding property deed is locked on the blockchain for the mortgage period. The bank issues tokens representing the mortgage amount, which are locked until the repayment is completed.

Clear Audit Trails and Record Keeping:

- The use of blockchain technology ensures that every transaction is recorded transparently and immutably. This creates a clear audit trail, which is crucial for due diligence and compliance.

Enhanced Security and Compliance:

- The platform ensures that all transactions comply with banking regulations and standards. The security protocols in place protect against fraud and unauthorized access.

User-Friendly Interface for Easy Transactions:

- The Bank Portal is designed to be intuitive and user-friendly, allowing users to easily navigate and manage their transactions, whether it's for buying property, mortgage management, or converting tokens to fiat currency.

Integration with Legal and Government Portals:

- The Bank Portal works in conjunction with the Legal and Government Portals of DeedX, ensuring that all financial transactions align with legal requirements and government regulations.

In summary, the Bank Portal on the DeedX platform represents a groundbreaking approach to integrating traditional banking with blockchain technology. It provides a secure, transparent, and efficient mechanism for managing real estate transactions, mortgages, and currency conversions, thereby enhancing the overall real estate transaction experience.

DEEDX WALLET

A User-Friendly Gateway to Real Estate Investments

The DeedX Wallet is an innovative tool that simplifies interactions with digital assets. It supports multiple cryptocurrencies, integrates with financial institutions, and offers functionalities like asset swaps and investment in fractionalized properties.

Key Features and Functionalities of the DeedX Wallet

Account Abstraction for User-Friendly Experience

- The wallet is designed with account abstraction, making it accessible and easy to use, even for individuals without prior knowledge of web3 technologies. This approach simplifies interactions with blockchain-based assets and transactions.

Integration with SDK and API for Financial Institutions

- The DeedX Wallet offers a Software Development Kit (SDK) and Application Programming Interface (API) for banks, loan lenders, leasing companies, and other financial institutions. This integration allows these entities to connect their services seamlessly with the DeedX platform.

Facilitation of On-Ramp and Off-Ramp Transactions

- The wallet supports both on-ramp (converting fiat to crypto) and off-ramp (converting crypto to fiat) transactions, making it a versatile tool for users to engage in real estate transactions using both traditional and digital currencies.

Support for Multiple Cryptocurrencies and Digital Assets

- Users can store various cryptocurrencies and digital assets in the DeedX Wallet. This feature caters to a diverse range of investment preferences and transaction needs.

Asset Swaps and Deposits

- The wallet enables users to swap different assets and deposit them for various purposes. This flexibility is crucial for users looking to diversify their portfolios or engage in different types of transactions.

Interest Rates on Investment for Fractionalized Properties

- One of the innovative features of the DeedX Wallet is its ability to handle investments in fractionalized properties. Users can earn interest on these investments, making it an attractive option for those looking to invest in real estate without buying entire properties.

Bringing Real-World Asset Use Cases to the Wallet:

- The DeedX Wallet is designed to bridge the gap between real-world assets and the digital world. It enables users to manage real estate assets, investments, and transactions all in one place, leveraging blockchain technology for security and transparency.

Enhanced Security Protocols:

- The wallet incorporates advanced security measures to protect users' assets and personal information. This includes encryption, multi-factor authentication, and regular security audits.

Seamless Integration with DeedX Ecosystem:

- The wallet is fully integrated with other components of the DeedX platform, including the Government, Legal, Real Estate Agent, and Bank Portals, ensuring a cohesive and efficient user experience.

In summary, the DeedX Wallet is a sophisticated, secure, and user-friendly platform that plays a pivotal role in the DeedX ecosystem. It not only simplifies the management of digital and traditional assets but also opens up new opportunities for investment and participation in the real estate market.



What is asset fractionalisation?

It's the concept of splitting up ownership of something so that many people can receive benefits from it in a proportion to the amount they own. It's a traditional concept which already exists today, as we discuss later. But why do people increasingly associate fractionalisation with digital assets recorded as tokens on blockchains, and what opportunities are being created?

Shares

When applied to financial securities, fractionalisation has been around for hundreds of years—when you buy a share of a company, you are buying a fraction of ownership of it. For many shares, the price of one unit is investible by an average retail investor, costing maybe only a few dollars. So ownership (and control) of a company can be, and often is, fractionalised. It's worth remembering that even one share usually offers voting rights at company AGMs and most shares will pay a dividend based on company performance.

REITs

Another example of fractionalisation today is a Real Estate Investment Trust (REIT). Although the specifics differ around the world, typically a REIT is a fund or company that owns, operates, and manages real estate assets (buildings for residential, commercial or industrial use), and shares of that company are listed on a public exchange, bought by a mix of institutional and retail investors. Owning a REIT lets you participate in the income generated from the pool of properties as REITs are required to distribute at least 90 percent of their taxable income to shareholders annually in the form of dividends. Investors may also benefit in the potential upside from the buying & selling of portfolio assets. Yet a REIT is little more than a share of a specialised company, and owning a share of a REIT doesn't give you legal ownership of a specific floor of a building or piece of land, but it does give you a share of the income generated by the assets.

ETFs

Exchange Traded Funds (ETFs) also use a fractionalisation concept. A fund is created which owns some underlying assets, and shares of that the fund are listed on a public exchange, and multiple parties can own fractions of that fund. ETFs have been very successful and today manage over USD 5 trillion in assets offering investors exposure to mainstream indices and a whole range of thematic and specialised assets across equities, bonds, commodities and currencies.

Mutual funds

Mutual funds operate on a similar basis—investors pool money into a fund, and the money is used to buy assets. Investors own a fraction on the fund.

REITs, ETFs, and mutual funds can be further fractionalised, just as any other stock can be, if the fund does a stock split where existing investors are each given more shares in some ratio (eg 2 new shares for 1 old share), and the share price immediately reduces to compensate (in this case dropping by 50% per share).

So we can already fractionalise. The way we do this, at a high level, is to create a vehicle—a company or other similar legal entity, have the vehicle own some assets, and have shares of the vehicle sold to investors—voila, fractionalisation.

What's new?

So what's new with tokens recorded on blockchains? Are having shares represented as tokens any better? Do they allow smaller fractions of assets to be created and traded? And would that matter? What about cost? Can we fractionalise more cheaply? What impact would that have? Could they provide exposure to new assets? And could value mean something different, maybe more than just a financial return?

Well, fractionalisation is just part of the story. It's not just about fractionalisation in itself—we can already do that. It's about reimagining the whole end-to-end process of finding and matching investors with investment opportunities, and the subsequent secondary market opportunities once an investment has been made. There are potentially new opportunities on both the supply and demand side.

Private markets

The impact won't be seen in the public markets—they are already fairly efficient and high-tech. It will be seen in the private markets which are manual, slow, opaque, and with high overheads.

The process of matching capital to investment opportunities involves a number of steps from finding and qualifying investors, finding and qualifying investment opportunities, through the initial capital allocation to the opportunities, to secondary trading of the assets, and the management of the assets which may have events associated with them throughout their lifecycle.

Not just blockchains

It's not just a blockchain story: today, new and better technologies are being applied to the entire end-to-end investment process. For instance, new platforms with automated tools are making it easier to identify investors and qualify them as eligible, based on jurisdictional regulatory requirements. They combine technologies such as OCR (optical character recognition) or computer vision for data entry, with machine learning algorithms that can tell apart real documents from fakes (all part of the growing intelligent automation line-up). ID selfies taken with smartphones and sent over the internet are replacing physical "meet and greet" identity checks, and electronic signatures on pdf files are replacing wet-ink-on-dead-wood sent via courier. These processes are being built with regulatory compliance in mind, as opposed to added as separate steps.

The assets themselves are being created more cheaply, with standardised templates and contracts. Some are being recorded as tokens on blockchains, with smart contracts defining them, and determining what can and can't happen to them. Automatic regulatory reporting is being built in instead of being expensively tacked on. Lifecycle events are becoming more automated and streamlined. This cheapens and reduces risks in processes and events that would otherwise be found in the small print of pdf files and managed in systems outside of the asset. (The pdf files are still important, but the parameters and key dates and events are becoming part of the definition or smart contract of the digital asset itself, which means that computers can act on them.)

Today: PDF files

In short, the entire cost structure of the end-to-end investment process is being driven lower by technology and it's becoming more efficient. For the assets themselves, pdf files are being replaced by digital records containing structured data, which define what they are and how they are allowed to change. Tokens can be held in wallets on smartphones and sent frictionlessly to other investors, and traded on exchanges. This is a huge improvement to private markets today where assets exist as pdf files, which are complicated to split and re-sell.

For instance, a \$50m loan to fund the building of some real estate might exist in the private markets as a series of bilateral pdf files between the issuer (borrower) and a small number of investors (lenders). Each bilateral contract has a cost in terms of time and administrative overhead for the issuer. Each investor holds a pdf file for say 6 months to two years until they get their money back.

These pdf files are hard to "re-sell" in whole or in part to a new investor because: either the new investor needs to trust the existing investor to pass on the return of capital (and trust that they haven't already sold this asset to another investor); or the pdf files held by the original investor and the issuer need to be "re-papered" and replaced by new ones with the new investor's name on it. If an investor needs to sell such an asset, no liquid secondary market exists so they will typically take big financial "haircut" if they need to sell in a hurry—and then only if they can find a buyer.

So, perhaps you can fractionalise a pdf file but it is complicated and troublesome for the investors and the issuer. The user experience is terrible.

Tomorrow: Tokens

Tokens, on the other hand, live on systems that are built to record the existence of assets, and guarantee that they can't be spent twice, and guarantee that they can only change in accordance with their governing smart contract. Bitcoin has shown us the way, with wallets that can contain fungible tokens that have been issued, split up (fractionalised), and re-combined in a simple way that can be extended to other assets. This is a much better experience for both investors and issuers and offers a choice for investors to self-custody their assets or delegate this responsibility to professional custodians.

When costs are reduced and when the user experience improves, more investment opportunities can be created and more investors can participate. When more investors participate, financing becomes cheaper and easier, and capital can be deployed to where it is more productive, increasing opportunities for both investors and projects requiring capital. We already see live examples of fractionalised building loans, art and private companies. Classic cars, fine wine and many more are being discussed. These potentially offer access to new investable asset classes.

New asset types

To date, most digital assets exist as an equivalent to traditional securities, but it doesn't need to be this way. Coupons and dividends are traditionally paid quarterly or semi-annually but with automated systems and straight through processing of payments it is feasible that a digital asset can pay a daily or even hourly yield. With the rise in environmental, social & governance (collectively, ESG) screened assets, investors are now challenging the notion that value is simply a financial return. You can imagine an asset producing a combination of financial yield and environmental impact, for example a 2% yield and 10 trees planted a year. You could also imagine a yield and experience combination for investors (maybe an hour in classic car for every 3 months you hold a token). The potential is huge and very interesting. It challenges our concept of ownership: As a shareholder of Amazon, why don't you get a discount at the store that you own a fraction of?

Conclusion

So fractionalisation in itself isn't a particularly interesting driver of change. But it is just one small part of the bigger picture of the tokenisation of private market assets. REITs & ETFs have shown us the way for public markets, now there are ways of cheapening the process and making the investor and issuer experience richer and better in the private markets. Once the processes become standardised and generally accepted, tokenised assets with their respective smart contracts offer the potential to open up a whole new world of opportunities.

OVERVIEW OF GRIDX WITHIN DEEDX

GridX serves as a specialized portal within the DeedX ecosystem, focusing on fractionalized real estate investments. It allows investors to purchase fractions of property, enabling them to invest in real estate with lower capital outlay and enjoy proportional benefits.

The Flow of Fractionalized Investment on GridX

- **Property Listing and Fractionalization:**
 - Property owners or developers list their properties on GridX.
 - Each property is assessed, verified, and then fractionalized into smaller, investable units, represented as digital tokens on the blockchain.
- **Investor Onboarding and KYC:**
 - Investors register on GridX and undergo a Know Your Customer (KYC) process.
 - This ensures regulatory compliance and investor eligibility for participating in fractionalized investments.
- **Investment Process:**
 - Investors browse available properties and select the ones they wish to invest in.
 - They purchase fractions of the property in the form of digital tokens, representing their share of ownership.
- **Smart Contracts for Investment Management:**
 - Each fractionalized investment is governed by a smart contract, outlining terms such as dividend distribution, voting rights, and resale conditions.
 - Smart contracts automate the distribution of rental income and other benefits to token holders.
- **Secondary Market Trading:**
 - Investors can trade their fractional shares on a secondary market within GridX.
 - This provides liquidity, allowing investors to enter and exit investments more freely.
- **Asset Management and Reporting:**
 - GridX provides ongoing management and reporting for the fractionalized properties.
 - Investors receive regular updates on property performance, valuation, and income distributions.

- **Integration with DeedX Wallet:**
 - All transactions, including purchases, sales, and dividend distributions, are facilitated through the DeedX Wallet.
 - This integration ensures a seamless and secure transaction experience.
- **Exit Mechanism:**
 - Investors can exit their investments either by selling their tokens on the secondary market or through a buy-back mechanism, if available.

Benefits of Fractionalized Investment on GridX

- **Accessibility:** Lowers the barrier to entry for real estate investment, making it accessible to a broader range of investors.
- **Diversification:** Allows investors to diversify their portfolio by investing in multiple properties.
- **Liquidity:** Provides enhanced liquidity compared to traditional real estate investments.
- **Transparency and Security:** Blockchain technology ensures transparency, security, and immutability of investments.

By integrating asset fractionalization through GridX within the DeedX platform, real estate investment becomes more accessible, flexible, and transparent. This approach aligns with the evolving trends in digital assets and tokenization, offering a modern solution to traditional real estate investment challenges.

TECHNICAL MAP OF DEEDX ECOSYSTEM

Integration of Clean ID in DeedX

Leveraging Blockchain for Enhanced User Verification

Introduction to Clean ID:

- Clean ID is a blockchain-based identification solution developed by CodingLegends. It offers a secure and efficient method for user verification and KYC (Know Your Customer) processes.

Integration with DeedX Platform:

- DeedX integrates Clean ID to streamline the onboarding process for users, including renters, landlords, investors, and real estate agents.
- This integration enhances the security and reliability of user identification on the DeedX platform.

Shared KYC System:

- Clean ID provides a shared KYC system, allowing users to undergo the KYC process once and have their verified identity shared securely across the DeedX platform.
- This reduces redundancy and improves the efficiency of the verification process for multiple transactions or interactions within the platform.

Blockchain-Enabled Security and Privacy:

- Leveraging blockchain technology, Clean ID ensures the security and privacy of users' personal information.
- Blockchain's immutable nature guarantees that the stored data cannot be altered or tampered with, providing a high level of trust and integrity in the verification process.

Seamless User Experience:

- The integration of Clean ID into DeedX simplifies the user experience by minimizing the need for repeated identity verifications for different transactions or services within the platform.
- Users can quickly and securely access various functionalities of DeedX, including property listings, investments, and rental agreements, with their verified identity.

Compliance and Regulatory Adherence:

- Clean ID ensures that DeedX's user verification process adheres to global regulatory standards for KYC and anti-money laundering (AML) procedures.
- This compliance is crucial for maintaining the platform's credibility and trustworthiness in the real estate market.

Future-Proofing Identity Verification:

- The integration of Clean ID positions DeedX at the forefront of technological advancements in identity verification.
- It opens avenues for further innovations in user authentication and blockchain applications within the real estate sector.

Leveraging Blockchain for Advanced User Verification

Introduction to Clean ID and Its Framework:

Clean ID is a blockchain-based identification solution developed by CodingLegends, employing advanced cryptographic and algorithms for secure and efficient user verification. It is a pivotal component in the KYC process, utilizing a unique blend of hash functions, encryption algorithms, and consensus mechanisms.

Integration with DeedX Platform:

User Onboarding Process:

- **Identity Verification Function (IVF):** Let U be a user. $IVF(U)$ involves hashing and encrypting personal data of U , represented as $IVF(U) = E(H(U))$, where H is a hash function and E is an encryption function.
- **Blockchain Record:** The output $IVF(U)$ is stored on the blockchain as an immutable record, ensuring the integrity and non-repudiation of the user's identity.

Shared KYC System:

- **KYC Verification Token ID (KVT):** Upon successful KYC, a user U is assigned a KVT, such that $KVT = \text{sign}(SK, IVF(U))$, where sign is a digital signature function and SK is the private key of the verifying authority.
- **Token ID Utilization:** This token ID can be presented across the DeedX platform, eliminating the need for multiple KYC processes.

Blockchain-Enabled Security and Privacy

- **Data Storage and Security Model:**
 - **Data Encryption:** Personal data is encrypted using public-key cryptography, $E(U) = \text{Encrypt}(P_u, U)$, where P_u is the public key.
 - **Blockchain Immutability:** The blockchain ledger ensures that once a transaction (KYC record) is appended, it cannot be altered, adhering to $T_i = \text{hash}(T_{i-1} + \text{Data} + \text{Nonce})$ for each transaction T_i .

Seamless User Experience

- **Efficient Identity Verification:** The cryptographic algorithms reduce the computational complexity of repeated verifications, enhancing the user experience.
- **Algorithmic Consistency Checks:** Regular consistency checks using algorithms like $C = \text{Verify}(P_u, \text{sign}(SK, IVF(U)))$, ensure the validity of KYC tokens across transactions.

Compliance and Regulatory Adherence

- **Compliance Algorithms:** Clean ID uses regulatory compliance algorithms to match user data against global compliance standards. Mathematically, this can be represented as $R(U) = \text{match}(U, \text{ComplianceRules})$, where R is the compliance result.

Future-Proofing Identity Verification

- **Advanced Cryptographic Techniques:** The use of elliptic curve cryptography (ECC) and quantum-resistant algorithms positions Clean ID for future advancements in blockchain and cybersecurity.

The incorporation of Clean ID into the DeedX platform represents a significant advancement in user verification and KYC processes. By leveraging blockchain technology, DeedX ensures a secure, efficient, and compliant environment for all stakeholders involved in real estate transactions. This integration not only enhances user trust and safety but also streamlines the overall experience on the platform, making real estate transactions more accessible and reliable.

TECHNICAL FRAMEWORK OF DEEDX INTEGRATION WITH POLYGON

Transaction Throughput and Latency

- Polygon's Layer-2 Scaling: Utilizes a Proof-of-Stake (PoS) sidechain for higher transaction throughput.
- Mathematical Model: If Ethereum handles approximately 15 transactions per second (TPS) and Polygon enhances this to n TPS, the throughput increase factor is $n/15$.
- Latency Reduction: Reduced block confirmation times on Polygon lead to lower latency. If Ethereum's average block time is T_e seconds and Polygon's is T_p seconds, the latency reduction factor is T_e / T_p .

Gas Cost Optimization

- Gas Consumption Formula: If G_e is the gas cost on Ethereum and G_p on Polygon, the cost reduction factor for a transaction is G_e / G_p .
- Batch Transactions: Aggregating multiple transactions into one to save on gas costs. If b transactions are batched, the effective cost per transaction is G_p / b .

Smart Contract Efficiency

- Computational Complexity: Analyze the complexity of smart contract functions. For a function with a complexity of $O(n)$, optimizations on Polygon should aim to reduce this.
- Data Storage Costs: Given the cost S per byte of storage, the total cost for storing d bytes is $S * d$.

Security and Validation Model

- Validator Nodes and Staking: In Polygon's PoS, validators stake tokens. The probability P of being chosen as a block producer is proportional to the stake amount.
- Security Model: If V is the total number of validators and s_i is the stake of the i -th validator, the security metric can be represented as $\sum(s_i^2) / (\sum s_i)^2$, where $i = 1$ to V .

Interoperability Overheads

- Cross-Chain Communication: Mathematical representation of cross-chain transaction costs and latencies. If C_E is the cost on Ethereum and C_P on Polygon, the interoperability cost factor is $C_E + C_P$.

Data Management and Analytics

- On-Chain Data Handling: Optimal data storage calculation considering block size limits and costs.
- Off-Chain Storage Calculations: For D amount of data, with an off-chain storage cost C_d , total cost is $D * C_d$.

Network Efficiency and Scalability

- Sharding Mechanism: Polygon's sharding improves network capacity. If S_n shards are used, and each shard handles t TPS, the total capacity is $S_n * t$.
- Load Balancing: Mathematical modeling of load distribution across nodes and shards.

Tokenomics and Economic Models

- Staking Rewards: If R is the total reward pool and s_v is the stake of validator v , the reward r_v for validator v is $r_v = R * (s_v / \sum s_i)$.
- Fee Distribution Model: Modeling the distribution of transaction fees among stakeholders.

PROPERTY SELLING ON DEEDX

1. Agent Verification

- Let A be the set of all agents.
- For an agent $a \in A$, the verification function can be defined as $V(a)$, where $V : A \rightarrow \{0, 1\}$. If $V(a) = 1$, the agent is verified.

2. Property Listing

- Let P be the set of all properties.
- The minting function for property $p \in P$ can be represented as $M(p)$, where $M : P \rightarrow T$ and T is the set of all tokens representing properties.

3. Transaction Handling

- Let C represent the commission structure, defined as a function $C : P \times A \rightarrow \mathbb{R}$, mapping a property and an agent to a real number representing the commission.
- Escrow account for a property p , denoted as $E(p)$, holds funds till conditions are met. Let F be the set of all funds, $E : P \rightarrow F$.

4. Government and Legal Compliance

- Let G and L be the sets of all government and legal checks.
- Compliance functions can be defined as $G_c : P \rightarrow \{0, 1\}$ and $L_c : P \rightarrow \{0, 1\}$.

PROPERTY RENTAL ON DEEDX

1. Rental Agreement Processing

- Define a rental agreement as a tuple $R = (p, t, d, s)$ for property p , tenant t , duration d , and security s .
- The rental agreement function can be represented as $R_f : P \times T \times D \times S \rightarrow R$, where D and S are sets of possible durations and security deposits.

2. Payment Management

- Define a payment function $Pay : R \times \mathbb{N} \rightarrow F$, mapping a rental agreement and time period to a fund transfer.

PROPERTY BUYING ON DEEDX

1. Purchase Process

- Let B be the set of buyers.
- Define a purchase function $Pu : P \times B \rightarrow \mathbb{R}$, mapping a property and a buyer to a price.

2. Mortgage and Financing

- Mortgage function $M_f : B \times P \rightarrow \mathbb{R} \times D$, maps a buyer and property to a loan amount and duration.

3. Escrow and Ownership Transfer

- Define escrow as $E(p, b)$ for property p and buyer b .
- Ownership transfer can be represented as $O_t : P \times B \rightarrow \{0, 1\}$.

Integration with DeedX Wallet

- Let W be the DeedX Wallet.
- Wallet interactions can be represented as functions involving fund transfers $W_f : F \times A \times P \times B \rightarrow \mathbb{R}$, handling funds for various processes.

Integration with Portals

- Define integration functions I_b, I_l, I_g for bank, legal, and government portals respectively.
- Each function maps relevant parameters to outcomes, ensuring compliance and integration, e.g., $I_g : G \times P \rightarrow \{0, 1\}$.

DETAILED TECHNICAL FLOW OF DEEDX PLATFORM

User Registration and KYC Integration

- Process:** Users sign up on the DeedX platform and submit KYC (Know Your Customer) documents.
- Backend Handling:** The backend system securely processes and stores this information.
- Future Integration:** Plans to implement CleanID for more streamlined and secure KYC verification.
- Walletx Integration:** Post-KYC verification, the walletx system is utilized to create multiple wallets for each user, linked to their KYC data. This ensures that each user's property holdings remain private, enhancing user privacy.

Property Listing

- User Action:** Users list their property by filling out a detailed form on the platform.
- Data Handling:** The backend processes this information, categorizing it into public and private data.
- Encryption:** Private data is encrypted using advanced cryptographic techniques to ensure confidentiality.

Deed Verification and Minting

- Public Data Handling:** Public data about the property is uploaded to IPFS, generating a unique content identifier (CID) using IPFS's hashing algorithm.
- ERC721 Minting:** The backend, using Ethereum's ether.js library, interacts with the deedxContract (an ERC721 smart contract) to mint a unique NFT for the property. The NFT's metadata includes the IPFS CID.
- Encryption & Blockchain:** Encrypted private data is securely stored in the backend, with references to the blockchain transaction for added security and traceability.

Property Ownership Anonymity

- Walletx Functionality:** WalletxContract allows users to manage multiple wallets, linked to their verified identity. This lets users list properties under different wallets, obscuring the total number of assets owned by a single user.
- Algorithmic Linking:** Advanced algorithms link these wallets to the user's KYC data without revealing this linkage publicly, maintaining a balance between user privacy and regulatory compliance.

Property Fractionalization and Trading

ERC1155 Integration: When a property is fractionalized, the gridxContract (an ERC1155 smart contract) creates fungible tokens representing shares of the property.

Linking to ERC721: These tokens are linked to the ERC721 token of the property, ensuring that each share is directly connected to the actual property.

Trading Platform: Users can trade these shares on the DeedX platform, with each transaction being securely processed and recorded on the blockchain.

Rental Agreements and Smart Contracts

Legal Portal: A legal portal facilitated by a real-time communication protocol allows renters, buyers, and lawyers to negotiate and draft rental agreements.

SmartAgreementContract: These agreements are then formalized in the smartAgreementContract, a specialized smart contract that manages the terms of the rental, including the handling of security deposits and the temporary transfer of property rights (ERC721 tokens).

Security Deposit Management

Blockchain Recording: Security deposits are recorded on the blockchain for transparency.

DeedX Management: During the rental period, DeedX oversees the deposit, potentially using it as collateral or investing it based on the agreement terms.

Automated Settlement: At the end of the rental period, the smart contract automates the settlement process, ensuring fair and transparent handling of the deposit.

8. Backend and Blockchain Interaction:

Data Syncing: The backend regularly syncs with blockchain data to update property statuses, ownership details, and transaction histories.

Security Measures: Advanced security protocols are in place to protect data integrity and user privacy.

ERC721 - UNIQUE PROPERTY IDENTIFICATION

Unique ID Generation:

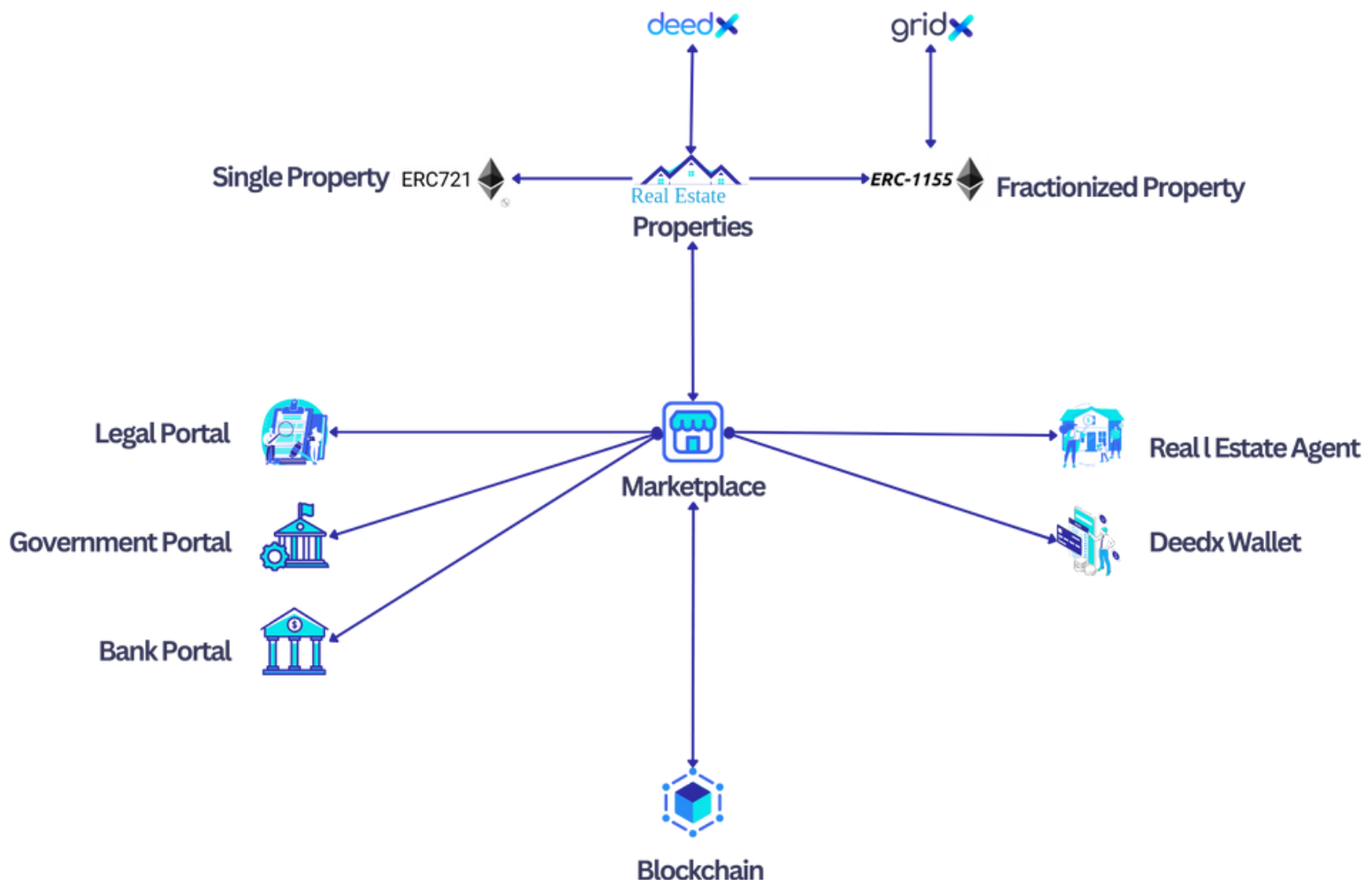
Let's denote the unique ID of an ERC721 token as $ID_{\{ERC721\}}$.

This ID is a hash value, typically generated using a cryptographic hash function such as SHA-256, which ensures uniqueness and security. and it can be represented as $ID_{\{ERC721\}} = \text{SHA-256}(\text{property_details})$, where `property_details` includes all unique attributes of the property.

ERC1155 - FRACTIONAL OWNERSHIP

Integration with ERC721

- **Linking Mechanism:** In this model, ERC1155 tokens represent fractional ownership. If a property is divided into n shares, each share is an ERC1155 token linked to the ERC721 token. Mathematically, this can be represented as a mapping function M : $ID_{\{ERC721\}} \rightarrow \{ID_{\{ERC1155_1\}}, ID_{\{ERC1155_2\}}, \dots, ID_{\{ERC1155_n\}}\}$, where each $ID_{\{ERC1155_i\}}$ is an identifier for a share of the property.
- **Token Relationship:** Each ERC1155 token is a fraction of the ERC721 token. If the total property value is V , and there are n shares, the value of each ERC1155 token is V/n .



Benefits Quantified

- **Tradeability and Liquidity:** The ease of transfer of ERC1155 tokens can be quantified by the volume of trades over a period, indicating market liquidity.

Agreement Contract Functionality

- **ERC721 Token Transfer:** The temporary transfer of the token during the rental period can be represented as a state change function $S: ID_{\{ERC721\}} \times Time \rightarrow \{Owner, DeedX\}$, where Time denotes the rental period.
- **Security Deposit Management:** If D is the security deposit and r is the interest rate (if applicable), the future value of the deposit can be calculated using $FV = D * (1 + r)^t$, where t is the time period.
- **Automated Settlement Logic:** The smart contract enforces the conditions C (like returning the deposit) at the end of the rental period t . This can be represented as a conditional function $F: C \times t \rightarrow \{Execute, Null\}$, where Execute triggers the contractual actions.

Technical Aspects:

- **Smart Contract Code Execution:** The execution of Solidity code can be abstracted as a series of state transitions on the Ethereum Virtual Machine (EVM), where each operation changes the state based on predefined rules.

INTRODUCTION TO ERC-4337 | DEEDX WALLET

ERC-4337 offers an account model that abstracts away the need for users to hold Ether for transaction fees, manage nonces, and sign transactions with private keys. Instead, it allows transactions to be validated by 'validators' who execute user-intended actions if certain conditions are met.

Foundations

User Operations : (U) is a set of operations a user can perform, such as transfers, trades, or contract interactions.

Validator Set : (V) is a set of validators that are responsible for executing operations in (U) .

Execution Condition : (C) is a condition set that must be satisfied for (V) to execute an operation from (U) .

Algorithmic Process

Initialization:

A user's account is deployed as a smart contract on the Ethereum blockchain, with built-in logic for execution conditions (C) .

The DeedX Wallet is configured to communicate with this smart contract and relay user operations (U) to the validators (V) .

Transaction Request:

A user requests a transaction through the DeedX Wallet, which forms an operation $(u \in U)$.

The wallet constructs a bundle of data (B) that describes (u) along with a signature (S) that proves the user's intent without revealing their private key.

Validation:

Validators $(v \in V)$ receive (B) and verify (S) against the user's smart contract.

They evaluate the execution conditions (C) for the operation (u) to ensure they are met.

Execution

Upon successful validation, the validator submits the transaction to the Ethereum network.

The transaction includes a mechanism for the validator to be reimbursed for the gas fee, either from the user's account or an agreed-upon third party.

Confirmation:

The smart contract of the user's account on-chain executes the transaction.

DeedX Wallet receives a confirmation and updates the user interface accordingly.

Formulation of Gas Fee Reimbursement

Let's denote (g) as the gas used by the transaction, (p) as the gas price, and (r) as the reimbursement to the validator. The reimbursement model can be expressed as:

$$[r = g \times p]$$

Where (r) must be less than or equal to the total value of the transaction to prevent abuse by validators. This ensures that validators have an incentive to process user transactions without charging excessive fees.

Security Considerations

To ensure security, ERC-4337 integrates several mechanisms:

Signature Verification:

Validators must verify the signature (S) to confirm that the operation (u) is indeed intended by the user.

Replay Protection:

The smart contract includes nonce-based or timestamp-based conditions to prevent replay attacks.

Validator Incentives:

Validators are incentivized to act honestly through a fee model and can be penalized for malicious behavior through a staking system.

By integrating ERC-4337 with the DeedX Wallet, the platform can offer a more seamless user experience by removing the need for users to directly interact with the complexities of blockchain transactions, while still ensuring a high degree of security and efficiency. This integration would place DeedX at the forefront of blockchain-based real estate transactions, offering a sophisticated yet user-friendly wallet solution.

Implementing Title Insurance on DeedX

Background

Title insurance is a form of indemnity insurance that protects lenders and homebuyers from financial loss sustained from defects in a title to a property. The most common claims filed against a title are back taxes, liens, and conflicting wills.

Integration with Blockchain

Integrating title insurance on DeedX involves creating a decentralized and transparent ledger of property titles, which can be audited in real-time to prevent fraud and errors in title transfers.

Verification Process

Title Record Tokenization

Upon a property's registration on DeedX, a unique ERC-721 token is minted, representing the property's title.

Historical data of the property, including past ownership, liens, and disputes, are recorded on the blockchain.

Automated Title Verification

Smart contracts are employed to verify the validity and accuracy of the title data against multiple trusted sources.

Mathematical algorithms calculate risk scores based on the historical data, which determine the insurance premium.

Issuance of Title Insurance Policy

Once the title is verified and the risk is assessed, a smart contract issues a title insurance policy, represented as an ERC-721 token, which is tied to the property's title token.

The insurance policy details the coverage terms, premium, and duration, all transparently recorded on the blockchain.

Claims Processing and Resolution:

In case of a claim, the smart contract automates the initial verification process, checking the claim against the policy terms.

A multi-signature wallet holds the insurance funds, and disbursement is executed only after the claim is validated by predefined oracles or adjudicators.

Benefits

Transparency: Blockchain provides a transparent and immutable record of property titles and insurance policies, increasing trust among parties.

Efficiency: Automating the verification and claims processes reduces administrative costs and speeds up resolution.

Security: Decentralized storage of title information mitigates the risk of fraud and centralized data breaches.

Accessibility: Tokenization of title insurance policies allows for easy transfer and management within the DeedX ecosystem.

Conclusion:

Integrating title insurance into the DeedX platform can significantly enhance the security and reliability of real estate transactions. By leveraging blockchain's inherent properties, DeedX can ensure that all titles are accurate and insured against potential defects, thereby reducing the risk for all parties involved and increasing confidence in the real estate market.

Sets and Functions

1. **Properties Set (P):** A set containing all the properties listed on DeedX, each represented by a unique ERC-721 token.
2. **Titles Set (T):** A subset of P , where each element represents a tokenized title with its unique historical data on the blockchain.
3. **Insurance Policies Set (I):** A set of all insurance policies issued, represented as ERC-721 tokens linked to elements of T .
4. **Claims Set (C):** A set representing all claims made against policies in I .
5. **Historical Data Function (H):** A function that maps an element of P to its historical data $H(p)$.
6. **Risk Assessment Function (R):** A function that calculates risk based on $H(p)$, resulting in a risk score $R(H(p))$.
7. **Premium Calculation Function (M):** A function that determines the insurance premium based on $R(H(p))$.

Flow Process

Tokenization of Property and Title:

- For each property $p \in P$, tokenize the property to create a unique ERC-721 token τ_p .
- Tokenize the title, creating a unique ERC-721 token τ_t linked to τ_p .

Verification and Insurance Policy Issuance:

- Collect historical data $H(p)$ for each property.
- Assess risk $R(H(p))$ using predefined algorithms that consider factors like liens, past disputes, etc.
- Calculate the insurance premium $M(R(H(p)))$ based on the risk assessment.
- Mint an insurance policy token τ_i for policies $i \in I$, with metadata containing $M(R(H(p)))$ and coverage details.

Claims Processing:

- For a claim $c \in C$ against a policy τ_i , trigger the claims processing function within the smart contract.
- The smart contract validates c against τ_i using verification oracles.
- If valid, the smart contract executes a payout from the multi-signature wallet proportionate to the claim and within the policy coverage limits.

Algorithmic Representation

Risk Assessment:

$$R(H(p)) = \sum_{d \in H(p)} w_d \times v_d$$

Where w_d is the weight assigned to each type of historical data d and v_d is the value or impact of d on the property's risk.

Premium Calculation:

$$M(R(H(p))) = f(R(H(p)))$$

Function f maps the risk score to a premium value, considering market factors and insurance standards.

Claims Validation and Payout:

$$\begin{cases} \text{Coverage}(\tau_i) & \text{if Validate}(c, \tau_i) = \text{true} \\ 0 & \text{otherwise} \end{cases}$$

Where `Validate` is a function that checks the legitimacy of the claim c against the policy τ_i , and `Coverage` determines the payout amount based on the policy terms.

The above mathematical model and flow process outline how title insurance can be algorithmically managed within a blockchain ecosystem like DeedX. The use of ERC-721 tokens for properties and policies ensures uniqueness and traceability, while smart contracts enable the automated execution of risk assessment, premium calculation, and claims processing. This implementation ensures that the system is transparent, immutable, and efficient, providing a secure and trustworthy environment for real estate transactions on the blockchain.



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