The Expanding Role of Blockchain Across Various Industries

Research Note

April 29, 2025

- **Despite slower progress compared to financial applications, blockchain adoption beyond finance is steadily growing, driven by its ability to enhance security, transparency, traceability, efficiency, and automation across industries.**
- **The most promising and widely pursued applications include supply chain management, entertainment, digital identity, IoT device security, tokenization of assets, and the development of decentralized physical networks.**
- **Ongoing advancements in blockchain speed and efficiency, driven by innovations such as new consensus mechanisms and Layer-2 scaling solutions, as well as new cryptographic and architectural solutions, such as zero-knowledge proofs, fully homomorphic encryption, and others, are helping to overcome previous barriers to adoption, enabling broader and deeper integration of blockchain across diverse industries.**

Blockchain's Successful Integration By Corporations Around The World

- The past several months have been transformative for the crypto industry. Long-awaited regulatory changes have either materialized or are on the horizon, bringing unprecedented attention and support to the sector. Under the new Trump administration, the crypto space has gained momentum, with even the traditionally conservative TradFi community recognizing the product-market fit of innovations like stablecoins and real-world asset tokenization.
- While blockchain applications in finance are well-established and receiving significant investment and adoption from TradFi institutions, blockchain adoption outside finance is also steadily progressing across industries, albeit at a slower pace.
- Over the past several months, we engaged with numerous enterprise companies exploring blockchain solutions. We were struck by the growing interest and tangible progress in integrating blockchain into operations. The key to mass adoption lies in leveraging distribution networks of corporations with millions of existing customers. Blockchain's benefits such as enhanced security, greater transparency, instant traceability, increased efficiency and speed, and automation make it an ideal technology for transforming existing products, launching new ones, and driving enterprise growth.
- In recent years, blockchain technology has become significantly more accessible to mainstream users, thanks to lower transaction fees, faster processing speeds, and more intuitive user interfaces. These advancements are accelerating corporate adoption across industries. Integration with AI/IoT and sustainability mandates also accelerates this growth.
- In our latest research note, we highlight key use cases, developments, and live projects across supply chain traceability, identity management, IoT security, circular economy initiatives, decarbonization efforts, loyalty solutions, and tokenization. These examples illustrate how blockchain is gradually reshaping industries beyond finance.
- **Finance-first, but not finance-only: While TradFi races to tokenize assets, retail tracks food safety on blockchain, and telecom companies digitize data on IoT networks, revealing a quieter revolution.**

TenSquared Capital (10SQ) is a venture capital firm focused on investing in blockchain-enabled startups solving real-world use cases at their inflection points of growth.

I. Tokenization of Real Estate

- Tokenization is the most viable and widespread application of blockchain in the real estate sector. Citi predicts that the tokenized assets market will reach $5T while tokenized real estate assets will be worth $1.5T by 2030.
- In recent years, the industry has seen a surge of innovation, with multiple startups offering blockchain-based solutions for real estate tokenization and traditional financial players launching proof-of-concept projects.
- Regulatory frameworks are key to driving tokenization adoption in various countries - tax advantages, securities status, and the ability of traditional brokerages to participate in the process are all critical ingredients to success.
- The benefits of real estate tokenization are clear:
  - **New capital sources:** Tokenization provides an alternative method for property owners to raise capital by selling tokens representing fractional ownership of their property. It also creates a new universe of buyers for whom tokens solve specific problems.
  - **Increased liquidity and lower costs:** Tokenization streamlines transaction processes, removes unnecessary third parties, and lowers the price barriers to entry. This enables low-cost and trusted coordination between mortgage lenders, notaries, escrow companies, and more. Assets can be transferred on-chain.
  - **Increased affordability:** High-value real estate becomes accessible to a broader range of investors. Instead of requiring large sums to buy an entire property, individuals can invest in fractional ownership through tokens.
  - **Reduced fraud:** Blockchain provides improved authentication and verifiable data that reduces information asymmetry and serves as a single source of truth for ownership and titles.
- Major challenges include lack of actual liquidity and standardized infrastructure, institutional hesitation, and lack of standardized valuation.

KDX KENEDIX NOMURA
MITSUI & CO. DIGITAL ASSET MANAGEMENT
Daiwa Securities SBI GROUP SBI証券
SMBC NIKKO
progmat for Fin
ODX Osaka Digital Exchange Co.,Ltd ADDX

- Japan has become a global leader in tokenizing real estate, with a remarkable growth in issuances over the last three years. The country sets the benchmark for clarity of crypto regulation, securitization infrastructure, distribution, and ecosystem development.
- The cumulative issuance amount of security tokens in Japan in 2024 reached JPY168B or $1.2B. Approximately 85-90% of the total public security token issuance in Japan was issued as beneficiary certificate issuance trusts backed by real estate, with real estate securitization continuing to lead the market.
- **The underlying real estate assets included residences, hotels/inns, commercial facilities, and logistics facilities. Additionally, security tokens backed by 484 rental detached properties located in the Tokyo Metropolitan Area were realized, demonstrating further diversification of underlying assets.**
- In Japan's tokenization landscape, prominent players include financial institutions like **MUFG, SMBC, Mizuho, Nomura, Daiwa Securities, and SBI Holdings,** along with blockchain infrastructure providers **Progmat and ibet for Fin,** and asset managers like **Kenedix and Mitsui & Co.**
- In FY2024, Japan tokenized its first infrastructure private fund as security tokens, with solar power generation facilities as the investment target [1].

Coadjute

- UK's **Coadjute** has launched a blockchain-based platform that enables communication and data sharing among all parties involved in a house sale. Rather than directly targeting estate agents or buyers, Coadjute opts to integrate with the existing property software platforms used by estate agents. Coadjute utilizes R3's Corda enterprise blockchain. The company has recently announced a funding round of $12.6M, led by Lloyds Bank, with participation from Natwest, Nationwide, and the UK's largest property website, RightMove (market capitalization: £4.35B).

CONSENSYS Codefi

- Blockchain for property registry has been trialed globally by local governments and authorities.
- Her Majesty's Land Registry, the U.K. government department responsible for recording 25 million ownership titles on lands and properties valued at over £7T ($8.7T), partnered with **Consensys Codefi** to explore the use of blockchain and smart contract technology to aid speed, simplicity and transparency in the real estate market [2].

1) https://boostry.co.jp/blog/st-market-fy2024e
2) https://consensys.io/blockchain-use-cases/finance/hmlr

II. New Tokenization Use Cases

- Tokenization is driving digital transformation by redefining how businesses manage value and data assets. By converting physical and intangible assets into blockchain-based digital tokens, it enables secure, transferable representations of ownership and rights, transforming asset management across industries.
- Beyond digitizing assets, tokenization fosters new ecosystems for trading, managing, and utilizing value and data assets in innovative ways. This shift revolutionizes digital storage, transfer, and perception of value.
- Cross-industry applications:
  - **Manufacturing:** Enhances asset tracking and verification.
  - **Energy:** Enables novel trading methods for resources like renewable energy credits.
  - **Intellectual Property:** Empowers creators with monetization and protection tools for patents, music, and more.
  - **Healthcare:** Secures and streamlines data sharing for research and patient care.
- Real-world asset (RWA) tokenization is advancing globally, encompassing both securities and non-securities. from real estate and debt instruments (such as bonds and loans) to investment funds, commodities, and even emerging sectors like carbon credits. Tokenized RWAs moved from pilot to at-scale deployment, reaching over $22B in total value, while tokenized US Treasuries surpassed $6B in April 2025, according to RWA.xyz. Startups are evolving beyond basic tokenization services to develop distribution and management infrastructure, integrating features like automated workflows and smart contracts, fractionalization and compliance tools, custody solutions and reporting systems.

Financial Services Commission + KYOBO Life

- **Korea's Financial Services Commission (FSC)** has designated **Kyobo Life** as a trust business for the issuance of security tokens **to finance aircraft engines.** It aims to fractionalize the cost of acquiring aircraft engines. The company will act as the trustee responsible for the real-world assets (RWA), in this case, the aircraft engine, and issue trust beneficiary certificates. **Galaxia Money Tree** will then tokenize these certificates on its tokenization platform as part of a security token offering (STO) [1].

MIZUHO

- **Mizuho Securities** has partnered with **Blue Sky Solar** for a private STO to fund a solar power business. Mizuho says this is the first infrastructure private placement fund to be tokenized in Japan.
- The tokenization relates to the revenues from a limited liability company that has acquired eight solar power generation facilities with an output of 9.5 megawatts which could power around 9,000 households.
- Blue Sky Group has a long track record in the sector, having managed 376 projects totaling 318 megawatts.

FOX

- **Fox Corporation** has been actively involved in several blockchain-based intellectual property (IP) projects, focusing on content verification, NFTs, and AI licensing.
  Fox Corporation launched **Verify,** an open-source blockchain platform built on Polygon, to track and manage media content usage by AI firms. It cryptographically signs content to establish provenance, enabling media companies to negotiate licensing deals with AI developers. **Over 80,000 pieces of Fox content (news, sports, entertainment) have been registered since its beta launch in 2023** [2]**.**

tixbase

PASSO

- **Tixbase,** a startup that issues tickets on the blockchain, signed a deal with **Passo,** a Turkish company issuing tickets for the Champions and Europa league. The deal will move Passo's 25 million [3] tickets issued annually onto the blockchain. Having tickets issued on blockchain prevents fraud in secondary transactions and also allows the original ticket issuer to charge a fee on secondary transactions.

VIVA aerobus

volaris

travelX

- In the airline industry, two of the largest mexican airlines, **VivaAerobus and Volaris,** have already tokenized over **70% of their domestic flights in Mexico** (190 million population), using the Algorand blockchain. Both airlines have been working with TravelX to tokenize all their tickets as NFTs to improve their inventory management and reduce costs
- Last year alone, **44 million passengers** flew using tokenized tickets, making this one of the largest real-world uses of blockchain technology. Tokenized tickets mean more control for passengers, cheaper fees, transparency, reduced fraud, and a more efficient system all around. It's proof that blockchain can improve industries beyond finance [4].

1) https://www.ledgerinsights.com/koreas-kyobo-life-to-tokenize-aircraft-engines-with-shinhan-consortium/
2) https://techcrunch.com/2024/01/09/2648953/
3) https://www.altcoinbuzz.io/cryptocurrency-news/tixbase-and-passo-seal-largest-blockchain-ticketing-deal/
4) https://www.infobae.com/mexico/2025/01/31/aerolineas-rompen-record-de-pasajeros-en-2024-como-le-fue-a-mexicana-de-aviacion/

III. Supply Chain Transparency and Traceability (1/2)

- Blockchain adoption in supply chains has been steadily progressing, though it has not yet reached the level of widespread corporate implementation. By recording each transaction and the movement of goods as a block, the data cannot be modified or deleted. Key benefits of integrating blockchain into the supply chain include:
  - **Provenance tracking:** verification of the origin of products, ethical sourcing, authenticity and identification of counterfeit goods; every product will have a unique digital identity on the blockchain.
  - **Clear ownership:** Goods moving through a supply chain change ownership and custody. Knowing where a product is and who is responsible for it is important to determine insurance & liability and tax & tariffs.
  - **Efficiency gains:** automating payments and compliance, reduced administrative overhead, and speeding up transactions.
- The actual status of blockchain adoption in the supply chain by enterprises is characterized by a mix of pilot projects and limited real-world implementation. Successful implementation of blockchain in supply chains often requires cooperation from multiple actors, which can be difficult to achieve fast. Issues such as scalability and interoperability with existing systems can pose obstacles to widespread adoption.
- Some of the live corporate use cases:

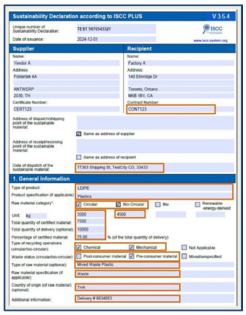
Walmart	- **Walmart and IBM** have partnered on the Food Trust blockchain to improve supply chain transparency by tracking the journey of food products from farm to table. This collaboration enhances food safety and minimizes the impact of recalls, thereby reducing Walmart's operational costs. - **In cases of contamination, Walmart can trace the origins of food products like leafy greens in 2.2 seconds, a process that used to take days** [1]. - In 2024, VeChain partnered with Walmart in China to improve product traceability through blockchain technology, **resulting in more than 200 million transactions that year** [2].
P&G	- **Procter & Gamble** has begun integrating blockchain technology as part of its broader "digital acumen" strategy. In its strategy report, P&G highlights three primary areas for blockchain utilization: **strengthening the supply chain, ensuring product quality and safety, and integrating AI with blockchain** [3]. Additionally, P&G is investigating blockchain technology to address **coupon fraud** and other challenges.
Nestlé	- **Nestlé** utilizes blockchain technology to monitor the full journey of its sustainably sourced coffee and milk. - In collaboration with a blockchain platform, **OpenSC**, Nespresso uses blockchain technology to develop digital transparency in its value chain. In the Democratic Republic of the Congo, customers can scan QR codes on packaging to verify the provenance of their coffee down to the farm level [4]. - Nestlé also uses the OpenSC platform to trace milk's journey from New Zealand to the Middle East [5].
De Beers	- **De Beers** utilizes blockchain technology to trace diamonds from the mine to the consumer. With its Tracr platform, De Beers ensures the authenticity and conflict-free status of its diamonds, providing comprehensive visibility throughout the diamond supply chain. **Tracr** is a digital solution for tracing natural diamonds from their source at scale, enabling the verification of provenance, authenticity, and traceability of the diamond's supply chain [6]. - **Tracr has registered and scanned over 2.8 million rough diamonds, with a combined value of rough and polished stones of $3.4B** [7].

1) https://www.horsesforsources.com/enterprise-blockchain-is-not-dead_102024/
2) https://www.thestreet.com/crypto/innovation/walmart-200-million-transactions-with-2-billion-crypto
3) https://us.pg.com/annualreport2022/strengthening-our-strategy/
4) https://www.nestle.com/sites/default/files/2024-02/creating-shared-value-sustainability-report-2023-en.pdf
5) https://eightception.com/nestle-supply-chain-business-growth/
6) https://www.debeersgroup.com/media/company-news/2024/de-beers-to-provide-country-of-origin-data-for-its-diamonds
7) https://www.accenture.com/gb-en/case-studies/natural-resources/tracr-diamond-traceability

III. Supply Chain Transparency and Traceability (2/2)

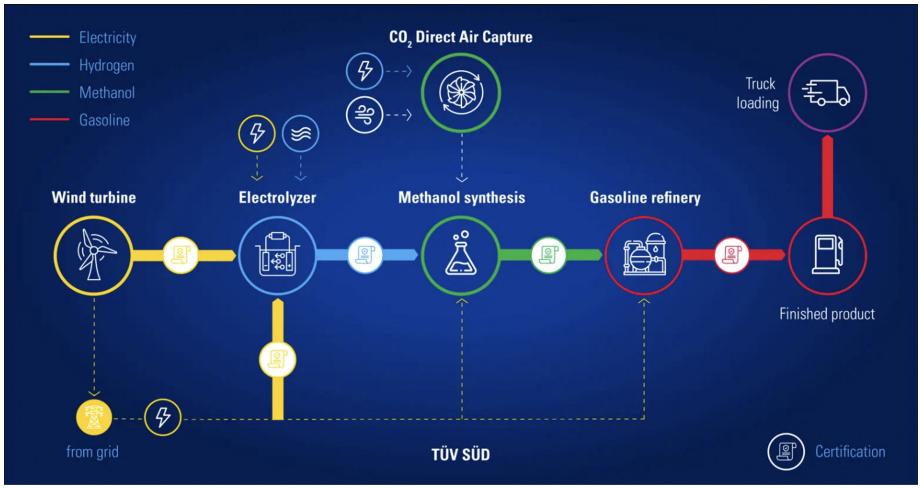
- Since 2022, **SAP and Unilever** have piloted the **GreenToken** by SAP solution to enhance traceability and transparency in Unilever's global palm oil supply chain [1]. The GreenToken platform enables Unilever to establish traceability of raw materials, consistently validate claims, and generate deforestation-free scores for their factories. It employs blockchain technology to create auditable material logs (featuring unique characteristics such as sustainability attributes) as they move through each stage of the supply chain [2].
- **Unilever monitors over 20 million hectares of oil palm concessions, over 2,000 mills in our universal mill list, and the 28,000 smallholders have been mapped [3].**

Example of sustainability declaration



- In 2022, **Siemens Energy**, TÜV SÜD, and the German Energy Agency (dena) initiated CertaLink Energy Certification, a blockchain-based system to ensure transparency in clean energy supply chains. The certification to prove the sustainability of e-fuels is a prerequisite for green hydrogen and its derivatives such as e-methanol, e-ammonia, or e-fuels to become tradable commodities [4]. Two companies are currently using **CertaLink Energy Certification:**
  - **Nobian:** The company has implemented CertaLink at its chlor-alkali electrolysis plant in Bitterfeld, Germany, for certification of green hydrogen for end customers.
  - **Porsche:** Siemens Energy has implemented and verified the CertaLink system at Chile's Haru Oni facility, proving the sustainable green origin of e-fuel used in a Porsche motorsport fleet.
- **Siemens** has been testing a blockchain-based energy trading system that enables decentralized energy producers, like homeowners with solar panels, to sell surplus energy directly to their neighbors. In 2024, Siemens Energy and LO3 Energy partnered on blockchain-enabled microgrids, emphasizing peer-to-peer energy trading and efficiency improvements [5].

CertaLink certification process



- **Previous examples demonstrate how blockchain technology is reshaping traditional industry operations, enabling cross-sector collaboration and driving ecosystem economy.** It acts as a key enabler of synergistic solutions across various industries. Prime examples are the emerging collaboration between the supply chain and retail sectors, agriculture and food safety, and the healthcare and insurance industries.

1) https://www.unilever.com/news/press-and-media/press-releases/2022/sap-unilever-pilot-blockchain-technology-supporting-deforestationfree-palm-oil/
2) https://www.unilever.com/news/news-search/2024/delivering-deforestationfree-palm-oil-through-transformative-technology/
3) https://www.unilever.com/sustainability/nature/deforestation-free-supply-chain/palm-oil-story/
4) https://www.dena.de/en/projects/certalink-energy-certification-manager/
5) https://www.siemens.com/global/en/company/stories/research-technologies/energytransition/a-microgrid-grows-in-brooklyn.html

IV. Security of Internet-of-Things Devices and Data

- Blockchain technology offers significant potential to enhance data security in IoT devices and networks. Here are the key ways blockchain can improve IoT security: data integrity, enhanced authentication, secure data sharing, privacy protection.
- Blockchain security leverages multiple cryptographic and architectural solutions to enhance privacy, integrity, and trust, like zero-knowledge proofs (ZKPs), fully homomorphic encryption (FHE), multi-party computation (MPC), multi-signature (Multisig) wallets, and trusted execution environments (TEEs).
- Top use cases of IoT-enabled blockchain technology include: supply chain management, smart homes, energy management, autonomous vehicles, agriculture and farming, smart healthcare and digital identity management. Most prominent technology companies have been offering sophisticated blockchain-based IoT solutions, including IBM, Microsoft, AWS, Intel, and others.
- The real-life adoption is represented by pilots launched by the largest corporations and independent blockchain startups, including decentralized physical infrastructure (DePins) projects.
- Some of the notable companies in the space include Xage Security, Atonomi, IOTA, as well as decentralized physical infrastructure projects (DePINs), like IoTeX, Helium, Spexi, DIMO, Natix, and others.
- Some of the recent examples of enterprise adoption of blockchain for IoT security:

Panasonic	- Last year, **Panasonic** collaborated with **Jasmy (JASMY)** blockchain to introduce a Web3 platform that facilitates personal data connection on the IoT. The newly developed platform, based on Jasmy's Personal Data Locker product, aims to offer a secure data storage solution while giving users complete control over access to their data. The goal is to create an open platform operational across various fields to attract a large user base and encourage widespread adoption [1]. - Panasonic has also been exploring the integration of Constellation's Hypergraph Transfer Protocol (HGTP) into the TOUGHBOOK line of mobile devices. HGTP provides Web3 developers with a network to cryptographically secure, validate, and process data for any digital application. Integrating HGTP will facilitate more secure data transfer between TOUGHBOOK devices. By supporting data validation at the device level, Constellation's HGTP significantly reduces reliance on cloud services, resulting in bandwidth and storage cost savings [2].
SIEMENS	- **Siemens** recognizes blockchain as a means to enhance security in the robotics, automotive, energy, and healthcare equipment sectors. This month, Siemens Cre8Ventures announced a partnership with **Minima**, an embedded blockchain that enables a full node to operate on an IoT device. Siemens will leverage Minima's blockchain technology, which verifies the integrity of device data and ensures that it remains tamper-proof. Minima's technology can facilitate secure communication between electric vehicles, charging points, and devices integrated into energy grids [3].
Telefónica	- Telefónica combines blockchain technology with other technologies like IoT, big data, or artificial intelligence to maximize its potential and complete the path toward digital transformation. - **Telefónica** Open Gateway partnered with **Chainlink** to elevate smart contract security. The integration enables data verification from various sources using Chainlink Functions with GSMA's Open Gateway SIM SWAP API. Additionally, it adds an extra layer of protection to blockchain transactions by enabling smart contracts to request information from the API, which verifies that a device's SIM card has not been tampered with. Using the GSMA Open Gateway API via Chainlink mitigates risk beyond transaction security, addressing two-factor authentication (2FA) and fraud detection in Web3 dApps and DeFi services [4].

1) https://www.iot-now.com/2024/03/28/143541-panasonic-and-jasmy-unveil-web3-platform-for-iot-data-control/
2) https://www.prnewswire.com/news-releases/constellation-network-joins-the-panasonic-connect-xcelerate-software-application-developer-program-for-toughbook-mobile-solutions-302285971.html
3) https://www.ledgerinsights.com/siemens-partners-with-iot-embedded-blockchain-minima/
4) https://www.telefonica.com/en/communication-room/press-room/telefonica-integrates-chainlink-to-strengthen-web3-security-with/

V. Blockchain Solutions for Circular Economy and Sustainability

- Blockchain is actively being used in sustainability and decarbonization projects. Blockchain's immutability and transparency are vital for climate accountability.
- **Circular economy:** A widespread use cases includes extending the useful life of a product to reduce waste. Durable goods can be sold with corresponding certificates on the blockchain with warranty & maintenance instructions, so-called digital product passports (DPPs). DPPs store immutable records of a product's components, manufacturing details, and repair history and facilitate resale & second-life markets. By integrating DPPs, industries move from linear "buy-use-discard" models to sustainable, lifecycle-extended systems.
- **Carbon tracking:** Blockchain is increasingly used to create immutable, transparent records of carbon emissions across supply chains: firms adopting blockchain for carbon tracking report measurable reductions in emissions due to improved accountability and data accuracy. Tokenized carbon credits on blockchain platforms also enable secure trading and reduce fraud in carbon markets.
- **Renewable energy systems:** Decentralized energy grids leveraging blockchain facilitate peer-to-peer energy trading and optimize renewable energy distribution (e.g., solar, wind). Smart contracts automate transactions, reducing inefficiencies and incentivizing clean energy adoption.
- Some of the notable startups driving circular economy, sustainability, and decarbonization efforts, include AllInfra, Regen, Retraced, Circulor, Empower, Moss.

HYUNDAI

KIA

- **Hyundai Motor Company** and **Kia Corporation** have launched an AI-enabled, blockchain-based **Supplier CO2 Emission Monitoring System (SCEMS)** to manage carbon emissions from their business partners.
- Since its introduction in 2023, SCEMS has tracked and verified emissions throughout the supply chains, ensuring data integrity related to raw materials, manufacturing, and logistics. In 2024, it was expanded into the Integration Greenhouse Gas Information System (IGIS) to cover the entire vehicle lifecycle, including production, operation, and disposal. The system monitors global emissions at supplier facilities and complies with standards like the Carbon Disclosure Project (CDP), ensuring that emissions data is securely recorded to prevent manipulation [1].

Shell

- In 2022, **Shell, Accenture, and Amex GBT** launched **Avelia,** a blockchain platform to support decarbonization and scaling of sustainable aviation fuel (SAF) in air freight.
- As a blockchain-powered reservation system for SAF purchases, Avelia is an efficient and transparent method to acquire detailed, traceable environmental data about SAF.
- **Already delivering SAF at 13 global airport locations and endorsed by more than 35 airlines and corporations, Avelia has facilitated the delivery of more than 18 million gallons of SAF and helped to avoid more than 165,000 tonnes of CO_2 emissions in business travel** alone [2].

Telefónica

- **Telefónica** has developed **the VICKY platform,** which uses blockchain to enhance traceability and control across the value chain of modems, routers, and TV set-top boxes to promote the refurbishment of customer premise equipment and facilitate their reconditioning for reuse.
- Since its implementation five years ago, Telefónica has reused over 19 million routers and set-top boxes in all its operations. In 2023, the company **achieved an 88% collection rate of all equipment, moving closer to its target of 90% by 2024.**

retraced + Victoria's Secret

- **Retraced,** a Germany-based startup, leverages blockchain to enable supply chain traceability in the fashion industry, providing consumers with insights into the materials used. The company works with over **150 fashion and sports brands and 20K+ textile suppliers,** and has 95% retention rate. Customers include **Victoria's Secret & Co, Marc O'Polo, Vaude, Calzedonia, Pangaia,** and many others. For example, Victoria's Secret & Co has mapped 100 percent of its Tier 1 and Tier 2 supply chain for its lingerie and apparel products using Retraced in such countries as Vietnam, Sri Lanka, Indonesia, U.S. and China [3].

1) https://www.iot-now.com/2024/03/28/143541-panasonic-and-jasmy-unveil-web3-platform-for-iot-data-control/

2) https://www.prnewswire.com/news-releases/constellation-network-joins-the-panasonic-connect-xcelerate-software-application-developer-program-for-toughbook-mobile-solutions-302285971.html

3) https://www.telefonica.com/en/communication-room/press-room/telefonica-integrates-chainlink-to-strengthen-web3-security-with/

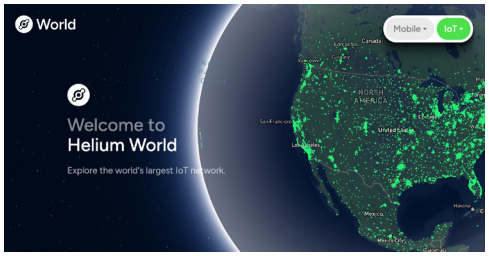
VI. New Decentralized Business Models

- Decentralized physical infrastructure networks (DePINs) are a growing Web3 concept that uses blockchains to link and help enhance physical infrastructures, such as energy grids, internet-mesh networks, storage, mobility, and cloud computing. Blockchain's inherent security, transparency, and decentralization are ideal for facilitating data communication and payment protocol across various network participants. Using cryptocurrencies to coordinate and incentivize people has proven to be an effective solution to customer/user acquisition, low-cost capex, community activation, and a way to bypass the "cold start problem" of marketplaces. As of February 2025, the DePIN ecosystem has grown to include over 1,170 active projects from the 650 projects reported in 2023.
- **Physical Resource Networks:**
  - **Energy:** Glow and Powerledger focus on decentralized energy solutions.
  - **Mobility:** Includes Rideshare and Delivery (e.g., DIMO), Drones (e.g., Spexi), and Robotics (e.g., Viam).
  - **Wireless:** Covers Helium Mobile, WiFi, 5G, IoT, and Broadband, with projects like Helium and Pollen.
  - **Geospatial:** Includes Environmental (e.g., PlanetWatch), Imagery (e.g., Hivemapper), and Positioning (e.g., XYO).
- **Digital Resource Networks:**
  - **Compute:** Includes AI, ML, & Inference (e.g., Golem), General Purpose (e.g., Akash), and Gaming (e.g., Cudos).
  - **Storage:** Features Filecoin, Arweave, and Storj, focusing on decentralized data storage solutions.
  - **Bandwidth:** Covers CDN (e.g., Media Network), VPN & Privacy (e.g., Orchid), and RTC (e.g., Livepeer).

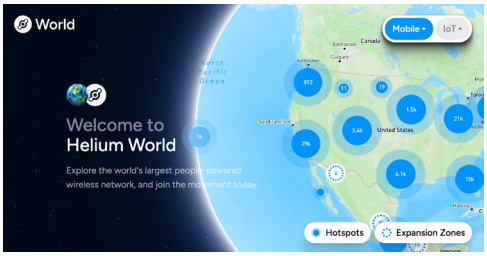
helium + T-Mobile

- **Helium** is a decentralized wireless network operated by Nova Labs. It leverages the community to build and maintain its 5G network, with users earning rewards for providing coverage. Helium has a Long Range Wide Area Networking (LoRaWAN) network for IoT devices and a 5G network for cellular communications. **As of today, Helium's network operates 375K IoT active hotspots and 91K 5G hotspots and services 648K daily users with 30TB of data transferred daily** [1]**.** Developers can build applications on the Helium blockchain and use its wireless networks to transmit data. Supply chain tracking is a prominent use case of the Helium blockchain.
- In 2022, Helium partnered with **T-Mobile** to offer subscribers access to both the Helium 5G network and T-Mobile's 5G network, calling it a "Dynamic Coverage." The Helium Network demonstrates the potential for decentralization in telecommunications. Subscribers from Helium Mobile and several other carriers can connect to and transfer data through Helium Mobile Hotspots.

Helium IoT Hotspot Map



Helium Mobile Hotspot Map



Glow

- **Glow** operates a decentralized physical infrastructure network, or DePIN, of solar farms in the United States and India. To encourage the farms on its network to outperform “dirty” energy grids, the founders designed an entire economy based on an incentive model of subsidies and tokens.
- Glow helps struggling solar farms by covering the costs of getting them up and running with money from financiers, a “recursive subsidy.” Then, the farm must contribute its electricity revenue to an incentive pool to be distributed to other solar farms.
  Each week 175,000 tokens are distributed to the highest-performing farms. Owners of each farm receive the stablecoin USDC for the production of Glow carbon credits and GLW, the native token, for electricity production [2].
- **There are 72 operational solar farms on the Glow network, which have produced 7.82 GWh of electricity to date** [3]**.**

1) https://world.helium.com/en/mobile
2) https://fortune.com/crypto/2024/10/31/exclusive-glow-a-blockchain-solar-company-raises-30-million-from-framework-and-union-square-ventures/
3) glow stats

VIII. Digital Identity Solutions (1/2)

- **Blockchain aims to be the global software infrastructure for identity registration and verification,** empowering individuals to travel and live freely across borders through a standardized digital identity system. It provides an interoperable and tamper-proof infrastructure, including unique cryptographic and architectural solutions (such as zero-knowledge proofs and fully homomorphic encryption) to enhance trust and privacy.

  Main applications of blockchain for identity management:

- **Self-sovereign identity (SSI).** Self-sovereign identity is the concept that people and businesses can store their own identity data on their own devices. Major enterprises like Microsoft, IBM, Okta, and others are exploring SSI solutions built on blockchain technology. Authentication systems and digital identity wallets are some of the examples of SSI.
  - **Blockchain-based authentication systems.** Passwordless authentication solutions on blockchain reduce the risk of credential theft and unauthorized access. Examples include blockchain-based single sign-on (SSO) solutions and decentralized authentication protocols like OAuth on blockchain networks.
  - **Secure digital identity wallets.** Enterprises can integrate digital identity wallets into their applications and services and offer users a convenient and secure way to manage their identities across different platforms and services.
- **Smart contracts.** Leveraging blockchain's decentralized ledger, smart contracts tied to on-chain identities can facilitate self-executing, software-defined agreements—reducing reliance on human oversight.
- **Identity for IoT.** As IoT devices proliferate, robust identity management enables novel workflows—including IoT-to-user and IoT-to-IoT transactions—previously unattainable.
- **Content authentication and proof-of-personhood.** As AI capabilities continue to evolve, proving content authenticity becomes a priority. Generative AI has the potential to create a flood of misinformation and deepfakes as the cost of content creation falls. There has been a 10x increase in the number of AI-powered fraud (mainly deepfakes) detected globally across all industries from 2022 to 2023 [1]. Researchers predict that as much as 90% of online content may be synthetically generated by 2026 [2]. Blockchain provides an essential framework to anchor the authenticity and provenance of content on-chain.
  - **Cryptographic digital signatures** can verify content creators by validating the signature through a corresponding public key. Digital signatures use encryption and public-key cryptography to sign and verify digital content.
  - Establishing **a verifiable provenance record** can also be used to differentiate between original and manipulated data. For example, Bundlr and Arweave are developing a standard known as the Digital Content Provenance Record. This standard will ensure that authentic digital content and data include an immutable cryptographic signature provided by the content creator and a cryptographic timestamp recorded on-chain.
  - **Proof of personhood** is a consensus mechanism that digitally verifies an individual's humanness and uniqueness to protect a blockchain network from identity fraud. PoP is an anti-Sybil attack blockchain mechanism that verifies an individual's digital identity using their unique attributes and features, this concept allows individuals to verify a digital document's existence without exposing its contents or relying on trusted intermediaries.
- Healthcare (secure digital health passes), government (mobile driver's licenses, vehicle registrations, outdoors licenses, permits, professional certifications), financial services, and marketplaces industries have been exploring blockchain ID solutions for some time.
- Some notable startups advancing secure digital identity and content authentication include Ceramic, SpruceID, ETHSign, World, Gitcoin, Rarimo, Humanode, AttestiV, Nodle, Numbers Protocol, Civic, zkMe, Dynamic.xyz, Consensys, Sismo, Quadrata, and SelfKey, among many others.
- Below are some of the live identity management initiatives conducted by large corporate enterprises:

J.P.Morgan

- **J.P. Morgan** is exploring blockchain-based digital identity solutions through its **Kinexys** division (formerly Onyx) to enhance privacy, compliance, and efficiency in financial markets.
- In 2024, J.P. Morgan introduced a framework for reusable digital identities to streamline KYC and AML processes. The solution incorporates Zero-Knowledge Proofs (ZKP) and Decentralized Identifiers (DIDs) to verify identities without exposing sensitive data. J.P. Morgan announced. The banking giant also released a whitepaper entitled Project EPIC: Fueling Tokenized Finance with On-Chain Enterprise Privacy, Identity, and Composability (EPIC) [3].
- **Kinexys platform** has processed over $1.5T in tokenized asset transactions across all its services, including payments, intraday repo, collateral management, and other offerings.

1) Sumsub Identity Fraud Report 2023
2) https://www.europol.europa.eu/cms/sites/default/files/documents/Europol_Innovation_Lab_Facing_Reality_Law_Enforcement_And_The_Challenge_Of_Deepfakes.pdf
3) https://www.jpmorgan.com/kinexys/documents/JPMC-Kinexys-Project-Epic-Whitepaper-2024.pdf

VIII. Digital Identity Solutions (2/2)

J.P.Morgan	It now averages around $2B in transactions daily and integrates confidential identity management to enable secure, private settlements. The platform explores Fully Homomorphic Encryption (FHE) for on-chain privacy. ▪ J.P. Morgan partnered with **Ava Cloud, Fhenix, and Parfin** to test privacy-preserving identity solutions for tokenized assets [1].
okta + SECURE KEY + Canada	▪ **Okta,** a leading identity and access management company, is working with some key customers in Canada who are extending their B2B and B2C applications to streamline cumbersome and expensive identity-proofing flows leveraging blockchain. **SecureKey Technologies** has developed a functional, secure credential-sharing network between financial institutions and the **Canada Revenue Agency** to simplify the login process for Canadian consumers. They are working to extend this and launch a new digital identity and attribute-sharing network based on blockchain. The goal is for entities to streamline the manual and time-consuming process of identity verification while opening a new bank account, renewing driver's licenses, submitting income tax returns, etc. [2].
EQUIFAX	▪ In 2022, credit reporting agency **Equifax** and blockchain-based, privacy-focused cloud computing company **Oasis Labs** have announced a partnership to build an identity management and know-your-customer (KYC) solution for Web3, the so-called decentralized iteration of the internet [3].
EthSign	▪ In June 2024, **EthSign** announced the launch of **SignPass**, a blockchain-based ID verification system. SignPass is a digital identity solution that, in partnership with the Immigration Department of Sierra Leone, enables holders to apply for and obtain permanent residency (PR) status in the country. Sierra Leone is the first nation to support this on-chain PR program, which the Sign Foundation manages in collaboration with Sierra Leonean authorities. **SignPass is actively being used as a pathway for obtaining permanent residency in Sierra Leone,** representing a novel approach that leverages digital identity and blockchain for global mobility.
WORLD	▪ World is creating **a digital identification system called World ID,** which provides biometric authentication devices that utilize optical scanning. World ID operates similarly to a digital passport. After a consumer uses the Orb to scan their iris, they will be recorded as a human and a World ID will be issued. Participants in certain countries also receive a crypto token called WLD as proof of their verification. As of April 2025, Worldcoin had 10M+ active users (4) and 20M+ downloads from dozens of countries [5].
Nodle + Adobe	▪ **Nodle** has partnered with **Adobe and the Linux Foundation** to advance the Content Authenticity Initiative, which aims to verify the authenticity and integrity of digital content using blockchain technology. This partnership includes the development of Nodle's **ContentSign** SDK, designed to validate data at its source and ensure a secure chain of custody for digital media. A key aspect of this collaboration is integrating cryptographic signing technology developed by Adobe, which is used in Nodle's Click Camera app. This allows users to capture images and videos that are cryptographically signed, confirming their authenticity and origin. The technology is part of the Content Authenticity Initiative, which both Nodle and Adobe actively support. ▪ Another Nodle's product is a smartphone-powered decentralized wireless network (DePIN) designed to connect IoT devices, authenticate media content, and enable real-world applications such as asset tracking and location verification. There are currently 780,001 active Nodle devices [6].

1) https://www.jpmorgan.com/kinexys/documents/JPMC-Kinexys-Project-Epic-Whitepaper-2024.pdf
2) https://www.okta.com/resources/whitepaper/practical-thoughts-on-blockchain-and-identity/
3) https://fortune.com/crypto/2022/10/26/equifax-and-oasis-partner-to-build-kyc-solution-crypto/
4) https://worldcoin.org/blog/announcements/tfh-world-app-passes-10-million-users
5) https://x.com/worldcoin/status/1869827136380621264
6) depinscan.io

VII. Blockchain & NFT-based Loyalty Programs (1/2)

Loyalty programs are proven to help companies generate more revenue and save on customer acquisition costs. Integrating blockchain can increase the efficacy of loyalty programs.

Blockchain technology can improve existing loyalty programs by:

- **Creating true ownership:** Customers own loyalty points and rewards issued on a blockchain, increasing their perceived value and strengthening the brand-customer relationship.
- **Building a direct relationship with customers:** Companies issue rewards directly to their customers' wallets rather than through an intermediary. Companies have a direct communication channel with their customers to incentivize behavior. Brands can send personalized rewards to customers or grant specific wallets unique access to a sale while gaining insight into the customer's purchase behavior.
- **Allowing interoperable brand partnerships:** Loyalty programs built on blockchains are interoperable, and different brands can work with one another to increase the value of their respective loyalty program. Legacy systems may have difficulty transmitting data between different IT systems. A potential use case would be that a fan of an artist can collect rewards for each show they attend, which is currently difficult to do with various music venues using different software systems.

Two additional factors are not native to blockchains but are benefits that typically complement a blockchain-based loyalty program:

- **Maintaining a record of transactions:** A user's wallet contains their transaction history, eliminating the need for companies to manually link purchases across multiple points of sale to build a customer profile.
- **Gamifying rewards:** Companies can gamify rewards to make the loyalty program feel less transactional, encourage customers to redeem their rewards, and lower the accounting liability on a company's balance sheet.

Major brand flagship NFT collection launches

NFTs Are About Customer Engagement And Brand Loyalty – A Way To Deliver Value At Zero Marginal Cost

1) Brands as ranked by Interbrand

Source: CBInsights, banklesstimes.com, Messari, Dematerialzd

Several catalysts have been driving change in the loyalty industry over the past few years:

1. **General Data Protection Regulation (GDPR) Cookie Consent:** GDPR's rules require that consumers opt-in to cookies that companies previously used to collect data and track website visitors.
2. **Apple Ad Tracking Transparency:** Apps built on iOS now require users to opt-in to the Identifier for Advertisers and allow the app to track the user.
3. **Direct-to-Consumer Business Models:** An increasing number of companies are selling directly to consumers and are directly owning the customer relationship.

- These changes have made it much more difficult for companies to use targeted online targeted ads to acquire new customers, while being able to communicate directly with your customers has become increasingly important.
- As a result, retaining customers has become more important for brands than spending heavily to acquire new customers to replace lost ones.
- Loyalty programs are becoming one of the most critical tools for brands to increase customer engagement and improve retention and lifetime spending.

Recent regulatory and industry developments are forcing companies to reexamine their loyalty programs, with blockchains emerging as a logical solution.

VIII. Blockchain & NFT-based Loyalty Programs (2/2)

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- **American Express** has partnered with **Superlogic**, a next-gen loyalty technology provider and TenSquared-backed company, to promote the Superlogic offering to its merchant brands. Superlogic provides a platform that allows brands to manage loyalty programs and offer personalized rewards, including experiential rewards from courtside seats at the NBA Finals and VIP music festival passes to private dining with Michelin-starred chefs and behind-the-scenes Broadway experiences.
- **Clients of Superlogic have seen an 800% increase in engagement with their loyalty programs and a 20% increase in purchase activities.**
  - **Loyalty programs:** Superlogic issues digital tokens to represent loyalty points. Brands can take advantage of using gamification techniques and benefit from accounting rules specific to NFTs.
  - **Connected commerce:** Physical items can have a QR code with digital twins. Brands can connect physical purchases with a customer's profile. The connected commerce software allows consumers to transact in the secondary market while authenticating goods easily. Clients can also generate incremental revenue by facilitating secondary transactions.
- Users can seamlessly utilize the Superlogic platform without needing any prior knowledge of cryptocurrency or NFTs, making it accessible to everyone.
  Brands using Superlogic's platform include **Warner Music Group, Ebay, Uber,** and many others.
- **More on SuperLogic:** Link

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- **Fnac Darty,** France's largest electronic retailer, has partnered with **Arianee,** a provider of open and interoperable digital product passports for durable goods. **Since 2017, Arianee has issued over 2M blockchain-based digital passports for over 40 brands, like Piaget, Breitling, Moncler, Vacheron Constantin, Mugler, Audemars Piguet, and Richmont,** among many others. Arianee's digital product passport (DPP) product is useful in many industries outside of luxury, like automobiles, furniture, appliances, and others, and can scale to millions of NFTs issued annually.
- Starting in 2026, the EU will begin requiring products to use DPPs. The regulations will require the DPP to: "provide consumers with transparent information about the origin, environmental impact, and safety of products."
  Key benefits of Arianee's digital product passport:
  - Data collection and tracking of product creation, maintenance & recycling to enable circular business models & carbon footprint reduction;
  - Certificate of authenticity and ownership;
  - E-maintenance booklet and product information;
  - CRM/marketing/loyalty tool.
- The DPP is an enterprise-grade product with APIs that can plug into a business's existing systems and completely abstract the blockchain technology required.

Examples of Arianee's digital product use cases

IX. Gaming, Media & Entertainment: Further Monetizing IP (1/2)

- The global gaming, media & entertainment industry generates between $1T - $1.5T [1] in revenue depending on how broadly sporting revenues are defined in the total figure.
- Blockchain has begun to change and improve how companies across video games, movies, TV, music and sports generate revenue and interact with fans.
- Key benefits of utilizing blockchain technology in the sector includes:
  - **Increased Revenue:** Blockchain technology allows companies to generate additional revenue from both current business models and in novel ways. For example, in-game items can be tokenized and the video game publisher can charge a transaction fee when the item is traded.
  - **Empowering Fandom/Improving The Fan Experience:** Companies and creators can issue or sell NFTs to their fans. Fans now have a financial incentive in addition to their fandom to share the creator's work. The more fans that a creator gains, the more valuable the NFT will be. NFTs can also help in community building and serve as proof of fandom.
  - **Extending IP:** Smart contracts and blockchains streamline the IP licensing process. Brands can further monetize IP or promote their IP in different channels to new customers.
  - **Reducing Operational Friction & Third Party Cost:** Blockchain technology can reduce the logistics challenges within the industry. Tickets can be verified on a blockchain ledger and a gamer can create an interoperable gaming profile that can move between different platforms.
- For these use cases that reach hundreds of millions of fans, many of whom have never interacted with blockchain or crypto, it was important that blockchain technology be easy to use and have a simple interface. Corporations and brands required solutions that were as simple to use as signing up for an email account or downloading an app from the App store.

SONY

Soneium

- **Sony** launched its own blockchain, **Soneium,** in 2024. The blockchain was designed to enable mass adoption of blockchain and target use cases for creators and their fans.
- As of April 2025, over 2 million accounts [2] have been active on the blockchain.
- Sony has issued music based NFTs as one of the first use cases:
  - **Sandal Telephone,** a J-pop group, rewarded super fans who previously purchased merchandise with a NFT.
  - **NUU$HI,** a Tokyo based producer represented by Coop Records, also sold his music as NFTs. Notably, the NFTs were priced at $2 and were not designed as a speculative investment instrument.

Telegram

TON

- **Telegram,** the social media and messaging application with 900 million users, also launched its own blockchain called **TON.** A cumulative 43 million wallets have been created on TON with 2.5 million MAU as of April 2025 [3].
- A key driver of traffic on the TON network are Free To Play mobile games. Most notably Hamster Kombat and Notcoin at one point had million of users. These games attracted users with the lure of tokens that the game would issue based on in-game activities.
  - Notcoin's token was launched at $2.5B valuation and Hamster Kombat's token was briefly worth $8B [4]. The tokens subsequently declined in value as users moved onto other games but still demonstrated the power of using cryptocurrency as an user acquisition tool.

WARNER MUSIC GROUP

Superlogic

- **Warner Music Group** utilizes a blockchain based loyalty program powered by Superlogic. Fans of Warner's artists earn NFT rewards for streaming music, watching music videos and sharing the record label's social media posts. Fans can exchange their NFTs for exclusive merchandise and in-person events.
- **Warner Bros.** also created NFTs for its famous movie and TV franchises including Game of Thrones and Matrix. These NFTs were issued while there were no TV shows or movies of these franchises being aired. The NFTs allowed Warner to make millions more in incremental revenue from its existing IP while continuing to engage its fans between new content was released.

1) Bain, Billboard, Grandview Research, Variety, GlobeNewswire
2) https://soneium.blockscout.com/stats
3) https://www.tonstat.com/
4) coinmarketcap

IX. Gaming, Media & Entertainment: Further Monetizing IP (2/2)

- **Coachella, one of the world's largest music festivals, issued NFTs granting holders access to the annual festivals and unique experiences and perks. The most recent set of NFTs was issued in partnership with OpenSea, and in the past, Coachella has worked with the now-infamous FTX.**
- The Keepsake NFTs granted the holders a VIP pass to the festival and access to a VIP lounge with complimentary drinks. Other NFTs granted VIP access and exclusive merch.
- *"Coachella is a lot like a mixed reality game, where you can choose your own adventure and interact with a wide variety of creative experiences. We wanted to take this idea to the next level and create virtual assets inspired by Coachella's creative spirit and history, and tie those to real-world power-ups at the festival."* [1] - Sam Schoonover, Innovation Lead For Coachella

- Video game studios are incorporating NFTs into existing franchises and licensing IP to others to create novel blockchain-based games.
- **Ubisoft turned traditional in-game items into NFTs in its Ghost Recon franchise. The gameplay experience is the same, but players can now trade their NFTs with Ubisoft, earning additional revenue from these transactions.**
- **Sega licensed its Code of Joker: Evolutions IP to a third-party studio to create an NFT-based card game.**
- **Orange Comet** is a blockchain gaming studio. The studio acquired the rights to the **Fast and Furious franchise and The Walking Dead franchise** to build unique gameplay experiences enabled by blockchain. For example, in the Fast and Furious game, gamers can use smart contracts to win cars from each other in a race, similar to what happens in the movies.

- **Gunzilla,** a blockchain gaming studio created the first AAA blockchain game, **Off The Grid** to reach ~1 million users [2].
- Off The Grid used blockchain to bring new gameplay mechanics to the battle royale game genre.
- Gunzilla showed that with a focus on gameplay rather than speculation, there is a real demand for Web3 games with 500K DAUs months after the game's release.

- **Uptop,** a blockchain fan engagement and loyalty startup, partnered with the **Cleveland Cavaliers** to launch Cavs Rewards. The program allows fans' everyday purchases to be turned into rewards and experiences. The program grants the team direct access to its fans and has grown the team's fan database by 50% [3].

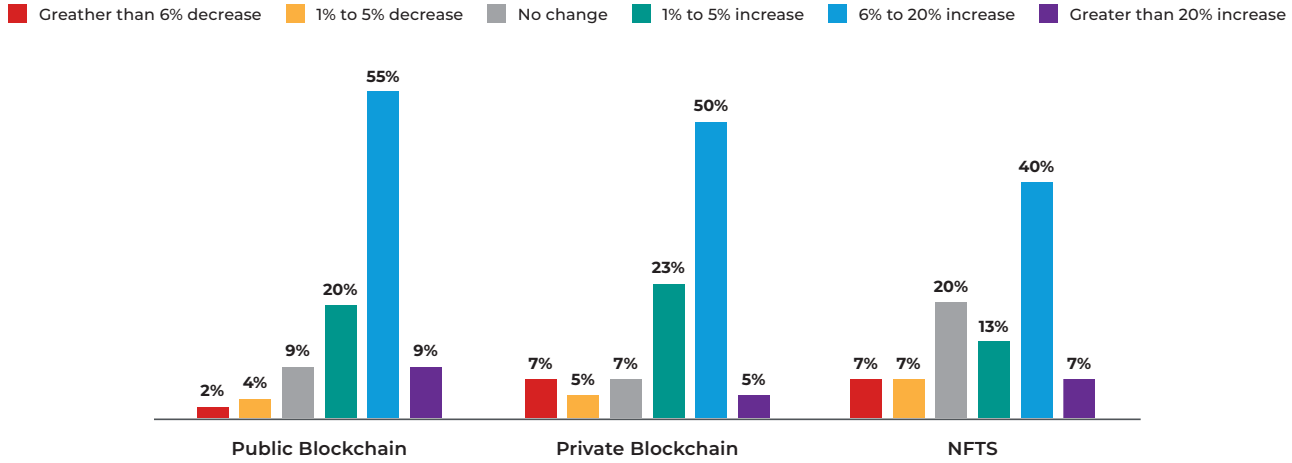
- Sports betting on **Polymarket,** a predictions marketplace, saw $1.15B in bets placed on the **2024 Superbowl.**
- This represents a substantial number compared to the $1.4B bet via official sports books [4].

- **Remaster** is a IP licensing and royalty payment platform using smart contracts to streamline and reduce the cost of licensing IP. Creators or owners of IP such as Minto can put their IP on the platform for buyers to find and use as an additional stream of revenue.

1) https://nftnow.com/features/coachella-opensea-partnership/
2) https://flipsidecrypto.xyz/Ali3N/off-the-grid-avalanche-l1-6j5GNj
3) https://www.sportsbusinessjournal.com/Articles/2025/04/14/cavs-rewards-paying-off-demonstrating-a-new-sports-loyalty-program-model
4) https://www.npr.org/2025/02/08/nx-s1-5290099/one-billion-super-bowl-lix-bets

Enterprises leveraging enterprise blockchain plan spending increases

In the next two years, to what extent will you increase or decrease spending on the following emerging technologies?
% respondents

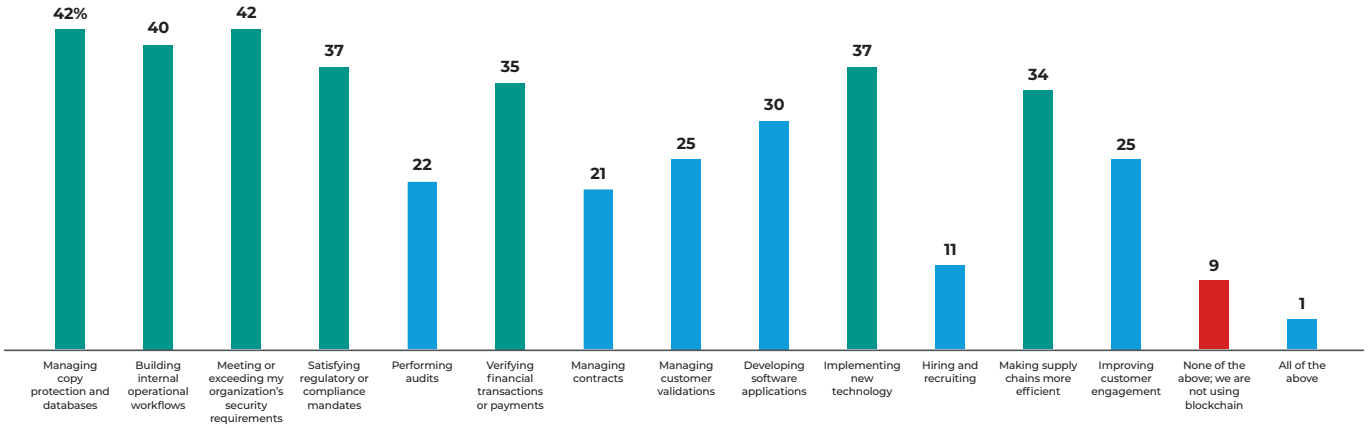


Source: HFS Pulse, 2024

Sample: 300 enterprises using one or more of the above technologies of the 600 surveyed

- Large enterprises have developed sophisticated technology infrastructures over time. However, significant opportunities remain to refine existing tech stacks. While IT leaders have already deployed blockchain in diverse experimental use cases, widespread migration of workloads into production environments is still in its early stages. In other words, organizations are only now starting to unlock blockchain's potential to fundamentally reshape their operations.

How companies use blockchain today, % of respondents



Source: The State of Enterprise Blockchain Adoption in 2023, Prove AI (formerly Casper Labs). Zogby Analytics was commissioned by Casper Labs to conduct an online survey of 603 business decision-makers divided across three countries: US, UK, and China.

- Companies embracing blockchain cite security and copy protection (42% each) as key advantages. However, its applications extend further: IT leaders globally use it to enhance workflows (40%), improve supply chain efficiency (34%), build software (30%), and manage contracts (21%).

At TenSquared, we believe that the key to the mass adoption of blockchain lies in leveraging the distribution networks of corporations with millions of existing customers. We look for startups that facilitate the adoption of blockchain by enterprises, have demonstrated product-market fit, and are addressing real pain points of enterprise blockchain technology adoption.

TenSquared Capital (10SQ) is a venture capital firm focused on investing in blockchain-enabled startups solving real-world use cases at their inflection points of growth.

IMPORTANT DISCLOSURES

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