



DECENTRALIZED FUTURES

Implications for Financial Institutions

TABLE OF CONTENTS

OUR DECENTRALIZED FUTURES TAXONOMY	3
CENTRAL BANK DIGITAL CURRENCY	5
DIGITAL ASSETS AND TOKENS	7
CRYPTOCURRENCIES AND PAYMENTS	9
DECENTRALIZED FINANCE (DeFi)	11
NON-FUNGIBLE TOKENS (NFTs) AND THE METAVERSE	13
WEB 3.0	15
NAVIGATING DECENTRALIZED FUTURES	17
IN CONCLUSION	21
OUR EXPERTS	22



OVERVIEW

OUR DECENTRALIZED FUTURES TAXONOMY

Blockchain, also commonly known as distributed ledger technology (DLT), has been around since 2009, creating market buzz and inciting widely divergent opinions since the inception of bitcoin. In its early years, adoption of DLT in financial services was low due to regulatory and privacy concerns, technology nascency, and complex consortia economic models. During the past 12 months or more, however, the financial industry has embraced blockchain for various use cases, including most notably central bank digital currencies, digital assets and non-fungible tokens (NFTs), and the beginnings of Web 3.0:

- **Central Banking Digital Currencies (CBDC):** Nine out of 10 central banks are experimenting with digital versions of fiat currencies in retail and wholesale sectors,¹ while policymakers are preparing regulatory frameworks for crypto assets. CBDCs are opening up a whole new economic model through programmable wallets and atomic transfers, both of which help drive financial inclusion. Backed by regulators and central banks, CBDCs can build on existing two-tier financial systems while leveraging DLT to explore innovation potential.
- **Tokens and Digital Assets:** 72% of asset managers are building digital assets tokenization solutions,² and many assets (e.g., bonds) are already digitized. Interest in crypto has risen from consumers to institutional investors. The rise and adoption of tokens and digital assets has accelerated the development of new economic models around DLT beyond merely a technology or efficiency play. Capital markets have already operationalized digitization of financial instruments, new asset classes (art, real estate, in-gaming) are gaining adoption, and the emergence of virtual world is further ushering the growth of tokens and digital assets.
- **Web3.0 / 3rd Generation Blockchain:** DLT evolution to solve for many complex challenges around security, scalability, and decentralization has given birth to Web3.0,³ wherein an entirely new internet stack is being built, with seamless execution of smart contracts and decentralized applications (dApps). It has given rise to alternate financial institutions, referred to as decentralized autonomous organizations, which can run several banking functions including lending and deposits without any intermediaries.



Financial services use cases are growing rapidly

Decentralized technologies, including DLT and more recently Web 3.0, are finding increased adoption in the financial services business across banking, capital markets, payments, and insurance domains. Decentralization enables faster remittances and payments, especially in cross-border transactions, with greater transparency and immutability. Distributed ledgers can also provide single source of truth for identity management, which can be leveraged by all the parties on a network for KYC/AML purposes as well as fraud detection and prevention.

Smart contracts can automate claims processing, especially in case of parametric insurance, and can also be deployed to grant customer consent for data processing and risk assessment. Web 3.0 architecture, blockchain, and smart contracts can also add a high degree of trust without the need for intermediaries, simplifying the processing and contract management for mortgages and loans. Crypto tokens are also finding increased adoption in loyalty solutions, enabling customers to instantly earn, convert, and use loyalty rewards.

For the capital markets, tokenization is providing a long-sought solution to overcoming delays in the settlement of assets and securities and enabling instant delivery versus payment transactions. The insurance industry is also benefitting from automating several parts of the value chain by creating a trustworthy record of products' provenance for the benefit of all stakeholders. Existing peer-to-peer models, such as reciprocals and mutuals, are also being enhanced by automating tasks and holding funds in escrow on smart contracts.

In the subsequent sections of this paper, we examine six major areas and key developments driving DLT adoption across the financial services industry and their implications. We refer to these six areas as "Taxonomy 2.0," and they are an update of our taxonomy published last year, [Navigating Decentralized Futures](#).



CENTRAL BANK DIGITAL CURRENCY

Central Bank Digital Currencies (CBDCs) have gained significant momentum in the past year or so, as central banks are moving from research and exploration to pilot projects on several use cases.

Nine of 10

central banks are exploring digital currency, with more than 50% of the banks now running concrete experiments or developing CBDCs.⁴

Financial stability has come to the top of the list of priorities for central banks and regulators, triggered by the pandemic and fueled by the recent turn of geopolitical events. In addition, mainstream acceptance of cryptocurrencies as an alternate form of payment has paved the way for CBDC experimentations across most of the geographies.

Types of CBDCs

A CBDC is a digital currency issued by a central bank and denominated in the nation's fiat currency. CBDC is not just 'digital money' but represents a direct liability of the central bank. Broadly speaking, there are two types of CBDCs under exploration, retail CBDCs and wholesale CBDCs. Central banks are particularly interested in retail CBDCs, according to the 2021 BIS central bank survey on CBDCs and digital tokens.⁵ Almost one fifth of central banks are developing or testing a retail CBDC, which is twice the share of central banks building or piloting a wholesale CBDC.

Retail CBDCs are intended for public consumers as a new means of accounts and payments. Retail CBDCs typically involve low value, high volume transactions between citizens and businesses. Retail CBDCs can eliminate intermediaries and streamline transactions, and thereby reduce cost and settlement delays. Retail CBDCs are gaining momentum, with countries such as The Bahamas (the Sand Dollar), Nigeria (eNaira), Eastern Caribbean (DCash), and China (Digital Yuan) launching their digital currencies within the past couple of years.

China is one of the major economies with the most advanced CBDC rollouts, with pilot programs running in several regions in the country. More than 250 million e-wallets have been opened, and transactions worth more than 85 billion yuan have been conducted in e-CNY by the end of 2021.⁶ At the same time, proposals to ban the digital yuan are on the table in the U.S. amid concerns around privacy and security.⁷ The Monetary Authority of Singapore shortlisted 15 innovative solutions in retail CBDCs to enhance payment efficiencies.⁸ While Russia has launched a trial on a digital ruble,⁹ the Bank of Japan has entered the second phase of its CBDC experiments.¹⁰

Wholesale CBDCs are designed for intra-bank and inter-bank settlements between banks as well as with the central bank. Wholesale CBDCs involve high value, low volume transactions between financial institutions. Wholesale CBDCs can improve efficiency and risk management of inter-bank settlements, especially cross-border transfers. Interoperability will be a key driver for wholesale CBDC as we address in the later sections.

The Hong Kong Monetary Authority, in collaboration with the Bank of Thailand, has expanded its work on wholesale CBDC (initially dubbed the Inthanon-LionRock project) for further experimentation. The Central Bank of the United Arab Emirates, the Digital Currency Institute of the People's Bank of China, and the BIS Innovation Hub Hong Kong center have joined the bandwagon, with the project now renamed to mBridge.¹¹ This phase will involve further experimentation and open-sourcing to increase the efficiency of cross-border transfers.

CBDC models

There are three models under consideration by central banks today on the issuance, distribution, and settlement of CBDCs – direct, indirect, and hybrid models. In the direct model, the central bank provides account and wallet services directly to end-users without any intermediaries. The indirect model is similar to the current retail banking system, where intermediaries are responsible for customer onboarding, KYC, AML, account and wallet management, and more. A hybrid model is also being considered, which combines aspects of both direct and indirect models.

More than 70% of central banks exploring CBDCs are considering the indirect model,¹² as the direct model increases the overhead on the central bank and might lead to inefficiencies. The Bank of England's proposed platform model is also an indirect model with a public-private partnership, where the bank will provide a core ledger for CBDCs while payment interface providers would provide additional payment services and interact with end-users.¹³

The need for interoperability

While CBDCs can increase operational efficiency, enhance security, and improve the convenience of currency exchange, individual CBDC networks independent of an international infrastructure could lead to fragmentation and several parallel systems.

Most central banks working on retail CBDCs are also exploring interoperability with existing payment systems. Project Dunbar, led by the BIS Innovation Hub in partnership with the Reserve Bank of Australia, Central Bank of Malaysia, Monetary Authority of Singapore, and South African Reserve Bank has developed a shared platform for international settlements using multiple CBDCs.¹⁴



CBDC interoperability will be pivotal to increase compatibility, improve efficiency of cross-border payments, and foster global economic integration.

Existing payment service providers will play a key role in enabling interoperability and will have an increasing role to play in CBDC adoption. SWIFT, in collaboration with Capgemini, has been conducting new experiments to interlink domestic CBDCs to enable seamless cross-border payments.¹⁵ Visa has also partnered with ConsenSys to bridge the newly developed CBDC networks with traditional financial institutions.¹⁶

Implications and outlook

CBDCs can eliminate many inefficiencies plaguing current currency exchange mechanisms, both regionally and globally. As retail CBDCs become mainstream, via the indirect model, retail banks will have new opportunities around wallet services and custody solutions. As CBDCs

become increasingly accessible to the public through wallets, financial inclusion is also expected to increase.

CBDCs are here to stay, and more and more central banks are going to issue a retail CBDC – and maybe a wholesale CBDC too – in the near future. Emerging markets are expected to lead the way in CBDC adoption, and as legal and regulatory frameworks also evolve and adapt, a globally interconnected exchange system powered by CBDCs might soon be a reality.

However, implementing central banks as well as partnering retail banks need to be wary of various risks associated with the new technology, including cyber risks and financial and monetary policy implications. A staged adoption plan including appropriate risk management measures may be required for effective implementation.

DIGITAL ASSETS AND TOKENS



Tokenization has been a revolutionary blockchain-related use case for the financial services sector. DLT allows digital representation of any asset on the blockchain, streamlining the trade life cycle and eliminating the need for intermediaries. Tokenization enhances accessibility, transparency, cost-efficiency, and security of the trading system.

While anything and everything can be tokenized, there are two broad categories where tokenization is most rapidly gaining traction: a) streamlining the efficiency of traditional capital markets by tokenizing financial instruments; and b) facilitating exchange of new asset classes such as real estate and art through fractionalization. Several other use cases are also finding adoption, including tokenizing carbon credits,¹⁷ shares,¹⁸ and more.

Financial market infrastructure

Tokenization can bring operational efficiencies across the digital asset lifecycle – from issuance, distribution, exchange, clearance, and settlement to custody and asset servicing. DLT and smart contracts can provide many benefits, including faster and cheaper settlements, elimination of multiple data reconciliation processes, real-time monitoring, fraud detection, and more.

Tokenization of equity post-trading alone could result in gains of EUR 4.6 billion by 2030.¹⁹

Regulators and market infrastructure providers will act as pacesetters in this transformation journey. For example, the European Union (EU) is creating a pilot regime, “DLT Pilot,” for financial market infrastructures for trading and settlement of tokenized securities.²⁰ The legislation for DLT Pilot has also been finalized and is expected to be effective from March 2023.²¹ The UK government is also working on a regulatory sandbox for financial market infrastructure using DLT, to be operational by 2023.²²

Euroclear has launched an initiative called Distributed Financial Market Infrastructure (DFMI) to unlock market efficiencies using DLT.²³ The Monetary Authority of Singapore (MAS) recently announced the launch of Project Guardian, an industry initiative to pilot use cases in digital assets.²⁴ The first pilot will be led by DBS Bank, JP Morgan, and Marketnode to create a permissioned liquidity pool for tokenized bonds and deposits.

New asset classes

Perhaps an even more interesting application lies in fractionalization, where tokenization permits fractional ownership of high value assets.

Tokenization has the potential to unlock trillions of dollars trapped in illiquid assets today.

This has paved way for new asset classes including art, real estate, precious metals, which were previously difficult to trade.

VNX, for example, provides a regulated platform for investment in tokenized precious metals, and is the first of its kind in Europe.²⁵ Users can purchase tokenized gold using Euros, Ether, or bitcoin, which provides all the underlying advantages of the underlying commodity (each token represents one gram of physical gold) with the flexibility of a crypto asset. The physical gold is stored in a vault with full insurance and zero storage fees to secure the investments.

Tokenization increases liquidity of high-value assets by allowing a greater number of traders, including retail investors, to trade and exchange tokens on a secondary market.

Digital assets custody

As DLT adoption accelerates in the financial markets, there is an increased demand for safe keeping of digital assets. Digital assets custody has become of primary importance, amid growing concerns around theft and illicit usage of digital assets. With growing institutional interest in digital assets, major players in the banking industry are trying to capture the market share and gain first mover advantage by partnering with niche players. Citi²⁶ and Societe Generale,²⁷ for example, have selected Metaco to develop institutional digital asset custody platforms to enable a seamless and secure way to store and transact digital assets for their clients.

Digital asset storage essentially means safekeeping of a “private key,” which is meant to be kept private, to access the digital assets as well as to authorize the transaction to send on blockchain. There are various storage options offered by the custodians to secure and access the private key. In cold storage, the private key is stored offline, on paper or hardware devices, and requires human intervention. In hot storage, the key is stored online and made easily accessible for investors. Warm storage options also exist, which combines the security of cold storage with the automation of hot storage.

Other custody/storage mechanisms have also developed, including options such as multi-signature and multi-party computation. In multi-signature storage, multiple individuals with their own private keys are required to authorize the transaction and send it over the blockchain. In multi-party computation, one private key is broken down into multiple key shares stored in different locations or systems. Each safekeeping mechanism has its own pros and cons. Custodians will have to assess the demand at hand and provide storage options as described above or as combinations of the above.

Implications and outlook

With the growing prominence of digital assets, we can anticipate an unprecedented demand for custody services. Incumbents have a significant advantage because of the credibility and expertise they carry, and trustworthiness with both retail and institutional investors. Financial service providers can either invest in building capabilities, or partner with niche/boutique players in this space.

A hybrid approach with state-of-the-art custody solutions covering both traditional and digital assets could prove to be a differentiator.

There are several factors driving interest from industry players in tokenization. There has been an increased demand for real-time and efficient transactions with robust data privacy and security. Investor interest in non-traditional asset classes has also been growing rapidly. With the help of tokenization, industry players can not only address these drivers but also unlock several other benefits.

As we called out in the previous edition of our taxonomy, transforming a highly regulated capital market would require significant efforts and collaboration between policy makers, regulators, and incumbent financial institutions.

A global set of standards for legislation and regulation around KYC, AML, etc., will be necessary for adopting tokenization at scale. As the number of financial market infrastructure projects on DLT increase, standardization across asset classes will also become essential for interoperability. When it comes to new asset classes, classification of such assets either under existing categories or under new regimes will be required for effective governance, including taxation.

CRYPTOCURRENCIES AND PAYMENTS

Cryptocurrencies have witnessed rapid growth in the past couple of years; even in the face of the market crash in June 2022, total market capitalization of cryptocurrencies stood at just over USD 1 trillion.²⁸ The Asia Pacific region is leading in crypto adoption, while countries in emerging markets have also shown huge growth with the rise in peer-to-peer platforms.²⁹

Crypto has emerged as an alternate source of livelihood amid economic turmoil in countries like Philippines, with the emergence of play-to-win games.³⁰



Diminishing barriers to entry and technological advancements have also paved way for increased adoption. Users today are able to buy and sell cryptocurrencies instantly at crypto ATMs through providers like Bitcoin Depot,³¹ Coin Flip,³² Kurant,³³ and more. Customers prefer accessing crypto services through centralized institutions primarily due to the trust factor; niche players are partnering with large banks to provide crypto accessibility for end consumers. Bakkt, for example, has been selected by the American Bank to provide crypto trading services to its customers.³⁴

Institutional appetite for crypto assets has also been on the rise. Goldman Sachs, soon after offering a bitcoin-backed loan,³⁵ has also executed its first trade of Ether-linked derivative, a non-deliverable forward that pays out based on the price of Ether.³⁶

Crypto-custody, advisory, and asset management services for crypto-backed assets is emerging as low-hanging fruit for incumbents.

BNY Melon has launched a crypto custody platform,³⁷ Commonwealth Bank of Australia has designed a crypto exchange and custody service feature on its CommBank app,³⁸ Nomura is establishing a new subsidiary to assist their institutional clients in crypto investments,³⁹ and Visa has launched a global crypto advisory practice.⁴⁰

Crypto rewards and loyalty programs

Loyalty programs have also emerged as a compelling use case for crypto, with several card providers starting to offer reward points in cryptocurrencies. Visa was one of the pioneers in this space when they partnered with BlockFi to launch a signature credit card that offers bitcoin rewards.⁴¹ Mastercard is also integrating crypto into loyalty solutions, enabling its partners to offer crypto rewards to customers.⁴² And American Express is launching a crypto card in collaboration with Abra, which will let users earn crypto rewards on transactions.⁴³

Stablecoins: are they stable?

Stablecoins are cryptocurrencies whose value is pegged to that of another asset, or a basket of assets, such as currencies, commodities, or financial instruments. Stablecoins are poised to have a higher potential than other cryptocurrencies which face the risk of a high degree of volatility.

While stablecoins can derive value from any underlying asset, they can be categorized broadly into three categories:⁴⁴

- Public reserve-backed stablecoins such as Tether, USDC, BUSD, etc., which are backed by cash-equivalent reserves like fiat currency, deposits, etc.
- Public algorithmic stablecoins such as DAI, TerraUSD, etc., which are backed by smart contracts and algorithms that automatically defend the peg
- Institutional stablecoins like the JPM Coin, which are issued on private networks for internal/enterprise use

While public reserve-backed coins are largely stable because they follow the asset(s) to which they are pegged, algorithmic stablecoins are relatively risky and do exhibit volatility. Algorithmic stablecoins are not backed by any asset and are completely decentralized, and hence subject to market volatility.

Stablecoins provide a comparatively less risky alternative to cryptocurrencies. However, the design and governance of stablecoins will be pivotal in estimating their trade life cycle and making informed investment decisions. Several incumbents are exploring public reserve-backed stablecoins to derive benefits from the crypto market: ANZ bank issued a stablecoin pegged to the Australian Dollar which will let users buy and sell digital assets, cryptos, and NFTs;⁴⁵ Mitsubishi UFJ Bank is planning to issue Progmacoin for clearance and settlement of digital securities;⁴⁶ while several others are exploring other use cases.

Crypto and financial stability

While cryptocurrencies continue to gather mainstream adoption, the risk it poses to financial stability should not be underestimated. An increased adoption of crypto could be largely attributed to speculative investments, but we are also witnessing a shift towards crypto as a means of payment, with several businesses accepting crypto payments today. In the wake of global sanctions put in place because of the war in Ukraine, a few countries and emerging markets could also start widespread use of crypto assets to bypass capital restrictions and sanctions.⁴⁷

Crypto markets today lack regulation and are not covered by legal frameworks in most geographies. In addition, crypto poses volatility, and technical as well as security risks. As crypto becomes more entwined with the traditional financial system, these risks could reverberate into the traditional financial system and create systemic shocks.

With rapidly increasing institutional exposure to crypto assets, expanding/adapting regulations to cover crypto assets under financial assets may well be the need of the hour. Further measures to foster public-private collaboration on code regulation and governance can also improve stability. These measures may take time, however, and so a balanced approach, which limits greater exposure of regulated institutions to DeFi markets, combined with the steps described above could be beneficial.

With rapidly increasing institutional exposure to crypto assets, expanding/adapting regulations to cover crypto assets under financial assets may well be the need of the hour.

Implications and outlook

Volatility might be a factor that could hinder crypto adoption. Susceptibility to attacks, slow transactions, and high energy costs associated with verification methods could also be impediments. Yet, crypto-backed assets and stablecoins are finding increased market traction both in new retail markets as well as with institutional investors. Incumbents must reorient themselves to act as trusted advisors for their clients on their crypto journeys.

A coordinated approach to regulation between the Centralized Finance (CeFi) and the DeFi worlds might be needed to alleviate financial stability risks from the crypto ecosystem. The Basel Committee on Banking Supervision proposals on banks' crypto asset exposures are a significant step toward global standards to help address some cross-border issues. The EU is also finalizing a regulatory framework for the crypto sector across the 27 member states aimed at addressing issues such as investor protection and financial stability.⁴⁸

As for stablecoins, they may not always be stable, as the Terra crash demonstrated. Several factors – including the backing mechanism (currency versus commodity versus algorithm), the issuer, regulatory environment, and platform/protocol – will determine the potential of any stablecoin to become an alternate means of payment or payment instrument.



DECENTRALIZED FINANCE (DeFi)

Decentralized Finance (DeFi) lets users transact in a peer-to-peer fashion without the need for an intermediary. Several factors have contributed to the rise and prominence of DeFi. The emergence of smart contracts paved way for an automated means for financial transactions, eliminating the complex time delays and high cost associated with intermediaries. The growth of stablecoins has also accelerated DeFi adoption, as it offers a unit of denomination in the decentralized world.

The total value locked (TVL) in DeFi fell to a little less than USD 80 billion in June 2022,⁴⁹ falling over 60% from all-time highs in late 2021 and early 2022.

The trust in DeFi protocols was rattled in the aftermath of the Terra crash, and its effects rippled across the DeFi ecosystem. At the same time, the role of centralized exchanges is becoming more prominent in DeFi, though that might appear counter-intuitive. OKX, for example, was able to proactively notify its customers and release their volatile assets from staking pools, saving investors about 500 million UST.⁵⁰

Institutional investment in DeFi has also soared in the recent past with incumbents trying to generate value from DeFi protocols. JP Morgan is planning on tokenizing institutional assets to be potentially used as collateral in DeFi pools.⁵¹

We are also beginning to see a convergence of DeFi with real-world assets. Aave, in partnership with Centrifuge, has launched a Real-World Assets (RWAs) market bridging DeFi with the trillion-dollar real assets market.⁵² Users will be able to tokenize real world assets and collateralize them to borrow, as well as earn yields against digital assets.

DeFi: technical risks

Investors and depositors are exposed to technical, legal, as well as cyber risk on DeFi platforms. Cyber risks are also increasing on DeFi platforms, compromising users' wallet keys and access to DeFi funds.

More than USD 1.5 billion were stolen from DeFi platforms in Q1 2022 alone,⁵³ up from USD 3.2 billion for the whole of 2021.⁵⁴

Faulty codes, security breaches, and flash loan attacks constitute the major forms of theft mechanisms on DeFi protocols.

The open-source nature of decentralized applications (dApps) and bugs in software code makes it easier for hackers to target DeFi protocols. Anonymity on the platform and smart contract bugs makes DeFi more vulnerable to AML risks. Weak or absent KYC mechanisms, combined with the lack of regulation, make DeFi applications susceptible to financial crimes.

DeFi also suffers from scalability issues because most of the transactions today rely on Ethereum; network congestion and increased gas fees also act as impediments to adoption. L2 chains and the evolution of Web 3.0 (as we outline in a later section of this paper) will play a major role in improving the scalability of DeFi applications.

DeFi: CeFi and macro implications

DeFi offers relatively high deposit interest rates with narrow margins to attract depositors and borrowers. However, this could be highly vulnerable during periods of market stress because the platform holds thinner reserve buffers. Sharp declines in crypto prices could also trigger liquidation of DeFi loans, causing solvency risks. Further, while DeFi advocates and supports financial inclusion, it suffers from overcollateralization, implying the borrower might require more assets than they wish to borrow and thereby failing to fulfill its inclusivity promise.

While the DeFi market is still relatively small compared to the overall size of traditional financial markets, DeFi is becoming increasingly connected with CeFi because of an overlapping investor base. DeFi market volatility could thus create reverberations in the traditional financial market in the absence of a well-defined regulatory framework.

Decentralized autonomous organizations (DAOs)

Decentralized autonomous organizations (DAOs) are organizations which are governed by code, with the help of blockchain technology and Web 3.0 architecture, without any centralized leadership.

DAOs offer trusted and transparent decision-making leveraging peer-to-peer protocols and smart contracts for corporations or communities.

Popularized by The DAO⁵⁵ for venture capital funding, DAOs have since found usage for other multiple other use cases,⁵⁶ including community governance, automated market making, fund raising, and legal services. Digital assets worth nearly USD 14 billion are held in the treasuries of the top 20 DAOs.⁵⁷ Investment DAOs, which can raise and invest capital through smart contracts democratizing the investment process, are also gaining popularity. Private equity and venture capital firms could leverage DAOs to eliminate inefficiencies in traditional investment processes and promote inclusivity.

While DAOs are susceptible to attack, as evident through The DAO hack,⁵⁸ decentralized decision-making could possibly unlock many benefits for organizations when implemented with proper security and governance measures. However, anonymity on DAO networks could raise potential risks. Balancing technology with legal and regulatory frameworks will be required to promote further adoption.

Implications and outlook

DeFi is still in its nascency and may require much more time for the technology to mature and the regulatory environment to evolve before it can reap its true potential. Multiple interdependent exchanges also create a fragmented ecosystem. Interoperability between platforms and exchanges could further boost adoption: Binance Bridge 2.0, for example, enables users to bridge assets from any blockchain to the BNB chain.⁵⁹



While it might be tempting to dismiss the role of traditional financial service providers in the DeFi world, recent events suggest that centralized exchanges could play an effective role in governing DeFi and enabling an ecosystem where DeFi and CeFi can co-exist.

Incumbents could by themselves, or by partnering with fintechs, act as a trusted orchestrator and advisor on DeFi investments. Institutional DeFi could also become mainstream where incumbents can provide KYC requirements, adding an identity layer on top of DeFi protocols.

Verifiable credentials⁶⁰ combines the trust and immutability of cryptography with physical/digital credentials to decentralize digital identity and could play a major role in accelerating institutional as well as retail adoption of DeFi. Microsoft is exploring this space with its Azure Active Directory Verifiable Credentials,⁶¹ while players like Tokeny are offering blockchain-based identity solutions for regulatory compliance.⁶² Regulated financial institutions and incumbents have a major opportunity at hand to act as trust anchors for DeFi protocols.



NON-FUNGIBLE TOKENS (NFTs) AND THE METAVERSE

The NFT marketplace has ballooned over the past couple of years due to its promises of traceability, ownership, and distinctness. The total value traded in NFTs reached USD 17.6 billion in 2021, a whopping 21000% year-over-year increase from 2020, with 2.3 million buyers.⁶³

NFT market size is expected to further grow at a CAGR of 35% during 2021-2026,⁶⁴ and become a USD 200+ billion market by 2030.⁶⁵

NFTs are poised to have an increased utility with the advent of the metaverse. Gartner predicts that by 2026, 25% of people will spend at least one hour a day in the metaverse for work, shopping, education, social, or entertainment purposes.⁶⁶ NFTs could serve as the medium of value exchange in the token economy. Because the tokens are unique, NFTs can be used for utility items such as land purchase (as seen in Decentraland⁶⁷) as well as access tickets to various events in this space.⁶⁸

Enterprise interest in NFTs and the metaverse has also been on the rise. Nike released a collection of virtual sneaker NFTs with the acquisition of RTKFT⁶⁹ and made headlines with the sale of an NFT sneaker for USD 134,000.⁷⁰ Mastercard has filed for 15 trademarks in the areas of metaverse and NFT related services, including payments and credit cards.⁷¹ Investor interest has also seen an uptick on metaverse projects. Fidelity Investments launched an exclusive exchange-traded fund to offer investors exposure to metaverse related products and services.⁷² With the rapid growth of interest in metaverse and the rise of creator economy, NFTs could open a traditionally illiquid market and create a new platform for ownership and exchange.

Banking on the metaverse

The total addressable market for metaverse related services is projected to be worth between USD 8 trillion and USD 13 trillion, with 5 billion users by 2030, as per reports by Citibank.⁷³ The metaverse could be seen as the next frontier for customer engagement in the banking sector, evolving from traditional to digital banking, followed by open banking, and standing today at the cusp of decentralized finance.⁷⁴

JP Morgan became the first global bank to enter the metaverse when it launched the “Onyx Lounge” in Decentraland.⁷⁵ Banks like HSBC and Standard Chartered have dipped their toes in as well. HSBC announced their plan to buy a plot of land at The Sandbox metaverse to deliver innovative brand experiences for sports, e-sports, and gaming fans.⁷⁶ HSBC has also launched a fund to research investment opportunities in the metaverse for its affluent clients in Asia,⁷⁷ while Standard Chartered has partnered with Sandbox to create a metaverse experience,⁷⁸ and Worldline has established a dedicated virtual showroom.⁷⁹ In India, Kiyaverse is combining real-world banking with the metaverse via virtual interactions.⁸⁰ Kiyaverse will allow banks to extend metaverse services and aims to enable open finance via tokens and CBDCs.

Opportunities for financial services

NFTs have ushered a new era of digital goods and has the potential to transform financial industries as well. Financial services firms have started exploring and investing in NFTs and metaverse related offerings.

Facilitating NFT trading seems to be low-hanging fruit for financial services and will eliminate barriers to entry for non-crypto users.

Mastercard has partnered with Coinbase so that users will be able to make purchases using their credit cards on Coinbase's NFT marketplace.⁸¹ NFTs are emerging as a collateral in the DeFi lending space, where token holders are allowed to access funds without liquifying their unique holdings.

NFTs also open new possibilities of encrypting and managing sensitive data, as they provide a secure, transparent, and tamper-proof mechanism. Vera, in partnership with ONTOWallet, offers users a secure means to protect and manage their private data and digital assets through a digital identity.⁸² NFTs can also be utilized to tokenize documents such as letters of credit in trade finance, to eliminate intermediaries and help prevent fraud.

As is true for digital assets, tokenization, asset management, custody, and integration services (linking NFTs to different platforms, or even the metaverse) around NFTs are all opportunity areas for incumbents. Goldman Sachs, for example, is exploring NFTs to tokenize real-world assets like financial instruments.⁸³ Because the possibilities are so numerous, the financial services industry is expected to further adopt NFTs and the metaverse for business-centric use cases and to serve their customers in the new frontier.

As consumers increase their interactions and adoption of the metaverse, financial services firms can identify potential customers, onboard and engage them in the metaverse, and offer metaverse related services including wallet services, digital assets custody, and more. Insurance providers will also need to adapt their existing product portfolio to fit the virtual world, as well as to come up with new solutions for new products and experiences that customers will come to want and expect. Traditional insurance providers have started testing the waters via initial investments: AXA France has taken its first steps into the metaverse through the acquisition of a plot of land from The Sandbox.⁸⁴



Outlook and implications

The implications of NFTs and the metaverse within financial services still have a long way to go before realizing their full potential. NFTs inherently suffer from the technical, legal, and regulatory challenges outlined in other sections of this taxonomy, with trepidations needing to be addressed before complete adoption. Lack of regulation is also a concern, with countries like China intending to limit financial activities involving NFTs.⁸⁵

Standardization and regulations could boost adoption and utility for NFTs for many use cases. The United Nations has approved a project by Tencent to create a technical and security framework for NFTs.⁸⁶ The Metaverse Standards Forum has been set-up by 30+ organizations – including Microsoft, Meta, W3C, Nvidia, Qualcomm, Sony, Unity, Epic Games, and many others – to accelerate standardization efforts in the virtual world.⁸⁷



WEB 3.0

Web 3.0 is the next generation of the internet that utilizes machine learning, decentralized ledgers, artificial intelligence as well as other technologies to offer a semantic version of the internet. Web 3.0 reduces reliance on centralized storage systems and provides users and content creators more autonomy with their data and a high degree of security.

Web 3.0 provides a smart and autonomous network interface for information exchange which is serverless, open, trustless, and immutable.

To help understand Web 3.0 better, we have deciphered the underlying layers in the new internet stack. While the current version of the internet or Web 2.0 is built on communication protocols such as TCP/IP, the serverless Web 3.0 is built on value transfer protocols and distributed infrastructure that is interoperable. While the Web 3.0 stack is still young and being developed, for easier understanding we can classify the new technology stack into five layers:⁸⁸

- **Layer 0 (Infrastructure and Networking Layer)** is the foundation layer of Web 3.0, which defines computation – platform-neutral programming languages such as EVM (Ethereum), AVM (Algorand), and others – and communication (zero-trust, peer-to-peer, and secure networking suites such as devp2p) protocols.
- **Layer 1 (Protocol Layer)** provides the ability to distribute and interact with data including data protocols such as IPFS and BigChainDB (data distribution), or Whisper and Matrix (transient data pub/sub messaging), or consensus protocols such as Polkadot.
- **Layer 2 (Storage and Compute Layer)** enhances Layer 1 capabilities by providing functionalities such as increased scaling, encrypted messaging, and distributed computing. Some examples of Layer 2 functionalities include state channels (e.g., Bitcoin Lightning Network), plasma protocols (e.g., PlasmaChain), heavy computation protocols (e.g., Golem), storage protocols (e.g., storj), and oracles (e.g., Chainlink).

- **Layer 3 (Abstraction Layer)** has languages and libraries that allow developers to create applications; this could include Web 3.0 libraries (e.g., web3.js, ether.js, etc.), languages (e.g., Solidity), and APIs.

- **Layer 4 (Access Layer)** hosts the decentralized applications that allows users to interact with one or more layers. Examples include wallets and browsers (e.g., MetaMask, MyCrypto), DeFi platforms (e.g., Uniswap, Aave), marketplaces (e.g., OpenSea, Rarible), and so on.

While there is tremendous movement and development around Layer 3 and Layer 4, Web 3.0 architecture is only just evolving and will require more matured supporting layers to accelerate enterprise adoption soon. Network, storage, and computing protocols are evolving to address scalability and security and will be critical factors in driving Web 3.0 growth in this decade.

Opportunities for financial services

Web 3.0 will pave the way for a self-governing digital ecosystem without the need for a trusted third-party. The advent of Web 3.0 and proliferation of the metaverse will further accelerate the adoption of digital assets for transactions, including CBDCs, cryptocurrencies, NFTs, and other tokens.

A few financial service providers (both CeFi and DeFi) and Web 3.0 developers have already started investments within this space so that they do not run the risk of missing out on opportunities. Coinbase has rolled out Web 3.0 functionality on its app which will allow users to access DeFi, make exchanges at decentralized exchanges, trade NFTs, and more.⁸⁹ Uniswap has set up a venture capital fund to invest in Web 3.0 protocols and projects.⁹⁰ Fortanix is offering a suite of Web 3.0 infrastructure solutions to secure DLT, crypto, and DeFi businesses.⁹¹ Tintra has announced a Web 3.0 bank built on Web 3.0 technologies that will be compliant with existing regulations.⁹²

Web 3.0 will necessitate a “trustless” system with “borderless” exchange that is powered by an “always-on” KYC.

Technologies, ecosystems, and regulations around Web 3.0 will need further maturation before a scaled industry-wide adoption can happen. As we outlined in a prior section on DeFi, verifiable credentials and digital identity management will be a key consideration area for financial services.

Web 3.0 maturity and risks

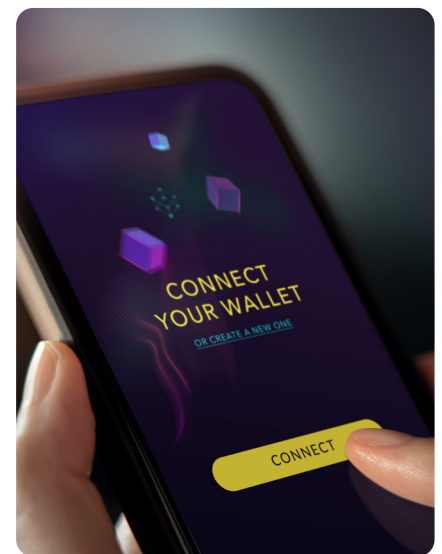
The lack of any central authority in the Web 3.0 world can cause accountability issues in cases of cyber-crimes and theft. Privacy concerns are also important as financial firms will likely be collecting massive amounts of personal data in order to offer products and services to customers. Web 3.0 linkages to several decentralized systems also inflates technical, legal, and cyber risks, as they can penetrate the Web 3.0 infrastructure from DeFi protocols or other networks. The use of AI for decision-making could also create biases due to limited or skewed information. Ethical and fair usage of AI will also be critical to realize the promises of Web 3.0.

Outlook and implications

Web 3.0 will play a key role in accelerating decentralization of the financial services industry, as well as in converging CeFi and DeFi. Web 3.0 is still in its early days and will require a collaborative ecosystem approach from technologists, industries, regulators, and governments to make it fruitful. The Monetary Authority of Singapore also recently launched a hackathon to accelerate the development of Web 3.0 technologies and Green Finance in Singapore.⁹³

While Web 3.0 is set to make its influence felt in financial services areas including capital markets, asset management, consumer banking, and insurance, its mainstream adoption will be hindered by challenges including complex technology architecture, technical limitations, non-functionals, expensive infrastructure, and poor user experience. Fintechs will have a natural advantage while traditional industry incumbents will have some work to do to catch up.

Enterprises will need to rethink their customer engagement strategies in the new internet frontier. While the technology is still evolving, early winds of the Web 3.0 space show tremendous potential and promise. As we decipher new realms of the economy powered by decentralization, Web 3.0 will provide avenues to maximise the value.



NAVIGATING DECENTRALIZED FUTURES



In this last section of our taxonomy point of view, we examine the key ingredients needed for enterprises to navigate the six defined taxonomy areas and the future of decentralization in financial services. From a technology perspective, platform design considerations including network architecture, smart contract language, and consensus mechanism are a major dilemma for enterprises. To address scalability issues and integrate blockchain technology and Web 3.0 architecture into legacy business models, interoperability with existing as well as new networks is another challenge that needs to be met. Further, as the ecosystem matures and the emergence of boutique players offering niche capabilities continues, a collaborative approach will help incumbents accelerate their DLT journey.

Technology: public versus private architectures

As blockchain technology evolved, the debate around public versus private blockchains has taken different shapes and forms. A public and a private blockchain differ primarily in the degree of decentralization and participation (who can join or access the network). A public blockchain network is not controlled by a single entity or organization, and the consensus algorithm ensures the maximum degree of decentralization (e.g.,

Bitcoin network). On the other hand, a private blockchain is controlled by a central authority or a closed group of organizations (a consortium) and so are less decentralized. Often, private blockchains differ from public ones in the consensus algorithms that ensure private blockchains are faster and more scalable; but public blockchains are often more secure and less scalable.

Today, public blockchains power the DeFi ecosystem, crypto currencies, NFT marketplaces, metaverse applications, and many payment applications and application protocols. Private blockchains are enabling enterprise applications where multi-party business transactions need to be carried out in a trusted environment, e.g., supply chain, trade finance, and document exchange.

Another feature that characterizes and differentiates blockchains is the “permissioning” aspect. A permissioned blockchain only allows specific entities or organizations to join the network; while a permissionless blockchain network can be joined by anyone without the need of a permission. Private blockchains are permissioned in nature whereas most public blockchains are permissionless.

The gap between private and public, or permissionless and permissioned, blockchains is closing. For example, there is an emerging trend of “public-permissioned” blockchain networks, where anyone can connect and use the network but only selected entities or organizations are permissioned to run their nodes on the network. An example of this type of blockchain is Hedera Hashgraph,⁹⁴ which offers “consensus as a service.”

Also, innovation is taking place in the area of advanced cryptographic primitives that allows applications and smart contracts to run on both public and private blockchains without compromising the privacy aspects of the transactions. A good example is “zero knowledge proof”-based primitives used in smart contracts. Enterprises are building hybrid architectures which incorporate both private and public blockchains.

While there was initial skepticism around public blockchains, today enterprises are largely considering public networks or a hybrid/layered architecture owing to their widespread reach and usability.

With advancements in cryptography and security, the privacy of transactions on public networks can be ensured like on private blockchains.

Interoperability: on-chain, off-chain, and cross-chain linkages

With widening adoption of blockchain in a variety of business applications ranging from DeFi to CBDCs, the DLT ecosystem is being built using multiple types of, and often incompatible, DLT networks. Interoperability is of paramount importance, because these DLT networks will often need to connect with other networks as well as traditional IT systems to be able to provide desired business outcomes.

Interoperability is defined primarily in two ways:

- **Cross-chain:** Cross-chain communication is characterized by any mechanism implemented to either exchange digital assets between two blockchains using their native assets, or transfer value or data from one blockchain to another. Popular mechanisms include Atomic Swaps⁹⁵ using HTLC or similar protocol, and Relay/Sidechain based solutions where information about consensus protocol on one chain is used by other chain to achieve cross-chain asset transfer. Certain DLTs are designed to address cross-chain interoperability, e.g., Cosmos, Polkadot. There are also significant developments to build general purpose cross-chain frameworks like IBC (Inter-Blockchain Communication protocol)⁹⁶ and CCIP (Cross-Chain Interoperability Protocol).⁹⁷
- **On chain-Off chain:** Due to the deterministic nature of DLT consensus protocols, DLTs by design have limitations in terms of consuming and/or sharing data which is outside the ledger; this can limit or impact the usability of the DLT application itself. As an example, a decentralized exchange application needs to know exchange rates from the open market. Specialized systems called “Oracles” can fill this gap and can integrate with DLT network’s smart contract layer to exchange data in a way that doesn’t impact the consensus protocol of the DLT. An Oracle application can be a single instance of an application, or it can take the form of a large, decentralized network of Oracle applications to ensure the data being injected into the DLT is of high quality. A good example is Chainlink⁹⁸ which provides an Oracle network of this type.

Key considerations for adopting an interoperability solution are security, atomicity of cross-chain transactions, quality of data, and scalability.

Interoperability is also a key factor when it comes to enterprise adoption of public DLT networks/protocols, as this allows application-level integration of their existing private DLT networks to interoperate with public networks. CBDC-based cross-border payment networks are a good example of cross-chain interoperability, as we addressed in the earlier section of this taxonomy.



Ecosystem opportunities: partnerships and business models

Strategic partnerships have long been a vital pillar of business growth strategy, and it is no different for the increasingly decentralized world today. Given the rapid pace of developments in this space, one very visible trend is the formation of strategic partnerships between traditional financial institutions and Web 3.0 start-ups, among different Web 3.0 start-ups, and between professional services companies and Web 3.0 start-ups to explore new use cases and to develop new capabilities.

Custody and safe keeping are emerging as hot areas for new business models and partnerships, with Citi and Societe Generale recently announcing partnerships with Metaco for digital asset custody. Caceis, French custodian for Credit Agricole, is partnering with Taurus to boost its digital assets offering, including custody, smart contract management, and digital assets issuance and tokenization via blockchain.⁹⁹

As digital assets become more mainstream, it is imperative for both CeFi and DeFi worlds to come together to function as interoperable entities driving the financial services sector forward and offer customers the best-in-class experiences.

Payment service providers have also been exploring new value creation propositions by bridging the best of both CeFi and DeFi worlds. Mastercard has been very active in forging partnerships, the latest being with Nexo to launch the world's first crypto-backed payment card,¹⁰⁰ and with Coinbase's NFT marketplace, following joining forces with Amber, Bitkub and CoinJar to launch crypto-linked cards in Asia-Pacific to enable customers to instantly convert their cryptocurrencies into traditional fiat currency.¹⁰¹

Visa has not been far behind, with its partnerships with Argentinian crypto exchange, Lemon Cash, Brazilian crypto firm Alterbank, Satoshi Tango, and Crypto.com to launch Bitcoin cashback cards in Latin America.¹⁰² Global Payments recently announced a strategic alliance with Bakkt to enable crypto redemption for their customers and enable the expansion of their banking-as-a-service offerings to include customer access to cryptocurrencies.¹⁰³ Bakkt has also formed partnerships with Mastercard and the America Bank, as we called out in earlier sections of this taxonomy point of view.

There is certainly a lot of momentum around CBDCs, and this area has also seen some interesting collaborations. The Central Bank of Brazil has identified partners as crypto exchange Mercado Bitcoin and DeFi platform Aave, among others, to evaluate use cases and start a pilot CBDC program.¹⁰⁴ Consensus has teamed up with Visa to launch a CBDC pilot program to test retail applications like cards and wallets.¹⁰⁵ Consensus is already working on three live CBDC pilots, with the Hong Kong Monetary Authority on a cross-border CBDC project, with Bank of Thailand on a retail CBDC project, and with Reserve Bank of Australia to explore the potential use cases of a wholesale CBDC.¹⁰⁶ In the UK, Ripple and Avalanche have joined hands with the Digital Pound Foundation to explore the development and facilitate rollout of the British CBDC.¹⁰⁷

It is natural to consider traditional banking and DeFi as competing, but real value is being unlocked through CeFi and DeFi institutions working together to make the most of synergies and to develop solutions and offerings for the future. As market developments suggest, Web 3.0 players bring new technologies and innovative solutions which, when combined with the trust and scale offered by incumbents, could result in new and better outcomes for all players and their customers in financial services. As Web 3.0 matures and the technology evolves further, strategic ecosystem partnerships will become a key differentiator for incumbents in providing innovative services to their customers.

IN CONCLUSION

The story of blockchain adoption in financial services has been fascinating to observe. CBDCs will rejuvenate national and international currency exchange mechanisms, digital assets will revolutionize capital markets, while cryptocurrencies will continue to exert pressure as an alternative means for payment. DeFi is still in the early stages of maturity, but we expect to see an increased adoption of it, and NFTs, too, alongside the emergence of the metaverse and Web 3.0.

We have seen significant progress across each area since we published the first version of our DeFi taxonomy, and we continue to believe that the financial services ecosystem will witness a convergence between centralized and decentralized systems. Crucial for enterprises on this journey will be a structured and balanced approach, with the right mix of business use case and technology considerations, that can be realized through effective collaboration with the emerging ecosystem.

At Capgemini, we believe that the future of financial services will comprise an equilibrium between centralized and decentralized financial systems and components, driving constant and rapid innovation while ensuring regulatory compliance.

To learn more about the latest developments in the DLT/DeFi/Web 3.0 world, visit capgemini.com/solutions/decentralized-futures or reach out to us at financialservices@capgemini.com.

OUR EXPERTS



Sudhir Pai

Chief Technology and
Innovation Officer
Financial Services Strategic
Business Unit

sudhir.pai@capgemini.com



Sankar Krishnan

Global Head, Blockchain &
DeFi Go-to-Market
Financial Services Strategic
Business Unit

sankar.krishnan@capgemini.com



Nilesh Vaidya

Global Industry Leader,
Retail Banking and Wealth
Management
Financial Services Strategic
Business Unit

nilesh.vaidya@capgemini.com



Rishabh Shah

Head of DLT Capabilities
Financial Services Strategic
Business Unit

rishabh.shah@capgemini.com



Muhammed Ahmed

Strategy Consultant,
Emerging Technologies
Financial Services Strategic
Business Unit

muhammed.ahmed@capgemini.com



Sanjeev Handa

DLT Solution Architect
Financial Services Strategic
Business Unit

sanjeev.handa@capgemini.com



Akshat Verma

Portfolio Manager
Sector Lead, Financial
Services
Capgemini Ventures

akshat.verma@capgemini.com



Aman Verma

Process Lead, Technology
Assessment Services (TAS)
- Decentralized Futures
Domain

aman.i.verma@capgemini.com

End notes

1. <https://www.bis.org/publ/bppdf/bispap125.htm>
2. <https://www.bnymellon.com/us/en/insights/all-insights/digital-assets-from-fringe-to-future.html>
3. <https://hbr.org/2022/05/what-is-web3>
4. <https://www.bis.org/publ/bppdf/bispap125.htm>
5. BIS Papers No 125 Gaining momentum – Results of the 2021 BIS survey on central bank digital currencies by Anneke Kosse and Ilaria Mattei, Monetary and Economic Department, May 2022
6. <https://www.reuters.com/markets/currencies/china-uses-digital-yuan-stimulate-virus-hit-consumption-2022-05-30/>
7. <https://cointelegraph.com/news/draft-bill-to-ban-china-s-digital-yuan-from-us-app-stores>
8. <https://www.mas.gov.sg/publications/monographs-or-information-paper/2022/global-cbdc-challenge-2021>
9. <https://cointelegraph.com/news/digital-ruble-trial-goes-live-as-bank-of-russia-insists-on-bitcoin-ban>
10. <https://www.ledgerinsights.com/bank-of-japan-enters-second-phase-of-cbdc-experiments/>
11. https://www.hkma.gov.hk/media/eng/doc/key-functions/financial-infrastructure/Inthanon-LionRock_to_mBridge_Building_a_multi_CBDC_platform_for_international_payments.pdf
12. Ibid 2
13. <https://www.bankofengland.co.uk/-/media/boe/files/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design.pdf>
14. <https://www.bis.org/about/bisih/topics/cbdc/dunbar.htm>
15. <https://www.swift.com/news-events/news/new-experiments-pave-way-international-payments-using-cbdc>
16. <https://www.paymentsjournal.com/visa-partners-with-consensus-to-help-bridge-cbdc-networks-with-existing-payment-rails/>
17. <https://www.theasset.com/article/46590/ocbc-metaverse-green-exchange-to-develop-green-financing-solutions>
18. <https://cointelegraph.com/news/defi-partnership-aims-to-tokenize-shares-of-pre-ipo-companies>
19. <https://www.rolandberger.com/en/Insights/Publications/Tokenization-The-future-of-financial-markets.html>
20. <https://www.pymnts.com/blockchain/2022/eus-dlt-pilot-to-trade-tokenized-securities-wins-political-regulatory-support/>
21. <https://www.ledgerinsights.com/eu-finalizes-laws-for-dlt-pilot-regime-for-tokenized-securities/>
22. <https://www.ledgerinsights.com/uk-plans-dlt-sandbox-for-financial-market-infrastructures-by-2023/>
23. https://www.ecb.europa.eu/paym/groups/pdf/omg/2022/220317/2022-03-17_OMG_Summary.pdf
24. <https://www.mas.gov.sg/news/media-releases/2022/mas-partners-the-industry-to-pilot-use-cases-in-digital-assets>
25. <https://morningtick.com/news/vnx-launches-as-the-first-european-regulated-precious-metals-tokenization-platform/>
26. https://www.metaco.com/press_releases/citi-strategic-partnership-metaco-digital-asset-custody/
27. <https://www.prnewswire.com/news-releases/societe-generale---forge-partners-with-metaco-to-expand-its-institutional-digital-assets-capabilities-301578706.html>
28. <https://coinmarketcap.com/charts/>
29. <https://blog.chainalysis.com/reports/2021-global-crypto-adoption-index/>
30. <https://www.weforum.org/agenda/2021/11/what-play-to-earn-games-mean-for-the-economy-and-metaverse/>
31. <https://bitcoindotcom.com/>
32. <https://coinflip.tech/>
33. <https://www.kurant.at/en/home-en/>
34. <https://finance.yahoo.com/news/american-bank-announces-partnership-bakkt-121400016.html?guccounter=1>
35. <https://www.bloomberg.com/news/articles/2022-04-28/goldman-offers-its-first-bitcoin-backed-loan-in-crypto-push#xj4y7vzkg>
36. <https://www.coindesk.com/business/2022/06/13/goldman-sachs-executes-its-first-trade-of-ether-linked-derivative-report/>
37. <https://www.coinspeaker.com/bny-mellon-crypto-custody-platform/>
38. <https://www.businessbecause.com/news/insights/7988/future-digital-currencies-asia?sponsored>
39. <https://cointelegraph.com/news/japan-s-largest-investment-bank-nomura-readies-new-crypto-subsiary>
40. <https://www.businesswire.com/news/home/20211207006007/en/Visa-Introduces-Crypto-Advisory-Services-to-help-Partners-Navigate-a-New-Era-of-Money-Movement>
41. <https://www.cnn.com/select/visa-backs-first-credit-card-to-offer-bitcoin-rewards/>
42. <https://www.mastercard.com/news/press/2021/october/mastercard-and-bakkt-partner-to-offer-innovative-crypto-and-loyalty-solutions/>
43. <https://news.bitcoin.com/new-american-express-credit-card-lets-shoppers-earn-crypto-rewards-tradable-across-100-cryptocurrencies/>
44. <https://www.federalreserve.gov/econres/ifdp/files/ifdp1334.pdf>
45. <https://www.afr.com/companies/financial-services/anz-the-first-bank-to-mint-an-australian-dollar-stablecoin-the-a-dc-20220323-p5a743>
46. <https://www.ndtv.com/business/japans-mitsubishi-bank-to-issue-yen-pegged-stable-coin-progmacoin-2757807>
47. <https://www.imf.org/en/Publications/GFSR/Issues/2022/04/19/global-financial-stability-report-april-2022>
48. <https://www.bloomberg.com/news/articles/2022-06-10/eu-aims-to-clinch-deal-on-landmark-crypto-law-this-month>
49. <https://defillama.com/>
50. <https://cointelegraph.com/news/terra-s-meltdown-highlights-benefits-of-cex-risk-management-systems>
51. <https://fortune.com/2022/06/12/jpmorgan-on-its-crypto-plans-the-overall-goal-is-to-bring-these-trillions-of-dollars-of-assets-into-defi/>
52. <https://medium.com/centrifuge/rwa-market-the-aave-market-for-real-world-assets-goes-live-48976b984dde>
53. <https://cointelegraph.com/news/defi-attacks-are-on-the-rise-how-the-industry-be-able-to-stem-the-tide>
54. <https://blog.chainalysis.com/reports/2022-defi-hacks/>
55. <https://medium.com/swlh/the-story-of-the-dao-its-history-and-consequences-71e6a8a551ee>
56. <https://www.forbes.com/sites/bernardmarr/2022/05/25/the-best-examples-of-daos-everyone-should-know-about/?sh=5251439440c3>
57. <https://consensus.net/blog/blockchain-explained/daos-where-are-you-going-where-have-you-been/>
58. <https://www.coindesk.com/learn/2016/06/25/understanding-the-dao-attack/>
59. <https://cointelegraph.com/news/binance-launches-binance-bridge-2-0-to-integrate-cefi-and-defi>
60. <https://www.w3.org/TR/vc-data-model/#abstract>
61. <https://docs.microsoft.com/en-us/azure/active-directory/verifiable-credentials/decentralized-identifier-overview>
62. <https://tokeny.com/onchainid/>
63. <https://www.cnn.com/2022/03/10/trading-in-nfts-spiked-21000percent-to-top-17-billion-in-2021-report.html>
64. <https://www.prnewswire.com/news-releases/non-fungible-token-nft-market-size-to-grow-by-usd-147-24----technavio-301529125.html>

65. <https://www.globenewswire.com/en/news-release/2022/05/27/2451899/28124/en/Non-fungible-Token-NFT-Global-Market-Growth-Forecasts-A-211-Billion-Market-by-2030-with-CAGR-of-33-During-2022-2030.html>
66. <https://www.gartner.com/en/newsroom/press-releases/2022-02-07-gartner-predicts-25-percent-of-people-will-spend-at-least-one-hour-per-day-in-the-metaverse-by-2026>
67. <https://blockzeit.com/how-to-buy-land-on-decentraland-a-simple-guide>
68. <https://www.businessinsider.in/crypto/story/jupiter-meta-to-launch-music-nfts-during-metaverse-concert-327612-2022-03-28>
69. <https://www.voguebusiness.com/technology/nike-and-rtfkt-take-on-digital-fashion-with-first-cryptokick-sneaker>
70. <https://www.nytimes.com/2022/05/26/style/nike-nft-sneaker.html>
71. <https://news.bitcoin.com/mastercard-files-15-trademark-applications-for-a-wide-range-of-metaverse-nft-services/>
72. <https://news.bitcoin.com/fidelity-investments-launches-crypto-metaverse-etfs-says-we-continue-to-see-demand/>
73. <https://fortune.com/2022/04/01/citi-metaverse-economy-13-trillion-2030>
74. <https://www.forbes.com/sites/forbestechcouncil/2022/03/15/banking-on-the-metaverse/?sh=737c407e6068>
75. <https://www.businessinsider.in/cryptocurrency/news/jpmorgan-opens-a-decentraland-lounge-featuring-a-tiger-as-the-bank-seeks-to-capitalize-on-1-trillion-revenue-opportunity-from-the-metaverse/articleshow/89601305.cms>
76. <https://www.coindesk.com/business/2022/03/16/hsbc-enters-the-metaverse-through-partnership-with-the-sandbox/>
77. <https://www.coindesk.com/business/2022/04/06/hsbc-starts-metaverse-fund-for-private-banking-clients-in-asia/>
78. <https://news.bitcoin.com/standard-chartered-bank-enters-the-metaverse/>
79. <https://www.metanews.com/worldline-steps-into-the-metaverse/>
80. <http://www.uniindia.com/kiya-ai-launches-india-s-1st-ever-banking-metaverse/business-economy/news/2747723.html>
81. <https://cointelegraph.com/news/coinbase-partners-with-mastercard-for-nft-marketplace-purchases>
82. <https://blog.vera.financial/vera-partners-with-ontowallet-to-bring-essential-financial-services-for-nfts-to-its-user-s-8e82cdad693>
83. [https://www.coindesk.com/business/2022/04/27/goldman-sachs-says-it-is-exploring-the-tokenization-of-real-assets/#:~:text=The%20global%20investment%20bank%20says,is%20where%20the%20power%20is-.&text=Goldman%20Sachs%20\(GS\)%20said%20it,deeper%20into%20the%20crypto%20space.](https://www.coindesk.com/business/2022/04/27/goldman-sachs-says-it-is-exploring-the-tokenization-of-real-assets/#:~:text=The%20global%20investment%20bank%20says,is%20where%20the%20power%20is-.&text=Goldman%20Sachs%20(GS)%20said%20it,deeper%20into%20the%20crypto%20space.)
84. <https://www.atlas-mag.net/en/article/axa-france-joins-the-metaverse>
85. <https://www.coindesk.com/policy/2022/04/13/chinese-banking-associations-target-nfts>
86. <https://cointelegraph.com/news/un-approves-nft-standards-initiative-led-by-tencent>
87. <https://metaverse-standards.org/news/press-releases/leading-standards-organizations-and-companies-unite-to-drive-open-metaverse-interoperability/>
88. <https://web3-technology-stack.readthedocs.io/en/latest/>
89. <https://cointelegraph.com/news/coinbase-unveils-web3-mobile-dapp-and-defi-wallet-and-browser>
90. <https://cointelegraph.com/news/uniswap-launches-venture-capital-wing-for-web3-investments>
91. <https://www.fintechfutures.com/techwire/fortanix-launches-the-industrys-first-web-3-0-era-solutions-based-on-confidential-computing-to-secure-sensitive-digital-assets-and-blockchain-infrastructure/>
92. <https://ibsintelligence.com/ibs-news/tintra-announces-the-worlds-first-web-3-0-bank-to-power-metaverse/>
93. <https://www.mas.gov.sg/news/media-releases/2022/mas-launches-2022-global-fintech-hackcelerator-on-web-3-0-and-green-finance>
94. <https://hedera.com/learning/hedera-hashgraph/what-is-hashgraph-consensus>
95. <https://www.coindesk.com/tech/2021/08/20/a-beginners-guide-to-atomic-swaps/>
96. <https://ibcprotocol.org/>
97. <https://chain.link/cross-chain#cross-chain-interoperability-protocol>
98. <https://chain.link/>
99. <https://www.finextra.com/newsarticle/40524/caceis-recruits-taurus-for-digital-custody-offering/crypto>
100. <https://www.reuters.com/technology/nexo-mastercard-launch-world-first-crypto-backed-payment-card-2022-04-13/>
101. <https://www.mastercard.com/news/ap/en/newsroom/press-releases/en/2021/november/mastercard-partners-with-leading-digital-currency-companies-across-asia-pacific-to-launch-the-region-s-first-crypto-linked-payment-cards/>
102. <https://www.finextra.com/newsarticle/40478/visa-launches-bitcoin-cashback-cards-in-brazil-and-argentina>
103. <https://investors.bakkt.com/news/news-details/2022/Bakkt-and-Global-Payments-Announce-Strategic-Alliance/default.aspx>
104. <https://www.coindesk.com/business/2022/03/03/central-bank-of-brazil-selects-9-partners-to-assist-in-creation-of-a-cbdc/>
105. <https://www.pymnts.com/cbdc/2022/visa-teams-with-consensus-for-central-bank-digital-currency-pilot/>
106. <https://consensus.net/blog/enterprise-blockchain/cbdc-pilots-on-ethereum/>
107. <https://timesofindia.indiatimes.com/business/cryptocurrency/ripple-partners-with-digital-pound-foundation-for-development-of-british-cbdc/articleshow/87084678.cms>



About Capgemini

Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided everyday by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of over 340,000 team members in more than 50 countries. With its strong 55-year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fueled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering and platforms. The Group reported in 2021 global revenues of €18 billion.

Get the Future You Want | www.capgemini.com