STATE STREET

THE STATE STREET DIGITAL DIGEST

Solving the Interoperability Puzzle

Begin

November 2023

Preface

How well do you play with others? I ask this because the central theme of our November Digital Digest is "interoperability"— that is, the ability of a system or piece of software to exchange and make use of information with other systems or software.

While our approach to all things digital is ever-evolving, we aim to bring together traditional asset servicing and digital finance in a seamless interoperable customer experience. This approach reduces fragmentation for clients and makes the transition to a digital-native environment easier for investors, and may even help adaptation.

We believe that cross-chain interoperability will be a key next-stage development in digital tokenization's ability to create a more inclusive and efficient financial infrastructure — and addressing the resulting fragmentation is the primary challenge that lies ahead.

This quarter's ***Digest*** explores interoperability in all its shapes and forms, whether it be the interoperability that exists between decentralized finance (DeFi) networks within a digital-native environment or between new DeFi systems and traditional financial (TradFi) infrastructure.

This edition revisits the "dual-track" and "hybrid" themes we introduced in last quarter's ***Digest***, and examines the interoperability that occurs when the DeFi and TradFi worlds operate in tandem, which we anticipate will remain the case for some time.

The November ***Digest*** also includes a technical introduction how interoperability is likely to work in practice, explaining the different systems and mechanisms available today, those currently being developed, and what investors and clients need to know. In addition, we examine:

- How large numbers of DeFi networks benefit and complement our new financial environment rather than pose a "problem" that needs "solving" by interoperability.

- Crypto developments in the exchange-traded fund (ETF) space, such as crypto company Grayscale® looking to convert its bitcoin trust into an ETF, and what it means for decentralized assets to trade in a (TradFi) ETF wrapper.
- Traditional and digital custody, and what toggling between them means for market infrastructure.

Astute readers of our Digest might note a new look and feel to this issue. In conjunction with State Street moving into our new global headquarters in Boston in September, we are very proud to have unveiled our new brand identity.

Founded as a bank in 1792 to support maritime industry and trade, State Street helped develop the Boston region and our then-young country. Since then, State Street has become well-known as a global custodian that is an integral part of the financial services industry.

As the industry grew and changed over the years and generations, so did our business. These changes have even more impact in the digital finance erathat we find ourselves in today. In this spirit, we modernized our brand to better reflect State Street's identity as an innovative, modern, forward-thinking, client-centric firm that has led the industry over generations.

Our new logo symbolizes our commitment to help clients navigate ever-changing markets—serving as a steadying hand that streamlines and accelerates progress, and acts as a strategic lever that helps them to drive value and unlock growth.

What has not changed, however, is the reason behind all that we do, which very much includes the publication of this quarterly thought leadership compendium of the most up-to-date financial technology developments and our purpose: helping achieve better investment outcomes for the world's institutional investors and the people they serve.

Donna Milrod
Chief Product Officer

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Digital finance network interoperability: An overview

By Khalid Ahmed, Digital Asset Technology Architecture Lead, and

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The ability for computer systems to collaborate as a means of exchanging information is referred to as “interoperability.” Collaboration in this context refers to the ability to transfer information – or an asset – between two or more systems, while maintaining the entity’s state and uniqueness.

Introduction

The distributed nature of blockchain makes this straightforward concept a complex one Interoperability in the context of blockchain technology refers to the exchange of data between blockchain networks.

Such an exchange may either include the replication of data from one blockchain to another, or the execution of functions conditional to the information that was exposed on another blockchain. For example, transferring tokens between blockchain networks requires a locking operation on the source blockchain before minting respective representations on the target blockchain.

Such proofs typically involve the replication of data to verify the locking event. On the other hand, exchanging tokens stored on distinct blockchains between two parties (atomic swaps), includes revealing information to the counterpart, who uses it to retrieve the exchanged asset. Thus, interoperability focuses on the communication between networks to exchange tokens, execute functions or retrieve information.

Currently, there is little technical interoperability between decentralized ledger technology (DLT) networks. The existing solutions involve a third party that mediates the transfer. This mediating third party is typically an asset-exchange entity operating in a centralized hub-and-spoke manner.

Many of these solutions centralize control at the hands of the mediating party, thereby diminishing the autonomy of blockchains and DLT networks and limiting their scalability.

Essentially, a blockchain interoperability solution must enable a blockchain to conduct verifiable transactions using information stored in another system. The definition above includes popular interoperability use cases, such as token exchanges and many other decentralized applications. It also contains uses such as reading stock market data from a non-decentralized system in a verifiable way. Thus, interoperability should retain the properties of a host blockchain and enable its extensibility.

Challenges

Many factors contribute to the complexity associated with blockchain interoperability. These include:

Multiple protocols

Security concerns

Lack of standardization

Data and transaction privacy

Scalability issues

Regulation

Click on each box to find out more.

Current interoperability solutions

Blockchain interoperability is a relatively new field with tremendous advancements.

There are numerous solutions with various methodologies for attaining interoperability.
Some of the potential interoperability projects/products for implementation are:

Overledger platform

Hyperledger FireFly

Cosmos

Hyperledger Cacti

Polkadot

Chainlink

Click on each box to find out more.

Conclusion

Blockchain interoperability is a critical step for the widespread use and optimization of blockchain technology. As explained in this article, it has the potential to establish a smooth and efficient ecosystem in which information and assets may be exchanged across various blockchain platforms.

However, the domain of blockchain interoperability is still growing. It remains an active research area with numerous technological, regulatory and security issues to be addressed. Enhancing the scalability, security and effectiveness of interoperability solutions must be the main goal of future development.

It is obvious that blockchain interoperability has great promise for the development of blockchain technology, creating a unified, varied and productive multi-chain ecosystem. Approaches for establishing interoperability are expected to advance and become efficient as blockchain technology develops, moving us closer to a genuinely interoperable blockchain world.

In conclusion, the promise of blockchain interoperability is a world where blockchain networks no longer operate in isolation, but instead as part of a larger, interconnected ecosystem.

This will not only unlock the full potential of individual blockchains, but also pave the way for new applications and innovations that span multiple blockchain platforms.

Digital asset custody network interoperability

This article is taken from “Digital Asset Custody Deciphered – A Primer To Navigating The Challenges Of Safeguarding Digital Assets,” a report produced by the Custody Working Group (CWG), a joint initiative of GBBC Digital Finance (GDF) – the financial services arm of the Global Blockchain Business Council (GBBC) – and the International Securities Services Association (ISSA). State Street is a co-chair of the CWG, and several State Street Digital® executives contributed to the full paper.

Digital asset custody network interoperability

Digital asset custody (DAC)

Digital assets may be bought on an exchange, with the blockchain's consensus mechanism assigning the asset to a digital wallet associated with the buyer. The wallet is accessed through the control of private keys. Custodians are responsible for securing these private keys to access the asset on behalf of the asset holder client. Corporate actions and other rights and entitlements may be managed via smart contracts or the ledger. Ledgers are either permissioned or permissionless and may (or may not) use third parties to establish consensus. In the case of permissionless ledgers, third parties that are used for this purpose are paid by the fees charged by the network for transactions to be validated.

In a custody context, interoperability refers to the extent to which a custody solution can:

- Support multiple assets across multiple networks
- Integrate with existing systems

These considerations can be grouped logically, with different risk factors and mitigants per group.

Interoperability among off-chain services

Most custody services are off-chain. While they connect to distributed ledger technology (DLT), and submit transactions into networks, they predominantly operate within off-chain — often legacy technology — environments such as accounting and reporting systems. These are likely to require integration for automation.

Examples of required interoperability include:

- Ability of custody or portfolio management systems to detect and accurately interpret asset activity across multiple networks
- Compatibility of network activity monitoring services (such as anti-money laundering transaction monitoring/alerting services) with local blockchain nodes across different networks

Digital asset custody network interoperability

Interoperability within a DLT network

Interoperability within a network refers to different types of tokens that are configured in different smart contracts. Networks are supposed to ingest all these contracts in order for the transactions to be executed. This a key consideration, as different process flows are able to span across multiple smart contracts. Examples of required interoperability include:

- Tokens on a blockchain with multiple smart contract elements (i.e., a fungible token with an embedded non-fungible token for additional data storage purposes)
- Smart contracts that are triggered based on live events resulting in automatic minting of new tokens

Interoperability between networks

The transfer of digital assets from one chain to another is known as “cross-chain bridging.” As various participants in an ecosystem may implement different networks, it is crucial that these networks are able to communicate with each other to enable the seamless transfer of assets or data.

When considering interoperability between networks, the consensus mechanism, smart contract language and authorization components are key factors in determining the settlement finality of the transaction. It would also ensure the records are appropriately updated on each ledger to display the ownership of each asset for custody purposes.

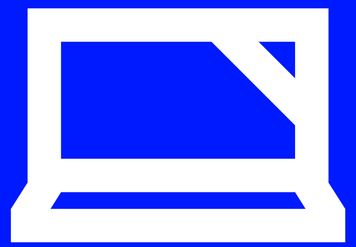
Examples of required interoperability include:

- Interoperability between public blockchain networks, like Ethereum to Polygon
- Interoperability between private networks and public networks (and vice versa)

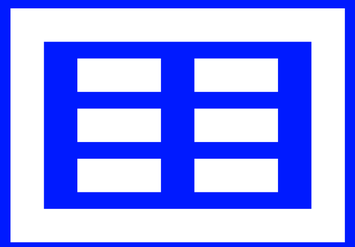
Digital asset custody network interoperability

Risks to be addressed

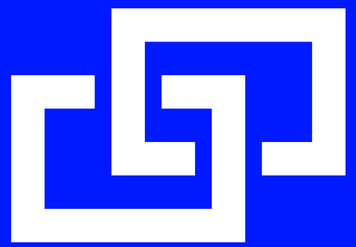
Monitoring of activities on- and off-chain



Cyber threats and incidents



Compatibility



Complex technical components

Click to explore

Digital asset custody network interoperability

Potential risk mitigants

Risks could be mitigated by simplifying the investor strategy based on the offerings of one or two custodians. This makes it easier for the investor to classify counterparty risks. Given the large amounts of data noted within public networks, adapting traditional monitoring tools to ingest data from the ledger would help reduce risk. Additionally, data could be easily transferred with the use of Application Programming Interfaces (APIs). APIs are considered more mature and can easily be adapted for the use of blockchain interoperability.

While there are new cyber threats introduced with smart contracts, there are many new participants in the market who focus on smart control audits and penetration testing to ensure there are no bugs within the code.

Barriers to risk mitigation

There are various types of digital asset tokens (security, utility, etc.) across various networks with different types of fungibility. Due to the range and diversity of digital assets, an investor holding multiple different assets may find it difficult to ensure the safe custody of all assets. There is no “one-size-fits-all” solution, and investors and custodians should consider which solutions best suit their needs.

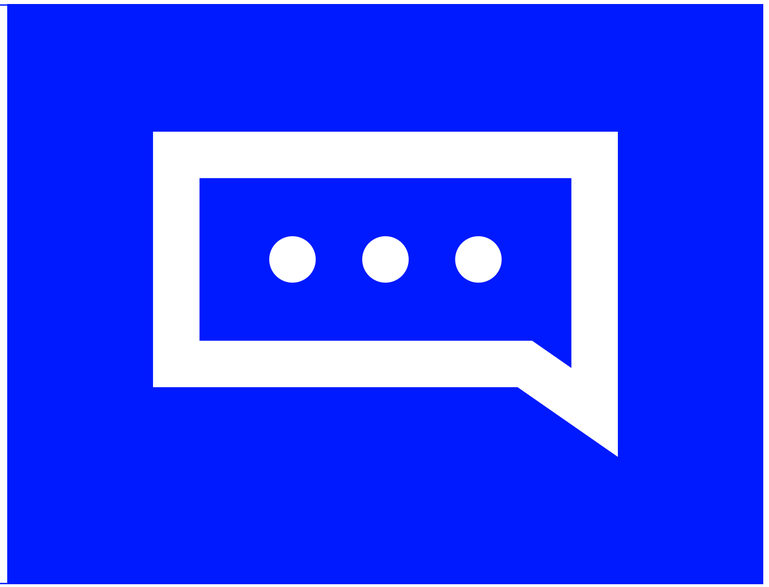
Due to market volatility and the technical complexities of institutional grade custody, there may be a limited number of firms that offer custody services to institutional investors across multiple digital assets. This results in investors being restricted to having only a small group of custodians to choose from based on their portfolio.

Digital asset custody network interoperability

Conclusion

Many principles that apply to traditional custody can and should be applied to digital assets custody (DAC). It is particularly important that the industry draws valuable lessons from recent industry failures and firms offering DAC meet the regulatory standards applicable to custodians of traditional assets.

The opportunity to rethink financial market structures must be tempered with understanding and commitment to the protection of investors' assets from fraud, malfeasance, misuse, misappropriation, or exposure due to operational or performance failures.



Crypto composability and cross-blockchain asset composition

By Patrick Kast and Adonis Nasr, State Street Digital Product Leads

The world of blockchain and cryptocurrencies has rapidly evolved since their inception. What started as a novel idea with bitcoin has blossomed into a complex ecosystem with thousands of digital assets and various blockchain protocols.

One of the most exciting developments in this space is the concept of “crypto composability” and the ability to compose assets across different blockchains and protocols.

In this article, we’ll delve into the intricacies of tokenization, bridging and how they enable crypto composability – while also exploring the risks and opportunities associated with this revolutionary trend.

Crypto composability and cross-blockchain asset composition

Bridging

Connecting islands of value

While tokenization has revolutionized the representation of assets on a single blockchain, the true power of crypto interoperability comes from bridging different blockchains and protocols. Each blockchain operates as its own “island” with its unique features and capabilities. However, for the full potential of blockchain technology to be realized, these islands must connect to form an archipelago of value.

Bridging is the process of creating connections between different blockchains to enable the transfer of assets and data seamlessly. Various bridging solutions have emerged, with some relying on specialized blockchains, such as Polkadot, to act as intermediaries, while others use bridges that connect specific blockchains directly.

Crypto composability

Building blocks of innovation

Crypto composability is the art of combining various blockchain-based assets and protocols to create new, more complex applications. It’s like building with Lego blocks, where each block represents a different blockchain or asset, and developers can stack them together to construct innovative financial products, services and applications.

For example, through crypto composability, one could use a stablecoin on Ethereum as collateral to mint synthetic assets on another blockchain like Binance Smart Chain, which can then be used as liquidity in decentralized finance (DeFi) protocols.

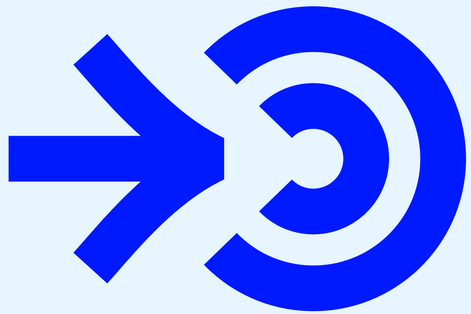
This composability unleashes a wave of creativity and innovation, providing fertile ground for developers to experiment and create new financial instruments, games and much more.

Crypto composability and cross-blockchain asset composition

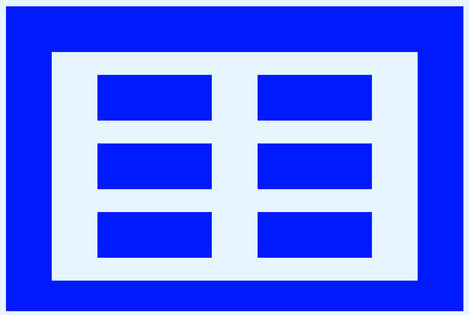
The risks and opportunities of crypto composability

As with any emerging technology, crypto composability presents both exciting opportunities as well as inherent risks; thus, it is equally crucial to highlight the importance of auditing and best security practices.

Opportunities



Risks



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Crypto composability and cross-blockchain asset composition

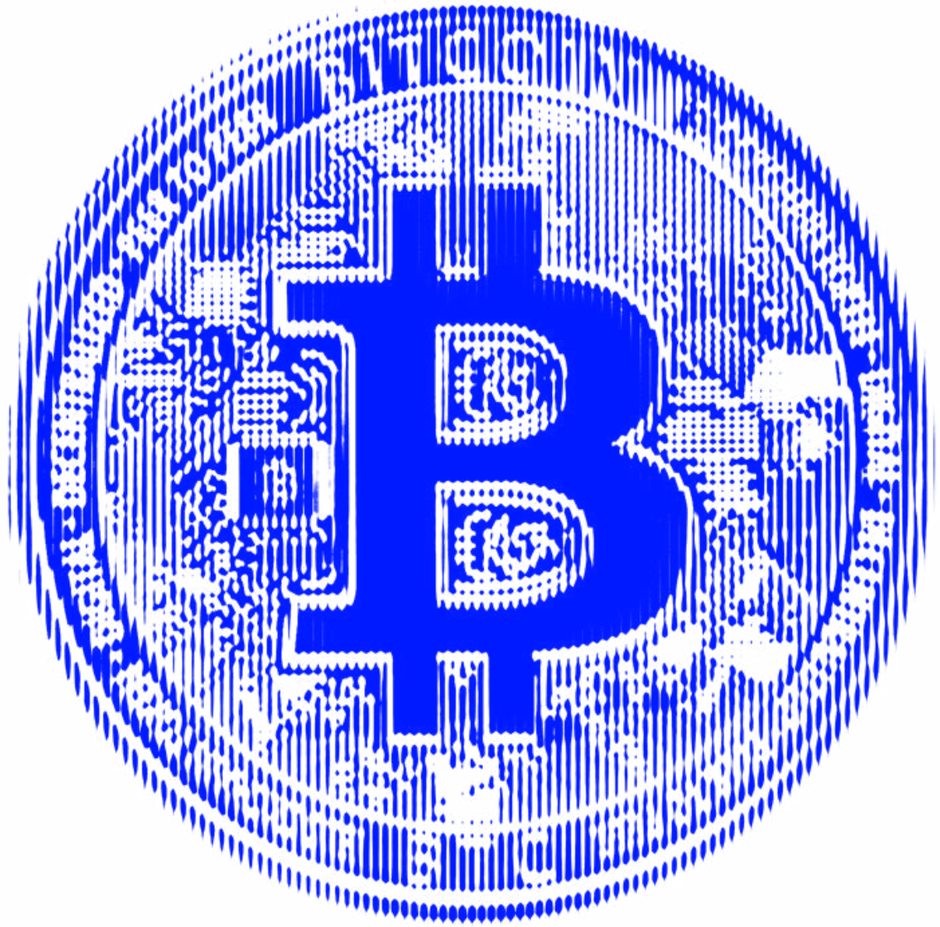
Conclusion

The future of finance is composable

Crypto composability is reshaping the financial landscape, offering a glimpse into a future where assets can seamlessly move across different blockchains and protocols. This revolution has the potential to democratize finance, foster innovation and provide unprecedented access to financial services.

However, as the ecosystem matures, addressing security concerns and navigating the regulatory landscape will be essential. The road to fully realizing the potential of crypto composability may be bumpy, but the destination promises a more inclusive, efficient and innovative financial world.

In the coming years, we can expect to see an explosion of creativity as developers continue to explore the possibilities of combining assets and protocols. As this unfolds, it is good to look out for the ever-expanding archipelago of value in the blockchain space –where the future of finance is being built, one block at a time.



Why firms are preparing for a digital ETF application surge

By James Biancamano, Head of Tokenization, State Street

The fund management industry is closely watching the United States' Securities and Exchange Commission (SEC)'s upcoming decision on the approval of the bitcoin ETF application by asset manager, Grayscale.

Why firms are preparing for a digital ETF application surge

Last year, the regulator rejected the application to list a bitcoin spot price (spot) ETF – the shares of which mirror the price of the cryptocurrency – on the New York Stock Exchange, claiming the firm had not provided sufficient safeguards against market manipulation.

Grayscale sued the SEC and last month, a court ordered them to revisit their decision, saying their decision was inconsistent with their acceptance of the market manipulation provisions in other funds, which track the price of bitcoin futures and have received SEC approval.

The ruling does not compel the regulator to approve the fund; it has the option to reject the application on other grounds (and the ability to take several months to make that decision), as well as the right to appeal to another court.

However, the enhanced likelihood of a bitcoin spot ETF approval is a boost to several other providers – including VanEck, WisdomTree, BlackRock and several others – that either have similar applications pending with the SEC, or plan to submit them, which will be ready to go live if and when approval is granted.

In our previous article, we've argued that ETFs will likely stand to be the major beneficiaries of digital tokenization, among the various traditional finance portfolio wrapper vehicles. The rush of spot ETFs that would come to market following the nod from the SEC – which Bloomberg estimates to have the potential to quickly reach US$100 billion in assets under management (AUM] – would only be the first wave of a mass of digital ETF products.

As I've said elsewhere: "You'll start to see clients or asset managers look to diversify and offer more sophisticated products with exposure to the space."

Why firms are preparing for a digital ETF application surge

The current market for crypto ETFs

Outside the US, other jurisdictions are moving ahead with crypto and digital regulation at their own pace and many, such as Singapore and the European Union (specifically in the Netherlands), have already sanctioned bitcoin spot ETFs.

In the US, we've seen a growing market for bitcoin futures ETFs, with US$1.14 billion AUM across nine products. These funds are small, with the largest one – the ProShares Bitcoin Strategy ETF – making up approximately 90 percent of the total AUM.

The existing US cryptocurrency ETFs are also currently limited to bitcoin futures exposure, with managers yet to move into tracking the futures of other large market cap cryptocurrencies such as Ether, or diversified bundles of multiple smaller currencies.

Additionally the institutional investment industry is moving at pace with regulators in several markets worldwide to advance its understanding and use of blockchain and distributed ledger technology for tokenizing more traditional assets.

Why firms are preparing for a digital ETF application surge

If approved, it is likely that spot ETFs would not stop at bitcoin, and funds following the price of other major cryptocurrencies (like Ether) will be among the first wave of new products to follow. Following this, ETFs that track the spot price of indexes of several cryptocurrencies are also on the fund management industry's radar.

There is a strong interest among asset managers to create innovative products under an ETF wrapper that combines cryptocurrencies and traditional financial assets.

These new ETF products can be complex, with the underlying assets possibly held in series of disparate custodians (i.e., digital, traditional and tangible custodians), with single shares representing the whole portfolio at the top.

For example, an ETF designed to act as a hedge against inflation could include gold, bitcoin and real estate: three assets that are historically considered as hedges against inflation, but that have completely different custodial needs.

Additionally, the industry is exploring a situation where the shares of ETFs themselves are digitally tokenized and can be traded atomically, despite representing a portfolio of less liquid, real and other assets.

Those underlying illiquid assets are also considered primary candidates to be digitally tokenized and fractionalized, which could accelerate the growth of tokenized ETFs by providing liquid underlying assets for new ETF products. At this point, it remains to be seen what will happen first.

However, the SEC's approval for spot ETFs would provide momentum toward the expansion of digital ETFs in the world's largest capital market, and that would represent a major transition in an industry that is ready and willing to innovate to serve its clients.

Glossary

Glossary

- **Bitcoin:** A decentralized digital cryptocurrency, with the token issued on the bitcoin protocol, that can be sent from user to user on a peer-to-peer network without an administrator or central bank involvement
- **Blockchain:** A distributed ledger technology that groups data into blocks when verified by members of the network, linked together to form the blockchain
- **Central bank digital currency (CBDC):** A digital token representing sovereign fiat currency
- **Cryptocurrency:** A digital token used as a medium of exchange or stored value, with transactions recorded using distributed ledger technology
- **Decentralized Autonomous Organization (DAO):** An organization represented by rules encoded as a computer program that is transparent, controlled by the organization members and not influenced by a central government
- **Decentralized finance (DeFi):** Distributed ledger technology-based financial services without traditional intermediaries and central authorities
- **Digital assets:** Any asset in a digital form on a blockchain
- **Digital custody:** The holding and administration of crypto assets and/or cryptographic keys used to safekeep or transfer crypto assets
- **Distributed ledger technology (DLT):** A system of record that is shared and stored across a network of participants such as a blockchain
- **Fiat currency:** A government-issued currency that is not backed by a physical commodity, but by the trust in the issuer
- **Fourth Industrial Revolution (AKA, 4IR or Industry 4.0):** AKA 4IR or Industry 4.0. The current age of automation and interconnectedness in business.
- **Instant settlement (AKA, "T+0," "same day" and "atomic settlement"):** The transfer of funds from one account to another in seconds

Glossary

- **Layer 1 systems:** A base network and its underlying infrastructure that can validate and finalize transactions without the need for another network
- **Non-fungible tokens (NFT):** A unique and non-interchangeable unit of data stored on a digital ledger
- **Programmable money:** A cryptocurrency that can be programmed for a specific outcome using smart contracts
- **Quantum computing (AKA, parallel computing):** In this computational model, traditional chips are replaced by ones capable of more than just binary chains of logic and instruction. A nascent technology, it has the potential to vastly increase computer processing speeds
- **Smart contract:** A dynamic, open-ended mechanism that provides coded sets of rules for a specific use case on a distributed ledger technology network
- **Stablecoin:** A cryptocurrency pegged to the value of a fiat currency such as the dollar, backed by traditional assets or algorithmically attached to digital assets that are automatically bought and sold in order to maintain a stable value
- **Tokenization:** The process of creating a digital token on a distributed ledger technology network
- **Tokenomic:** An analysis of the fundamental characteristics governing a token's utility and value
- **Web 3:** An extension of the World Wide Web through standards set by the World Wide Web Consortium (W3C), with the goal to make internet data machine-readable

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