Cryptomeria Capital.

STATE OF DEPIN

APRIL 2024

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KEY TAKEAWAYS

General

> dePIN is driving the demand for innovative cloud computing and data storage solutions, especially with the rise of AI/ML and the complexities of Web3 infrastructure.

> In markets dominated by monopolies—from Wireless, Sensors, and Computing to Storage Infrastructure — dePIN offers efficient startups and users affordable, reliable alternatives.

> At the end of 2023, the most authoritative crypto venture funds indicated that the dePIN market is one of the most promising directions for 2024.

> The choice of blockchain significantly influences the effectiveness, security, and cost-efficiency of DePIN projects. Key considerations include gas fees, scalability, throughput, block generation speed, and ecosystem development.

Storage

> By 2023, cloud storage hosted over 60% of corporate data, doubling from 30% in 2015, indicating a significant shift towards cloud-based solutions.

> An overwhelming 95% of businesses now prioritize multi-cloud strategies, highlighting the critical role of information security in contemporary business models.

> Three-quarters of organizations store over 40% of their sensitive data, including financial records, in the cloud, reflecting trust in cloud security.

> Despite the sensitive nature of cloud-stored data, only 22% of businesses encrypt at least half of this data. Furthermore, just over half (54%) are confident in their cloud security tools and skills.

> A mere 41% of organizations have adopted zero-trust architectures in their cloud infrastructure, suggesting a gap in comprehensive security measures.

> The DePIN model uses blockchain to secure physical infrastructure in a decentralized manner, embodying the principles of Zero Trust security.

> Encryption, distributed storage, replication, and guaranteed retention offer an all-encompassing solution against hacking and access interruptions, safeguarding against significant financial losses.

> Demonstrating reliability and cost-effectiveness, dePIN has vast implications for sectors such as AI/ML, healthcare, finance, government, academia, research, and e-commerce.

> Fueled by blockchain advancements, the decentralized storage market is poised for expansion, with opportunities to improve data integration and scalable storage solutions.

> Filecoin has expanded its platform to include L1 Computer Networks and is preparing for the InterPlanetary Consensus mainnet launch, signaling growth in capacity and community engagement.

> Arweave offers a permanent storage solution with a unique pricing model for up to 200 years, supported by recent significant updates and community development efforts.

> Despite early 2023 challenges, Storj witnessed a 226% year-on-year revenue growth by year-end, driven by system upgrades and the introduction of Storj Select for enhanced security and compliance.

Computing

> Cloud computing's market size has grown from $304 billion to $917 billion since 2019, demonstrating significant expansion and adoption across various industries.

> The evolution of cloud computing technology has enhanced scalability and usability alongside a growing emphasis on sustainability and energy efficiency.

> Key challenges facing the cloud computing industry include cost management for all organizational sizes, security concerns during user-cloud service interactions, and a general lack of expertise in the field.

> The rise of AI and ML has increased the demand for computational resources, highlighting decentralized computing platforms' cost-effectiveness and performance advantages over traditional cloud services.

> Render Network transitioned from the Ethereum blockchain to Solana and incorporated a new mechanism for distributing rewards among the nodes supporting new clients.

> Theta EdgeCloud, launching its 1st phase in Q2 2024, is a hybrid cloud platform designed for video, 3D rendering, and AI, built on a fully distributed edge architecture.

> The Akash Network has enhanced its infrastructure to better support the needs of LLMs and compute-intensive tasks through mainnet upgrades, collaboration with Thumper.ai for AI model training, and expanding GPU support to include both NVIDIA and AMD.

> Holochain Beta's release and developer engagement activities signify strides toward a secure and robust network, with an anticipated official launch in Q2 2024.

> Livepeer plans to integrate AI compute jobs, leveraging its decentralized network for advanced AI-driven video applications.

Wireless

> Despite a 2023 slowdown due to the 5G rollout cooling off, 2024 eyes growth in the wireless industry through revenue diversification, sustainability initiatives, and enhanced cybersecurity.

> AI's ongoing demand in 2023 is set to continue into 2024, driving improvements in digital infrastructure and network capabilities.

> Blockchain's emergence in wireless communication introduces a new age of security, privacy, and innovation, with the Wireless DePin segment marking a significant shift in securing networks.

> Key 2024 trends include Open RAN adoption for more flexible and efficient networks, AI integration for optimized network operations, and further 5G densification to meet low-latency demands.

> Blockchain brings unmatched data integrity to wireless communication, enhanced privacy, improved transparency, and increased scalability, revolutionizing security and trust in the sector.

> Developments in blockchain for wireless communication focus on secure identity and access management, data sharing, and IoT connectivity, ensuring robust network integrity and privacy.

> In April 2023, Helium migrated to Solana, enhancing its Proof-of-Coverage consensus with oracles and expanding its ecosystem to over 380,000 LoRaWAN devices and 3,600 5G nodes in the USA.

> Althea's blockchain Testnet 2 launch and anticipated Mainnet release in Q1-Q2 2024 mark critical advancements towards secure and decentralized wireless connectivity.

> Wayru's integration into the Peaq ecosystem in February 2024 and upcoming hotspot firmware update highlight the industry's shift towards interoperable and secure network solutions.

> FOAM's development milestones, including its Testnet launch and MVP unveiling in late 2023, demonstrate progress in establishing an open Proof of Location network, showcasing the potential for blockchain in enhancing geographic verification within wireless communication.

Sensor Networks

> IoT devices surpass non-IoT devices as of 2020, signaling a shift towards a more interconnected and smart world, with significant growth in market size projected to reach $374.39 billion by 2023.

> Energy Networks are essential for the sustainable operation of IoT devices, with a focus on smart energy management and CO2 reduction strategies leveraging renewable energy and energy efficiency.

> Challenges in energy networks include outdated battery technology, insufficient governmental support and investment, and legacy power infrastructure unable to support new energy types.

> The navigation and mapping industry shows potential for growth, with emerging applications outpacing traditional services like Google Maps by offering real-time updates and faster mapping capabilities.

> The combined potential of IoT, Energy Networks, and Mapping sectors highlights the necessity for DePIN to address scalability, security, and data management challenges, connecting these sectors with blockchain, storage, and computational solutions.

> Hivemapper has introduced significant updates like MIP-2 and DashcamOS 2.0, aimed at improving incentives for contributors and enhancing the mapping experience through advanced technology and streamlined processes.

> Hivemapper Scout and Honey Bursts introduce innovative features for real-time, street-level data monitoring and rewarding exceptional contributions.

> The introduction of the DIMO Macaron device and DIMO Ignite program aims to transform any car into a smart, connected vehicle and support developers in enhancing the DIMO Protocol infrastructure, offering comprehensive vehicle diagnostics and simplifying data access payments.

> WeatherXM has integrated a Merkle Tree structure for reward distribution and launched the $WXM smart contract on Ethereum, with future distributions planned on the Arbitrum mainnet.

> Natix's Drive&App has expedited its mapping efforts, surpassing 1 million kilometers in 11 weeks, and introduced a token reward system with gamification, significantly boosting user base and engagement for enhanced transportation data collection.

> GEODNET and Deep Sand Technology partner to offer affordable RTK services for precision agriculture in rural North America, promising significant cost savings for farmers.

> GEODNET's new GNSS Corrections Service provides centimeter precision for agricultural robotics, leveraging a network of reference stations to enhance accuracy in automated steering and drone applications.

DePIN & AI

> DePIN's integration with AI is enhancing practical applications in sectors like healthcare, supply chain management, and smart cities through secure data analysis and infrastructure optimization.

> Decentralized Computer Networks, like io.net and Nosana on the Solana blockchain, address the growing demand for GPU resources for AI amidst a notable GPU shortage and the rising computational requirements of AI models.

> Storage Networks are evolving to manage the surge in data from synthetic data and AI-generated content, focusing on scalability, security, and efficient data management for applications in healthcare, autonomous vehicles, and entertainment.

> AI Infrastructure Networks, including Bittensor, Autonolas, Delysium, Modulus Labs, and Ritual, are developing to provide decentralized platforms for AI development, data analysis, and automated task execution, emphasizing privacy and verifiable AI processes.

> The demand for decentralized computing and storage platforms is skyrocketing due to AI/ML developments, which are challenging major companies and democratizing progress for AI startups with a focus on modular data infrastructure.

> The market value of DePIN is projected to grow from $2.2 trillion to $3.5 trillion within four years, driven by the increasing integration of AI into various sectors and the demand for decentralized data processing and storage solutions.

> Vitalik Buterin highlights the potential of AI in the cryptocurrency space across four application areas, emphasizing the symbiosis between AI's data needs and blockchain's capabilities while cautioning against the risks of adversarial machine learning.

DePIN & ZK

L2 is focusing on data compression, cryptographic enhancements, and programming optimizations to reduce ZK-Rollup costs without compromising on privacy or reliability.

The primary cost factor for transactions is the on-chain publication of data, with efforts to optimize data compression and state outputs significantly lowering costs.

Off-chain Data Availability (DA) layers are being explored to reduce costs further and increase transaction speed and customization.

The anticipated EIP-4844 update in 2024 promises to slash data publication costs by up to 90%, potentially transforming cost dynamics for Ethereum-based rollups.

DePIN Storage Networks are emerging as crucial support for EVM-compatible blockchains, offering backup infrastructure and external DA for Rollups.

The rise of ZKP Markets introduces a new sector combining dePIN with ZKP for computational resource sharing, facing challenges akin to MEV scenarios.

DePIN Computing Networks are leading with distributed computing models as an additional revenue stream, setting a precedent for decentralized, equitable incentive systems.

The integration of ZK technology in dePIN solutions is gaining traction in AI and cybersecurity, showcasing innovative use cases like Nosana and Zorp for enhanced privacy and security.

WHY CHOOSE DEPIN?

01

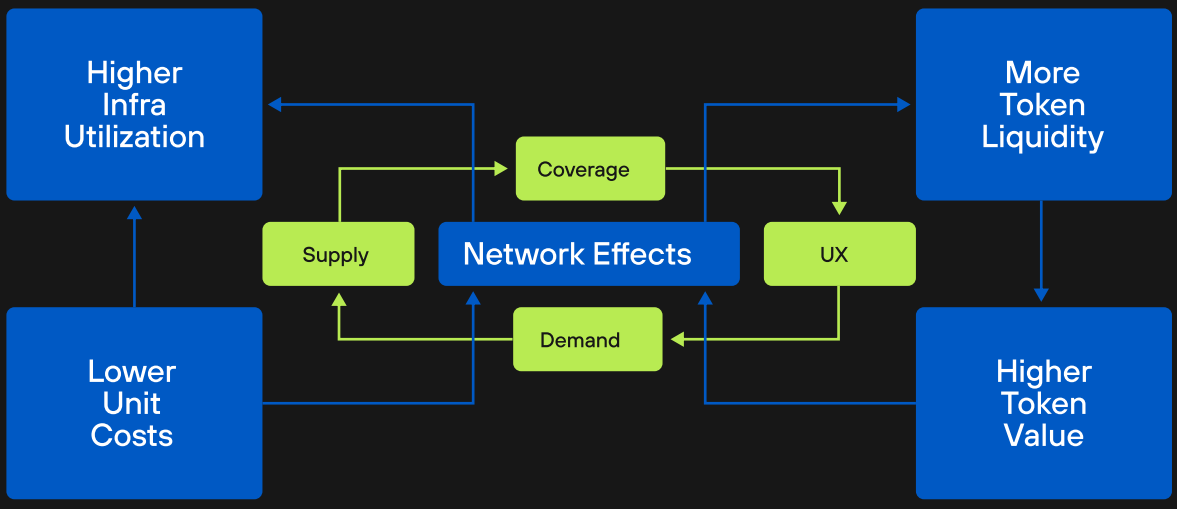
The dePIN market has been around for quite some time, with the first specialized networks such as Filecoin and Storj being established back in 2014. Since then, hundreds of new service and server solutions have emerged, dozens of which now provide services to thousands of users, generating significant revenue.

Conceptually, dePIN mirrors traditional blockchain models as it fosters communities, enables resource monetization, facilitates validation and governance decisions, and stores on-chain data to enhance user functionality.

Understanding dePIN can be challenging for Web2 users and crypto enthusiasts due to its nuanced positioning and blockchain utilization. The distinction lies in how dePIN projects present themselves and utilize blockchain and incentives to address common challenges.

The evolution of demand for cloud computing and data storage, coupled with the rise of AI/ML trends since 2020 and the increasing complexity of Web3 infrastructure, has propelled the growth of dePIN projects like Arweave, Render, Akash, Livepeer, Hivemapper, and Bittensor. These projects capitalize on familiar usage mechanics and address emerging needs in the digital landscape.

DePIN Flywheel



In times when the Wireless (Telecommunications, Networking, etc.), Sensors (IoT, Mapping, etc.), Computing, and Storage Infrastructure markets are almost entirely under the control of monopolies and global corporations, it is dePIN that comes to the aid of efficient startups and ordinary users looking for cheaper and more reliable alternatives.

The primary issues within these vital sectors stem from their centralized nature and the inherent limitations it imposes. Decentralization, coupled with a blockchain-based communication system and clear rules of engagement, presents vast opportunities where individuals can emulate the success of industry giants like AWS, Google Maps, or Dropbox.

Interestingly, achieving this does not necessitate investing billions in constructing data centers or hiring extensive staff. It is enough to create:

> Mutually beneficial conditions for the work of all project participants for the common good

> Stable logic and reliable code to minimize the human factor and centralization

> An effective tokenomics that reflects the product's success and will ensure the stable operation of all components for years

> (And hide the blockchain “under the hood” so as not to scare anyone away)

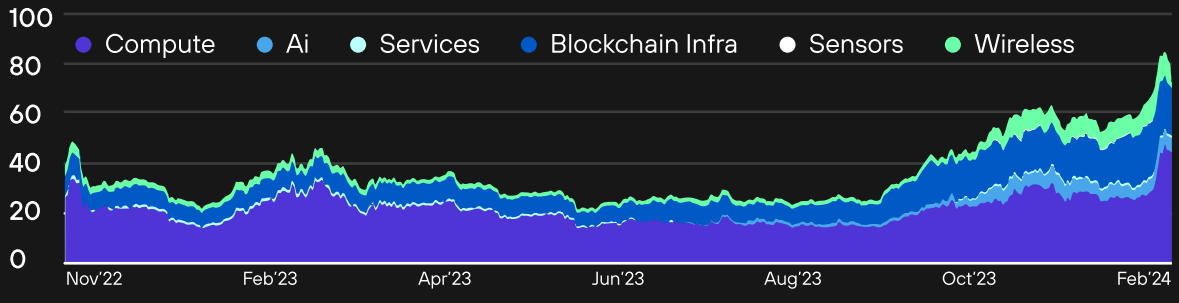
At the end of 2023, most authoritative crypto venture funds indicated that the dePIN market is one of the most promising directions for 2024. We certainly cannot disagree, as these solutions deserve attention even just for their relative independence from the general mood of the cryptocurrency market.

However, despite the fact that there are already many projects generating real revenue and having interest from consumers of services, the dePIN market is still in the early stages of its formation. This offers great prospects but also poses significant challenges.

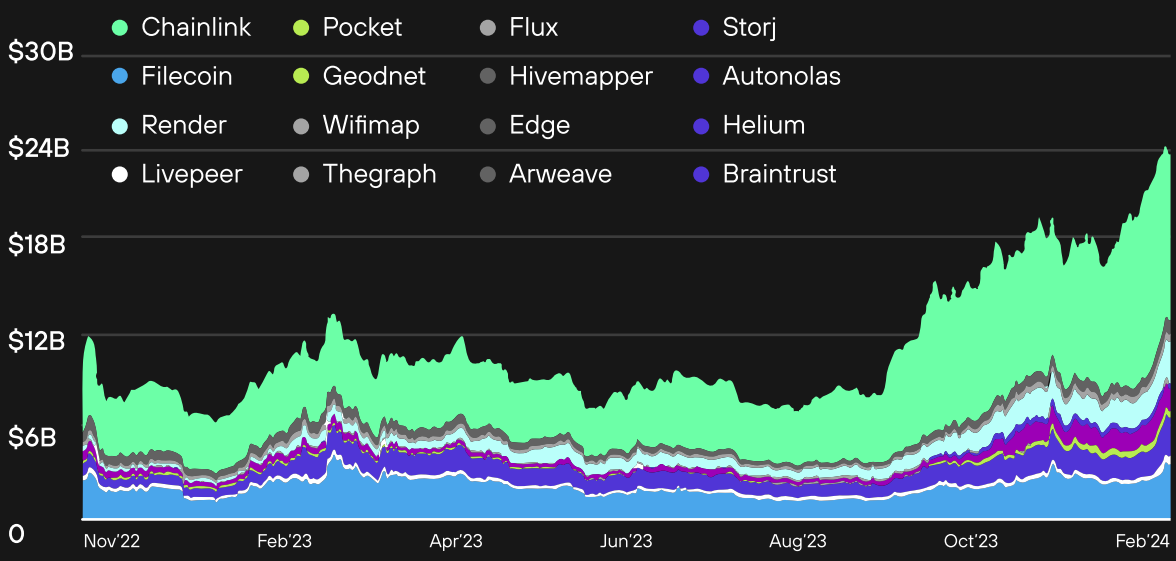
Even popular and established projects encounter technical issues, cost discrepancies, and undergo continuous updates. These services demand highly efficient economic models. It's essential to recognize that dePIN confronts both traditional challenges of the Web2 market and new Web3 challenges, including regulatory concerns.

Despite this, we at Cryptomeria Capital support the dePIN narrative and believe that good ideas always help achieve their goals. This project sector has the potential to serve as a gateway for millions of future Web3 users, offering substantial benefits overall. As advocates of innovation, we diligently track project updates in existing markets and actively seek emerging dePIN startups with unicorn potential.

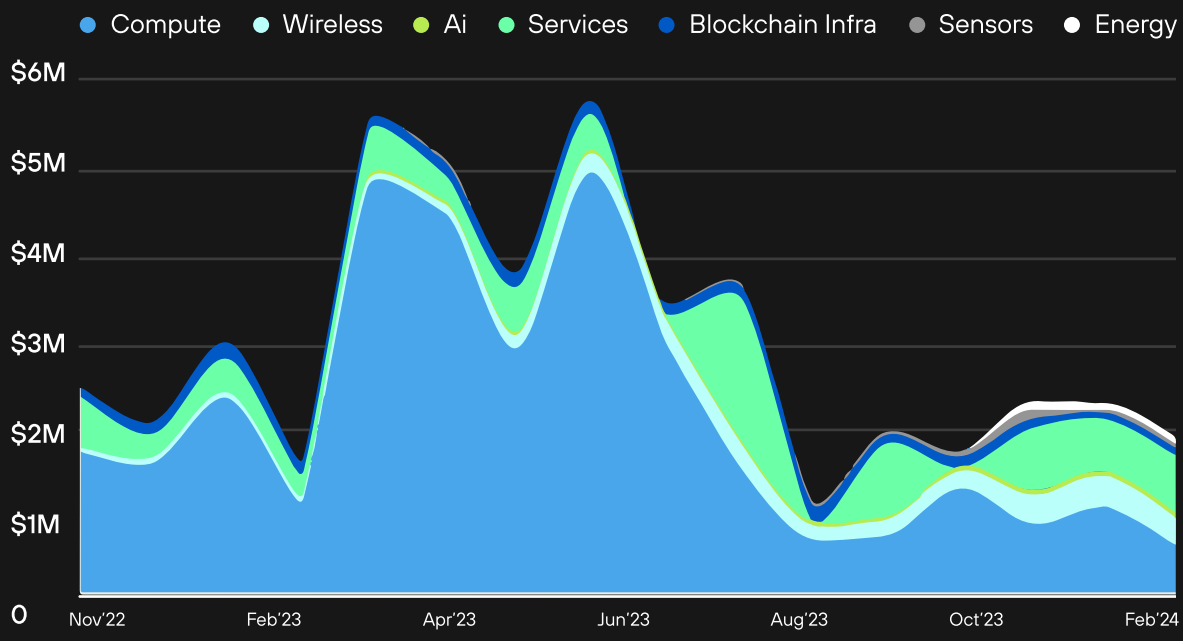
Aggregate DePIN Market Cap (By Category)



Aggregate DePIN Market Cap (By Project)



Onchain Revenue (By Category)



Among the VCs who actively support dePIN projects and think that this market is one of the most promising in 2024 are →

coinbase · Messari · VanEck · a16z · PANTERA · SPARTAN · Bitcoin Suisse · Outlier Ventures · HASHKEY Capital · Multicoin Capital · Borderless · CoinFund · DCG · POLYCHAIN CAPITAL

DEPIN INFRA-STRUCTURE

02

Traditional global infrastructure faces limited accessibility, scalability issues, high maintenance costs and security challenges. These hinder innovation and prompt a shift towards decentralized infrastructure, known as DePIN.

The choice of blockchain plays a pivotal role in the comprehensive resolution of issues and the realization of all DePIN benefits. In most cases, DePIN products require regular data transfer to maintain system functionality, resulting in gas fees when selecting the primary network on which a company will build its product. The lower the gas fees, the cheaper the maintenance of such a product, but this comes at the expense of blockchain technology and its security. Other crucial factors include scalability, throughput, block generation speed and the level of ecosystem development.

While each blockchain network presents its advantages and drawbacks, it's crucial to recognize that the choice of a network is just one factor in shaping the future of a project. Developers should prioritize aligning the network's features with their decentralized applications' specific needs and goals, as overall project execution and community engagement often play a more pivotal role in determining long-term success than the specific blockchain infrastructure chosen.

Solana

Many products prefer Solana as their infrastructure layer. Solana is rapidly gaining ground due to its integrated infrastructure and performance-focused developer community, attracting DePINs at every lifecycle stage. The high-performance blockchain enhances reach and liquidity through its impressive transaction throughput. Some products that initially launched their native networks eventually migrated to the Solana blockchain, favoring its infrastructure, capabilities, and network with over a million wallet addresses. Also, Solana proposes low fees, significant data compression (especially for NFTs), and the possibility of utilizing Rust for dApp development.

helium

Helium Network made a strategic move in April 2023, transitioning from its native layer-1 blockchain to Solana. Solana's ability to process thousands of transactions per second and its extensive developer ecosystem position it as an ideal choice. This migration allows Helium to concentrate on building wireless protocols, enhancing its decentralized wireless network. Helium operates a decentralized LoRaWAN network called "The People's Network." It facilitates IoT connectivity, empowering communities through user-owned hotspots.

The Render Network

Render, a P2P GPU provider for image and animation rendering services, also chose Solana. In November 2023, Render Network upgraded its base infrastructure from Ethereum to Solana. This move enables Render to explore features like real-time streaming and dynamic NFTs. Implementing a burn and mint equilibrium (BME) model in December 2023 enhances service pricing through supply and demand equilibrium.

NOSANA

Nosana offers a distributed GPU grid, allowing easy renting of compute power without typical drawbacks like high fees or commitment. They tackle GPU shortages, making it simpler for businesses to access necessary hardware. By utilizing underused devices like gaming PCs and MacBooks, Nosana provides competitive prices for AI-solution development, making it an ideal and cost-effective computing solution.

hivemapper

Hivemapper, a mapping and navigation platform that utilizes crowdsourced data to create detailed, up-to-date maps. Its architecture integrates user-generated content, primarily from dashcams, to continuously update and refine its mapping database. This approach leverages decentralized data collection, enabling real-time updates and comprehensive coverage.

grass

Grass, a network created by Wynd Network and based on Solana, allows users to monetize their unused internet bandwidth by selling it to corporations and institutions. The platform, accessible through a downloadable application on the Google Play Store or Chrome Extension Store, operates in the background of users' devices, generating passive income without impacting personal data privacy.

Polkadot

Polkadot is a software solution that aims to reward owners of computers connected to the global network for supporting blockchain operations. Polkadot works with two types of blockchains. The leading network called relay chain, is where all transactions are consistently recorded. Then, there are user-created networks called parachains. Parachains can be customized for various use cases and connected to the main blockchain, making transactions in parachains just as secure as in the main chain.

Polkadot has its substrate-based dePIN-oriented network Peaq. The product also has integrated support for three additional networks: Ethereum, Cosmos, and BNB Chain. As a result, Peaq supports four main networks, has a solid foundation in network capabilities, handling great TPS and low fees, which is very important for high-frequency dePIN mechanics.

Additionally, built on top of Peaq is the Krest network - the world's first and currently only simulation network for DePIN and the Economy of Things. Krest allows testing the impact in a live environment on a public blockchain network without the risk of causing real-world harm.

Deserving special attention as well are:

CRUST

Crust Network is a decentralized data storage provider. Among Crust's advantages, it is worth highlighting support for four different directions to meet the needs of each user: Decentralized Physical Infrastructure as primary data storage locations, Guaranteed Storage On IPFS, Omnichain Interoperability, and On-Chain Storage Market. Each of these solutions is decentralized and can be utilized for products in virtually any network, ranging from popular ones like Ethereum, Polygon, BNB Chain, Solana, and Polkadot to Moonriver, ZkSync, Optimism, and Shardeum.

Nodle

Nodle is a connectivity provider for the Internet of Things. The company has built a Bluetooth-powered network to help companies and cities connect and collect data from their devices and sensors. Every smartphone inside the Nodle ecosystem is a "node" waiting to get to work. Smartphones become nodes by locating and connecting devices within the network, and after being active, they receive rewards based on connectivity and availability.

PHALA
NETWORK

Phala Network is a Polkadot parachain representing a decentralized cloud computing protocol aiming to compete with traditional cloud computing services such as Amazon AWS and Google Cloud. The Phala network enables excess computing power from ordinary computers to facilitate a more distributed approach to cloud computing and data storage. Unlike Grass, Phala focuses on utilizing idle hardware resources rather than idle traffic.

Polygon

Polygon is a layer 2 scaling solution for blockchain networks, originally known as Matic Network. It utilizes a proof-of-stake chain and an SDK to enable the creation of sidechains, providing increased scalability and interoperability for decentralized applications on the Ethereum network.

As a blockchain solution, Polygon stands out with its multi-chain functionality, allowing seamless integration with various blockchains. Tackling Ethereum's scalability issues, Polygon employs sidechains and proof-of-stake, ensuring scalability for decentralized applications. The platform also supports smart contracts similar to Ethereum but with lower transaction costs and improved scalability through sidechains.

One of Polygon's distinctive features is its own Polygon zkEVM, which offers several advantages. The zkEVM ensures low transaction costs through the use of ZK proofs, exhibits high performance with fast network finality via Polygon Zero technology, maintains code compatibility with Ethereum's EVM, and enhances security through L2 batching, ZK proofs for transaction validity, and user fund protection, inheriting the robust security of Ethereum in Layer 2.

Due to the range of solutions offered by Polygon, the decision has been made to build the following products based on its infrastructure:

DIMO — transforming cars into data ecosystems
GEODNET — enhancing GPS accuracy through a decentralized network
XNET — a mobile network operator bridging the digital connectivity gap
Space and Time (SxT) — facilitating data access for smart contracts

Ethereum

Despite Ethereum's popularity in decentralized finance, it is not widely favored in modern DePIN due to high gas fees and expensive maintenance, especially for a large number of small but regular transactions.

But, it’s still sustainable and has a great level of security as infrastructure layer. Moreover, many devs already know Solidity, making it a devs friendly case. As one of the main Ethereum-based dePIN storages, Storj, is still using Ethereum as a native infrastructure layer from 2014.

STORJ

Storj is a decentralized cloud storage disrupting traditional providers. It ensures data reliability through distributed nodes, adopts a market maker model (client-service simplicity and cost-free migration), and uses a proprietary protocol for storage. Storj focuses on resilience, reliability, and security, providing a cost-effective alternative to centralized cloud storage. Storj is used for multimedia storage, private data, large file transfers, NFT storage, and IoT data integration.

dePIN and AI projects, such as Fetch.ai, SingularityNET, Lambda Network, FOAM and others also support EVM and Solidity smart contracts that users can freely deploy.

Cosmos SDK / Tendermint

Some developers are drawn to the Cosmos SDK Tendermint network for its robust framework that simplifies blockchain development. With modular components and a consensus algorithm that ensures security and scalability, Cosmos SDK provides an efficient and flexible environment for developers. The Inter-Blockchain Communication (IBC) protocol facilitates interoperability between blockchains.

Among the products operating at this level are:

Althea L1

Althea is a specialized settlement layer for infrastructure and connectivity, offering high availability and reliability. Upon its launch, Althea L1 will include Tendermint consensus and an EVM execution layer constructed using the Cosmos SDK. Althea L1 autonomously utilizes Cosmos' robust technological base, striving for expansion and broad acceptance without depending on the Cosmos ecosystem.

akash

Akash Network — a decentralized cloud computing platform anchored by a blockchain-based marketplace also utilizes Tendermint for the main technology on which the product operates. The product's main feature is that the user can specify the requirements for his application and the desired price, after which other providers can take this "order" and deploy the application without the need to configure or manage servers. This format allows Akash Network to create a decentralized market and make similar services cheaper than centralized options such as Azure, AWS and Google Cloud.

soarchain

Soarchain is a platform for the mobility sector utilizing blockchain and cellular-V2X technologies to facilitate a decentralized data and identity infrastructure. A Cosmos SDK-based Layer 1 network allows vehicles to share and access data as mobile servers in real-time, incentivized through token rewards.

LIGHTHOUSE

Lighthouse is a long-term file storage protocol utilizing a one-time subscription model for file registry. It integrates IPFS, Filecoin, and EVM-based smart contracts from networks like Ethereum, Polygon, and Fantom. The protocol's infrastructure is built on Cosmos SDK-based nodes, which channel client data to Filecoin for storage.

Big data storage players like The BNB Greenfield blockchain are also based on Tendermint. BNB acts as the staking token, initially validators' staked BNB being locked on the BNB Smart Chain. Greenfield Governance is also derived from the Cosmos and has the same structure.

L1 Storage and Computing native blockchains

In the decentralized infrastructure sector, Filecoin and Arweave emerged as significant players. They utilize blockchain technology to offer secure and reliable decentralized storage solutions, emphasizing user ownership and control of data. They are involved in different storage cases, from on-chain monitored backups to privacy-oriented encryption, all possible thanks to a variety of dApps settings and huge ecosystem development options. Also, some storage networks could provide computation services based on native blockchain infrastructure.

Filecoin

In the dynamic landscape of decentralized infrastructure, Filecoin has emerged as a frontrunner, providing an innovative and cost-effective alternative for temporary and scalable storage needs. Based on time and storage space requests, its multi-tiered payment model challenges traditional centralized storage services, including major players like Amazon Web Services and Google Drive. The main advantages of Filecoin native blockchain are cost-effective temporary storage, scalability, and their Virtual Machine (FVM) presence.

arweave

Arweave takes a distinctive approach in the same realm, focusing on permanent and persistent data storage. Arweave's blockchain model, which involves a one-time fee for eternal data storage, caters to users requiring unalterable, long-term data accessibility. Arweave is a good solution for long-term data storage and permanent web applications.

It also has a diverse range of permanent applications: Hosting various permanent applications, including ArDrive, Koii, Redstone, and Pianity, Arweave showcases its versatility and capacity to support a broad spectrum of decentralized applications.

BNB Greenfield

BNB Greenfield introduces a blockchain dedicated to data storage, interacting with a decentralized network of Storage Providers (SP) that utilises BNB Smart Chain for smart-contracts and user management. Users upload and regulate access to their data, ensuring security with backup support. User metadata is stored on the BNB Greenfield blockchain.

The built-in cross-chain bridge allows easy data transfer from BNB Greenfield to BNB Smart Chain. This data can be utilized in existing dApp ecosystems on BNB Chain and the next generation of dApps on BNB Greenfield. These dApps simplify user interaction within the Greenfield ecosystem and function as Web3 products utilizing available data.

THETA

Theta is a decentralized blockchain-based video streaming network where users share bandwidth and computational resources. Additionally, it is focused on generating media, AI, and entertainment. The Theta Network comprises two complementary subsystems: the Theta Blockchain and the Theta Edge Network. The blockchain provides payment, reward, and smart contract capabilities, while the edge network handles the storage and delivery of media assets like images and videos. Theta leverages available but unused resources to save bandwidth while ensuring continuous high-quality broadcasting. Central to Theta's blockchain operations are two native cryptocurrencies: THETA coin for voting on protocol changes and TFUEL for executing transactions. The THETA token powers the Theta Network Blockchain, allowing users to share their bandwidth as a reward.

The release of Theta Metachain 4.0.0 enabled horizontal scaling of the Theta blockchain network without requiring permissions. This scalability aims to achieve unlimited transaction throughput and block completion time in a fraction of a second. The Metachain consists of one "main chain" and an unlimited number of "sub-chains." Theta provides its own SDK for developers to launch sub-chains and connect them to the main chain, allowing for independent transaction processing and real scalability of Metachain's computational power.

Moreover, Theta is an EVM-compatible solution, and as of February 2022, Enterprise Validator Nodes on Theta, which are operated by major entities such as Google, Blockchain Ventures, Samsung, Sony Europe, Binance, gumi Cryptos, Creative Artists Agency, Theta Labs, and others, are enabling the network to process 1,000 transactions per second with virtually zero carbon footprint.

Layers 2 in DePIN

Layer 2 solutions are created to address existing issues and enhance the primary L1 networks. They are in high demand separately in DeFi, NFT, GameFi, and other segments where transaction speed and cost efficiency are crucial, and DePIN is no exception.

In DePIN products, although Layer 2 solutions may not be in high demand due to not being directly tailored to the specific characteristics of this segment, various of them are periodically utilized. For instance, Arbitrum has been integrated as the primary infrastructure by WeatherXM and Livepeer, while 4EVERLAND has incorporated many different Layer 1 and Layer 2 solutions, including Arbitrum.

Braintrust also plans to migrate 35k wallets to BASE (a Layer 2 solution by Coinbase) in Q1'24, making it the first DePIN to launch on Base.

Some products also integrate Optimism, such as Crust Network and FOAM. This is done to enhance the capabilities of individual products or networks, simplify further development, integrate existing solutions, and attract audiences to new products within existing ecosystems. It can be observed that Layer 2 plays a crucial role in the DePIN sector, though not necessarily a primary one.

Despite potential challenges related to networks not being fully prepared for working with DePIN, solutions are being found to make it a reality. Both the blockchains themselves and skilled product teams contribute to this, finding ways to implement it effectively, conveniently, and securely. Therefore, specific blockchains focusing on DePIN are a priority for developers, although they do not prohibit using any other network that allows the launch of independent products. That is why separate blockchains have been created, taking into account all the specifics of DePIN, and they are considered among the best solutions for launching a product in this niche.

DePIN focused blockchains

IoTeX

IoTeX is a DePIN-specific blockchain that currently boasts over $1 billion in on-chain assets, more than 400,000 users, and over 45,000 devices across hundreds of dApps. As a one-stop modular infrastructure for DePINs, IoTeX offers a comprehensive suite of building blocks and tools, ranging from hardware abstraction layer, off-chain computing layer, all the way to its Layer-1 blockchain layer serving as the trusted anchor for identity, governance, dApps, etc., to simplify deployment of DePIN projects significantly. IoTeX's Layer-1 blockchain is a high-performance one with a speed of 1000 TPS with a 5-second blocktime and instant finality, making it amongst the top EVM-compatible chains, with an emphasis on security and decentralization. The great performance of the IoTeX blockchain makes it an ideal Layer-1 option for accommodating scalability requirements of DePIN projects. IoTeX's identity layer (a.k.a, ioID), which leverages blockchain wallet addresses (either Externally-Owned Account (EOA) or Account Abstraction (AA) wallet) as on-chain identities and DIDs as off-chain identities, represents a unified identity system designed for handling on-chain and off-chain digital relationships among participants

(i.e., people and machines) in DePIN applications smoothly without relying on centralized identity providers.

IoTeX's hardware abstraction layer (a.k.a, ioConnect) is a universal embedded SDK that abstracts away complexity for various hardware platforms when connecting to decentralized networks and various L1/L2s. It works seamlessly on mainstream hardware platforms such as Raspberry Pi, ESP32, Arduino, STM32, etc., simplifying the complexity of connecting DePIN devices to Web3.

IoTeX's off-chain computing layer (a.k.a, W3bstream) is a decentralized multi-prover network, which allows DePIN builders to harness the power of modern verifiable computation techniques such as zero-knowledge proofs (ZKPs), trusted execution environments (TEEs), and secure multi-party computations (SMPCs) to ensure integrity of off-chain computing on data collected from DePIN devices. The off-chain computing layer is an essential component to address the scalability and verification challenges in DePINs. Besides building the key modules in a DePIN tech stack, IoTeX also offers various tools such as an DePINscan, DePIN Liquidity Hub, AA native wallet, cross-chain bridge, and ecosystem programs such as the Halo Grants and DePIN Accelerator which are meant to provide builders and investors with DePIN-specific go-to-market solutions. The IoTeX ecosystem is constantly evolving, and it is currently the second largest after Ethereum, within the DePIN sector. Some of the most notable projects, across various verticals, include DropWireless, Wayru, Ator, PowerPod, Inferix, Network3 and enviroBLOQ, to name just a few.

peaq

Peaq Network is a multi-chain Layer 1 blockchain based on Substrate and optimized for DePIN, designed to support more than 10,000 transactions per second with minimal transaction costs. It utilizes environmentally friendly blockchain architecture and integrates with major developer ecosystems like Ethereum and Polkadot.

Peaq supports EVM & ink! Smart Contracts and Pallets, providing a versatile platform for developers. It offers a range of backend functionalities essential for DePINs and dApps, including machine ID management, role-based access control, and machine data storage. This infrastructure facilitates seamless machine payment processing and enables the creation of Machine NFTs, autonomous AI agents, and data indexing. Peaq's SDK in JavaScript allows easy machine and device identity assignments within the network.

Peaq has integrated Wormhole, enhancing its ecosystem with cross-chain liquidity from over 30 Web3 networks. This enables real-world applications like solar panels and drone deliveries on peaq to access global Web3 liquidity, facilitating Machine DeFi growth. The integration, operational on peaq's Agung testnet, paves the way for its 2024 mainnet launch.

In 2023, Peaq launched 'Peaq verify,' a pioneering three-tier framework for robust and decentralized data verification. The system employs direct device verification, pattern matching, and oracle-backed validation to ensure the authenticity and integrity of data across various sources, supporting a secure and trustworthy ecosystem for machine-generated data.

In December, Bosch announced a collaboration with Peaq and Fetch.ai, introducing the XDK110 Rapid Prototyping Kit. This sensor kit, capable of measuring various environmental factors like temperature and humidity, integrates with Peaq's DePIN projects to supply network data. It leverages Fetch.ai's AI to optimize network selection, enhancing user rewards. Additionally, Bosch and Peaq are developing a peer-to-peer parking system allowing vehicles to autonomously interact with charging stations via an IoT network. This involvement of established companies in DePIN highlights the sector's potential for significant growth in 2024.

DEPIN ECOSYSTEM MAP

03


Physical Resource
BYOD
Specific Device
Sensor
Environmental
Fry Foundation
WiHi
WeatherFlow
Element
AquaSave
WeatherXM
Planet Watch
Kanda Weather
Energy
PowerLedger
Daylight Energy
M3tering
Starpower
Arkreen
Supply Chain
Axis
OriginTrail
Location
Onocoy
Geodnet
Foam
Mapping
Hivemapper
MapMetrics
NATIX
Smart City
Silencio
SmartPoint
Spexigon
Getdor
3DOS
Mobility
DIMO
2blox
Bistroo
Nride
Drife
Soarchain
Teleport
Smart Home
EnviroBLOQ
PiPhi
Aydo
Personal Wellness
Mindland
HealthBlocks
Wireless
LoRaWAN
CHIRP
Helium IOT
FOAM
Crankk
Althea L1
Drop Wireless
WiFi
WayRu
MetaBlox
Andrena L1
WiFi Map
Wifi Dabba
WiCrypt
Bluetooth
Nodle
5G
Althea L1
REALLY
Karrier One
Helium 5G
World Mobile
XNET
Drop Wireless
Blockchain
Cosmos
Arbitrum
Optimism
Ethereum
BNB Chain
IoTeX L1
CELO
Solana
Conflux
Eclipse
Polkadot
Peaq
Polygon
DePIN Module
Infra
W3bstream
Streamr
Storage
Filecoin
GlacierDB
IRYS
Wallet
IoPay
Phantom
Metamask
Helium
Web3Auth
Identity
World ID
IoTeX IoID
Peaq ID
DIMO Device ID
Cross Chain
Layer Zero
IoTube
Data Tools
DePINscan
DePIN Ninja
DePIN Hub
Hardware
Sensecap
JDI Global
Mycelium
Rak Wireless
HeliumDeploy
AutoPi
Payment
Solsplit
Sphere
C14
Digital Resource
Compute
General Purpose
Akash
FX Land
IExec
Network3
Inferix
Render
Autonolas
Streamr
Golem
CUDOS
Dynex
Acurast
Bacalhau
Koii
Fluence
Phala
Aphone
Iagon
Flux
TrueBit
DeepBrain
Nuco Cloud
StackOS
Holochain
Coinda
Web3Mine
Transcoding
Theta
Livepeer
DePIN Specific
W3bstream
Indexer
TheGraph
Chainstack
Covalent
Security
DATS
RPC
Pocket
Ankr
Bandwidth
CDN
Saturn
Meson
Media
Fleek
NKN
Grass
CESS
Search
Presearch
Verasity
ATOR
Brave
VPN
Sentinel
Incognito
Deeper
ICE NET
Masq
Mysterium
Orchid
Web Proxy
WYND
Artificial Intelligence
Bittensor
Gensyn
Together
Giza
Exabits
ChainML
Network3
Modulus Labs
AIOZ
Render
Akash
Aethir
GPUtopia
PAAL AI
Fetch AI
GPU.Net
Io.Net
Hypercycle
Glacier VectorDB
Nosana
Delysium
OORT
Grass
Storage
Database
Space And Time
Polybase
Octa
Shadow
Constellation
Ceramic
Kwill
Databroker
Jackal
TableLand
Lit
Aleph
Ocean
Holo
File Storage
Storj
Filecoin
Arweave
ScPrime
GenesysGo
4EverLand
DATAMALL
OORT
Threefold
Storx
Crust
Swarm
Zus
Sia
CESS
Filebase
BNB Greenfield

DEPIN ECOSYSTEM PROJECTS

04

STORAGE

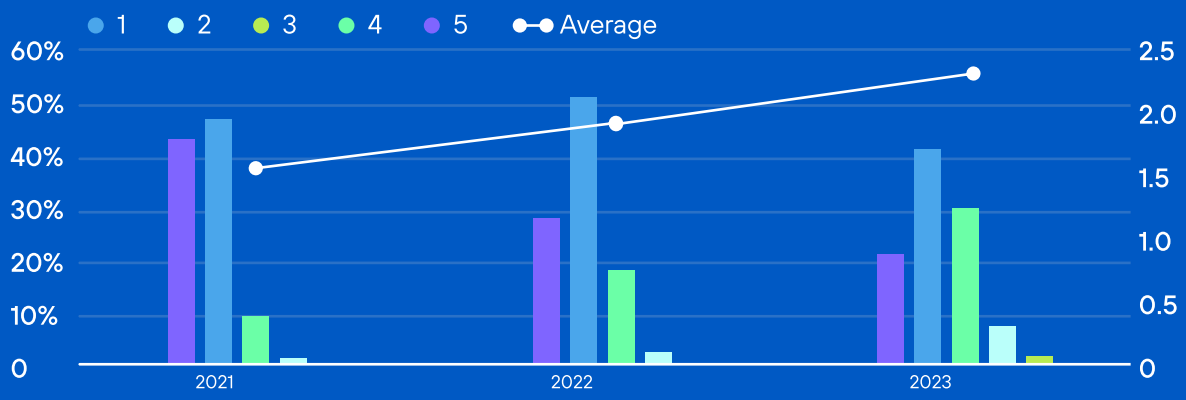
Data Storage trends

By 2025, cloud computing will host about 100 zettabytes of data, highlighting the rapid increase in global data production. In the same period, it's expected that over 200,000 terabytes of new data will be generated, with a substantial portion stored in the cloud. Concurrently, the number of IoT devices is projected to exceed 75 billion, encompassing a wide range of connected technologies in both commercial and consumer sectors.

In 2023, over 60% of corporate data had transitioned to cloud storage, a notable rise from the 30% recorded in 2015. This upward trend demonstrates the sustained momentum in cloud adoption, even after doubling in just seven years. The ongoing growth underscores the increasing reliance of businesses on cloud technologies for data management and storage solutions.

The trend towards adopting multi-cloud and hybrid cloud strategies by 79% companies showed a significant uptick. A remarkable 95% of businesses identified multi-cloud as a key strategic focus, underscoring the importance of information security. Despite the complexities and challenges associated with multi-cloud systems, an overwhelming 97% of IT leaders expressed plans to further expand their cloud infrastructure.

How many cloud providers does your company need?



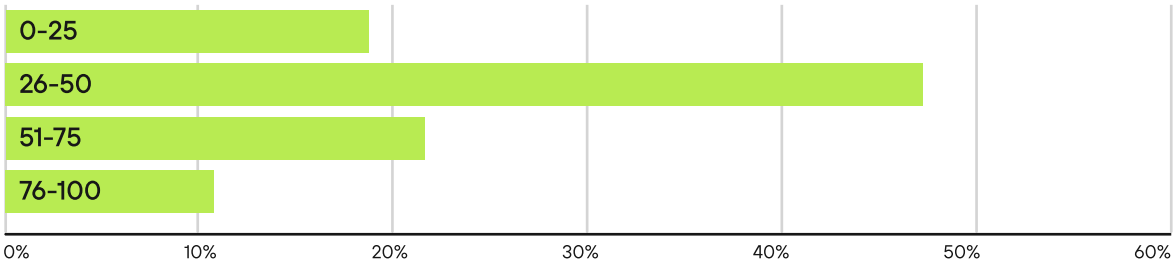
35%
Growth in the number of cloud providers reported over the last two years

Privacy issues

75% of organizations store more than 40% of their sensitive data in the cloud, such as finance and accounting records. Despite this, only 22% of businesses encrypt at least half of sensitive data they store in the cloud, and only 54% feel confident that they have the necessary tools or skills for effective execution.

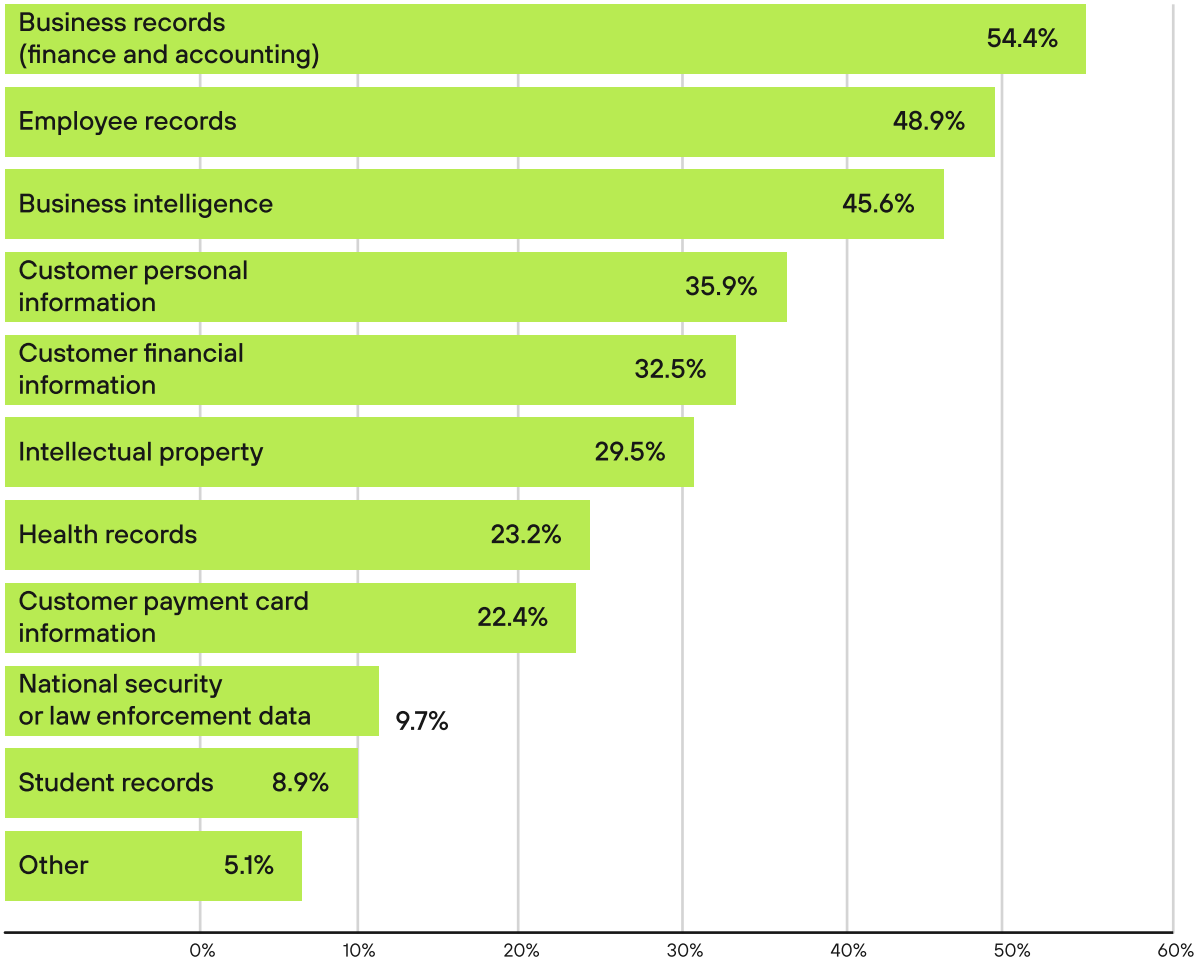
Significant amounts of sensitive data are unencrypted

What percentage of your organization's sensitive data in the cloud is encrypted?



45%
Average

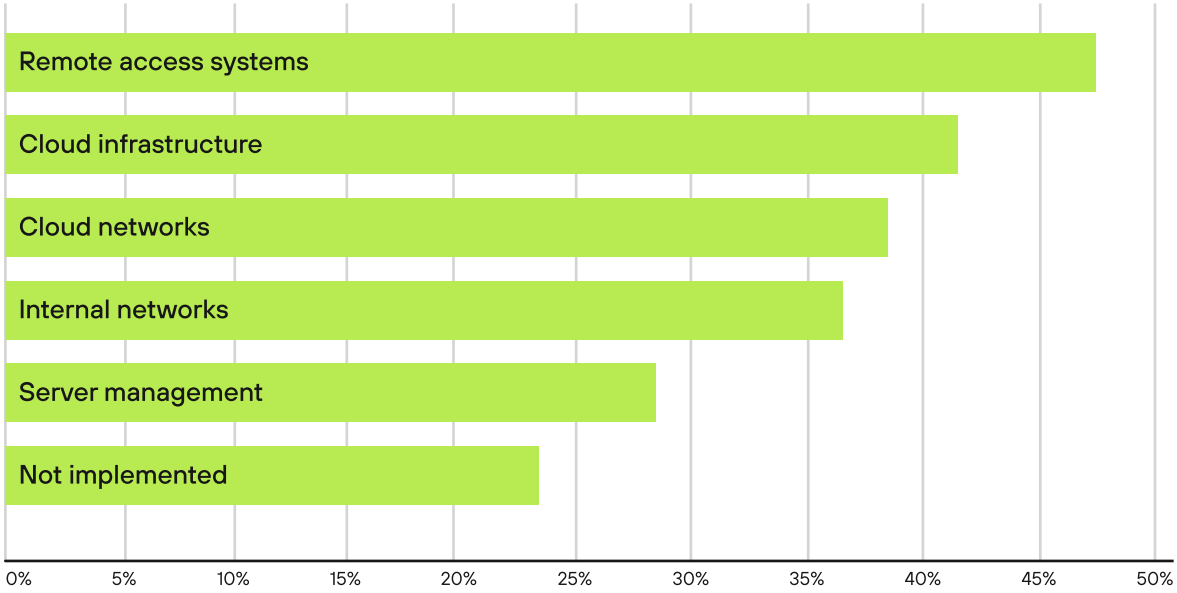
Sensitive Data in the Public Cloud



Identity and access management is a key defense against data breaches, yet it's insufficient for complete data security. Enhancing operational architectures and adopting Zero Trust models, especially in cloud environments, are crucial for stronger security. However, only 41% of organizations have implemented Zero Trust in cloud infrastructure, and fewer still in cloud networks, indicating a need for more comprehensive adoption of these security measures.

Zero trust use is improving, but more needed

How does your organization use zero trust practices?



These findings reflect the escalating concerns regarding the security and management of sensitive data in cloud environments. The complexities associated with multicloud adoption and the management of privacy and data protection regulations in the cloud have become more pronounced, necessitating robust security and privacy measures.

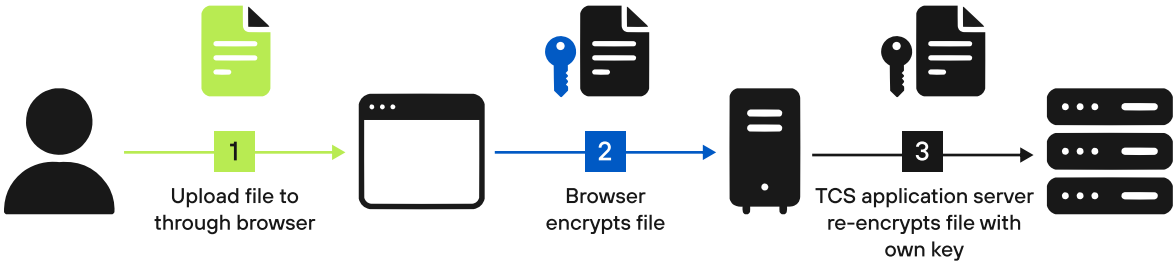
dePIN as Solution

> THE CONCEPT OF DEPIN INVOLVES USING BLOCKCHAIN TO MANAGE AND SECURE PHYSICAL INFRASTRUCTURE IN A DECENTRALIZED MANNER, WHICH IS A KEY ASPECT OF ZERO TRUST MODELS.

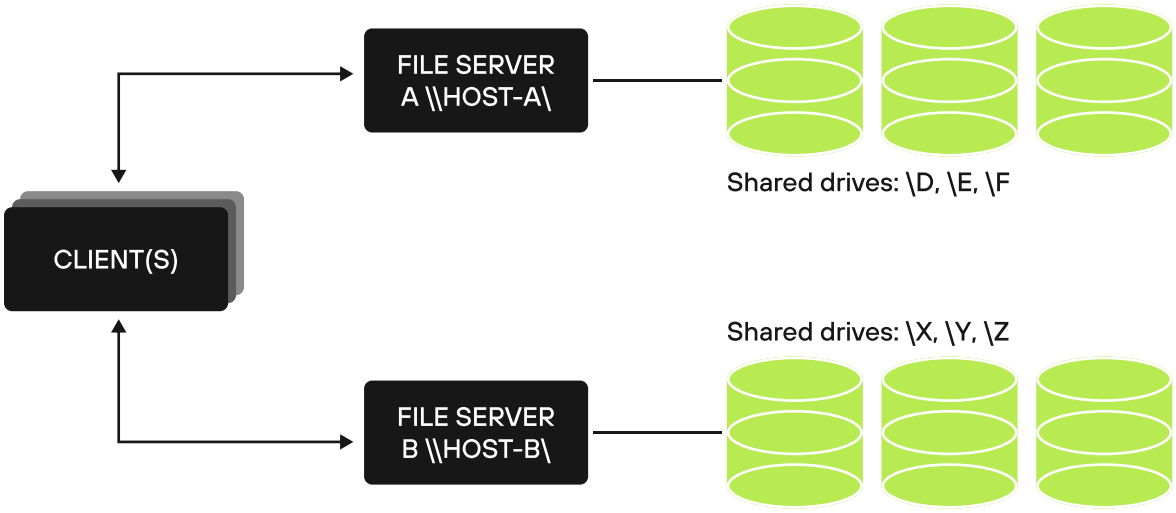
Therefore, in the context of cloud data storage, DePIN storages can be considered as conforming to the requirements of Zero Trust controls on cloud infrastructure. They are designed to offer a more secure alternative to traditional cloud storage methods by decentralizing the control and management of data and employing rigorous access controls and verification processes inherent to blockchain technology.

Finally, encryption and distributed storage, coupled with replication and guaranteed retention, create an all-in-one solution that can protect companies from multi-million dollar losses due to the risks of hacking and file access interruptions.

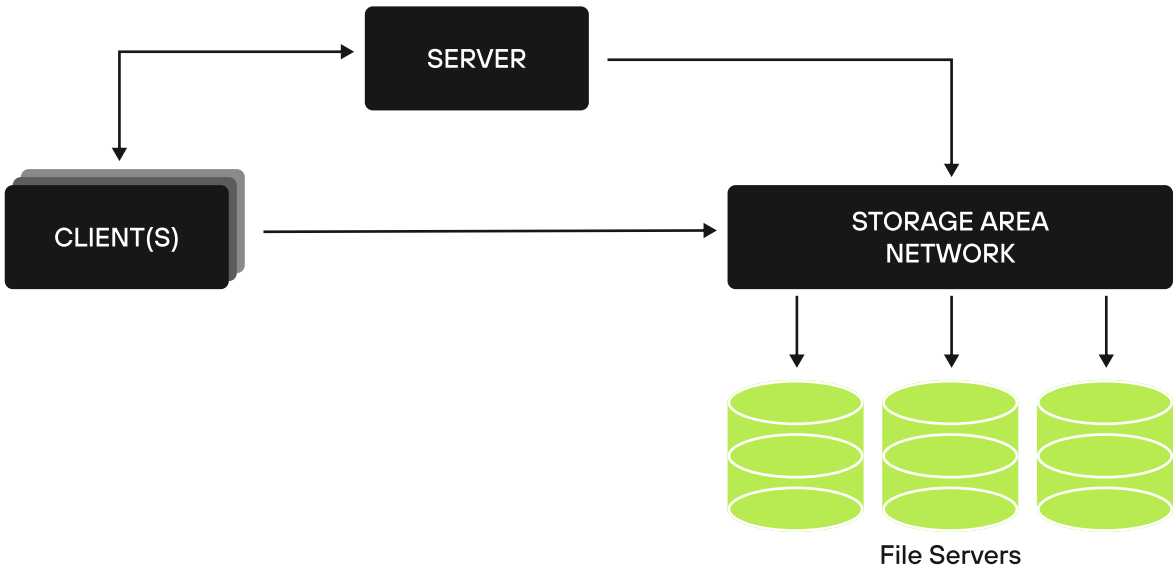
Traditional cloud storage encryption sequence



Traditional file system



Distributed file system adapted for file storage



DePIN storage is increasingly appealing to Web2 retail users and businesses by improving user experience, offering reliable storage, and being cost-effective over time. They hold significant potential across sectors like AI/ML, healthcare, finance, government, academia, research, and e-commerce. In the Web3 realm, the decentralized storage market is expected to grow, driven by blockchain advancements and complex storage needs. Opportunities include improving data integration through Oracle nodes, tackling blockchain state bloat, and providing scalable storage solutions for cross-chain and zero-knowledge protocols.

STORAGE

	FILECOIN	ARWEAVE	STORJ	SIA	BNB GREENFIELD
INFRA LAYER	Native L1 (Proof of Spacetime)	Native L1 (Proof of Accees)	Ethereum (Proof of Stake)	Native L1 (Proof of Work)	Native L1 (Proof of Stake) and BSC for management (Proof of Staked Authority)
STORAGE TYPE	Cold	Hot, Cold, Permanent	Hot	Hot	Hot, Cold
PROOF-OF-STORAGE	Proof of Replication	Succinct Proofs of Random Access (SPoRA)	Merkle Proof	Merkle Proof	Proof of Challenge
PRIVACY MECHANISMS	Encrypted by Option	Encrypted by Option	Encrypted by Default	Encrypted by Default	Encrypted by Option
DURABILITY MECHANISMS	Replication by Choice	Replication by Default	Erasure Coding by Default	Erasure Coding by Default	Erasure Coding by Default
BILLING MODEL	Staking size depends on the storage contract (P2P) conditions: the amount of data, storage time, and setting of the replication and encryption.	A one-time token payment for permanent storage allows users to pay a single fee to ensure their data is replicated and stored indefinitely. Also, the data could have additional encryption.	Subscription-based regular token payments. The amount is set by Storj.	Staking size depends on the storage contract (P2P) conditions: amount of data and storage time.	Staking size depends on the storage contract (P2P) conditions: amount of data, storage time, and setting of the encryption.
ACTIVE STORAGE NODES	3130	70	24,500	505	10
STORAGE CAPACITY	8.4 EiB	N/A	31 PiB	4,51 PiB	N/A
DATA ONBOARDED	2.0 EiB	152 TiB	29,2 PiB	1,45 PiB	217 GiB
FUNDRAISING	$205,92M	$20,91M	$35,36M	N/A	N/A

STORAGE

	ZUS	OORT	4EVERLAND	CESS	GLACIERDB
INFRA LAYER	Native L1 (Proof of Work) Multi-cloud storage	Native L1 (Proof of Stake) Multi-cloud storage	Arweave (PoA) and Native Cluster Service with IPFS nodes Multi-cloud storage	Substrate framework of Polkadot (Nominated Proof of Stake) Multi-cloud storage	Native L2 ZK-Rollup (Proof of Stake) Multi-cloud storage
STORAGE TYPE	Hot, Cold	Hot, Cold	Hot, Cold, Permanent	Hot, Cold	Hot, Cold, Permanent
PROOF-OF-STORAGE	Merkle Proof	Proof-of-Honesty	IPFS — PoSC based on TEE Arweave — SPoRA	Proof of Data Reduplication and Recovery	Merkle Proof
PRIVACY MECHANISMS	Encrypted by Option	Encrypted by Option	Encrypted by Option	Encrypted by Option	Encrypted by Option
DURABILITY MECHANISMS	Replication by Choice	Replication by Choice	Replication by Choice	Replication by Choice	Replication by Choice
BILLING MODEL	Token payment depends on the storage contract (P2P) conditions: the amount of data, storage time, and setting of the replication and encryption.	Token payment depends on subscription plan conditions: the amount of data, storage time, access control, additional tools, replication settings, and encryption.	Token payment size depends on usage needs: amount of data, storage time, bandwidth, and RPC settings.	Token payment depends on subscription plan conditions: the amount of data, storage time, access control, additional tools, replication settings, and encryption.	Token payment depends on subscription plan conditions: the amount of data, storage time, access control, additional tools, replication settings, and encryption.
ACTIVE STORAGE NODES	99	30,870	N/A	6475	N/A
STORAGE CAPACITY	10,3 PB	N/A	N/A	22 PiB	N/A
DATA ONBOARDED	435 TiB	N/A	21 TiB	6,92 PiB	N/A
FUNDRAISING	$39,00M	$16,20M	$3,50M	$8,00M	2,90M

Filecoin

01

Key Concepts

Filecoin is a decentralized storage network that transforms cloud storage into a system based on algorithms. It operates as a peer-to-peer network designed for file storage, incorporating economic incentives in FIL tokens and zk-SNARK proofs to guarantee the reliable and long-term storage of files. It combines IPFS's content-addressed data with blockchain storage guarantees.

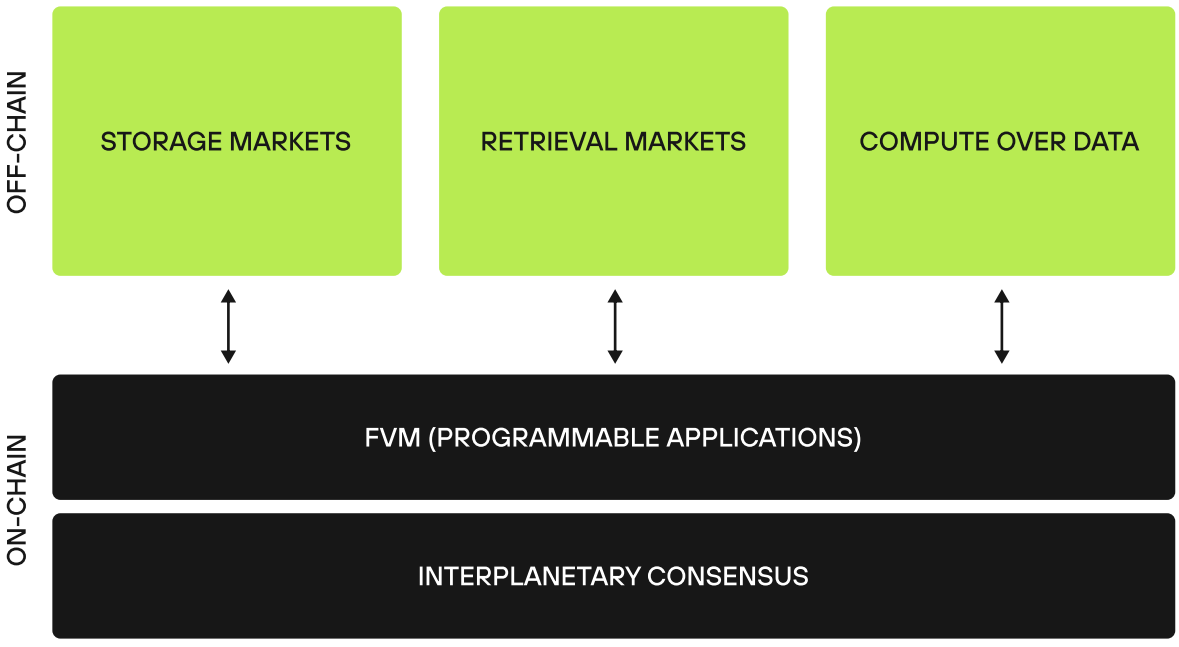
Last year, Filecoin also worked hard to expand its functionality on a computing concept called Compute over Data (CoD), which expands the potential market for the most famous decentralized storage provider. But in this section, we'll focus on the data storage components.

INFRASTRUCTURE LAYER: NATIVE BLOCKCHAIN

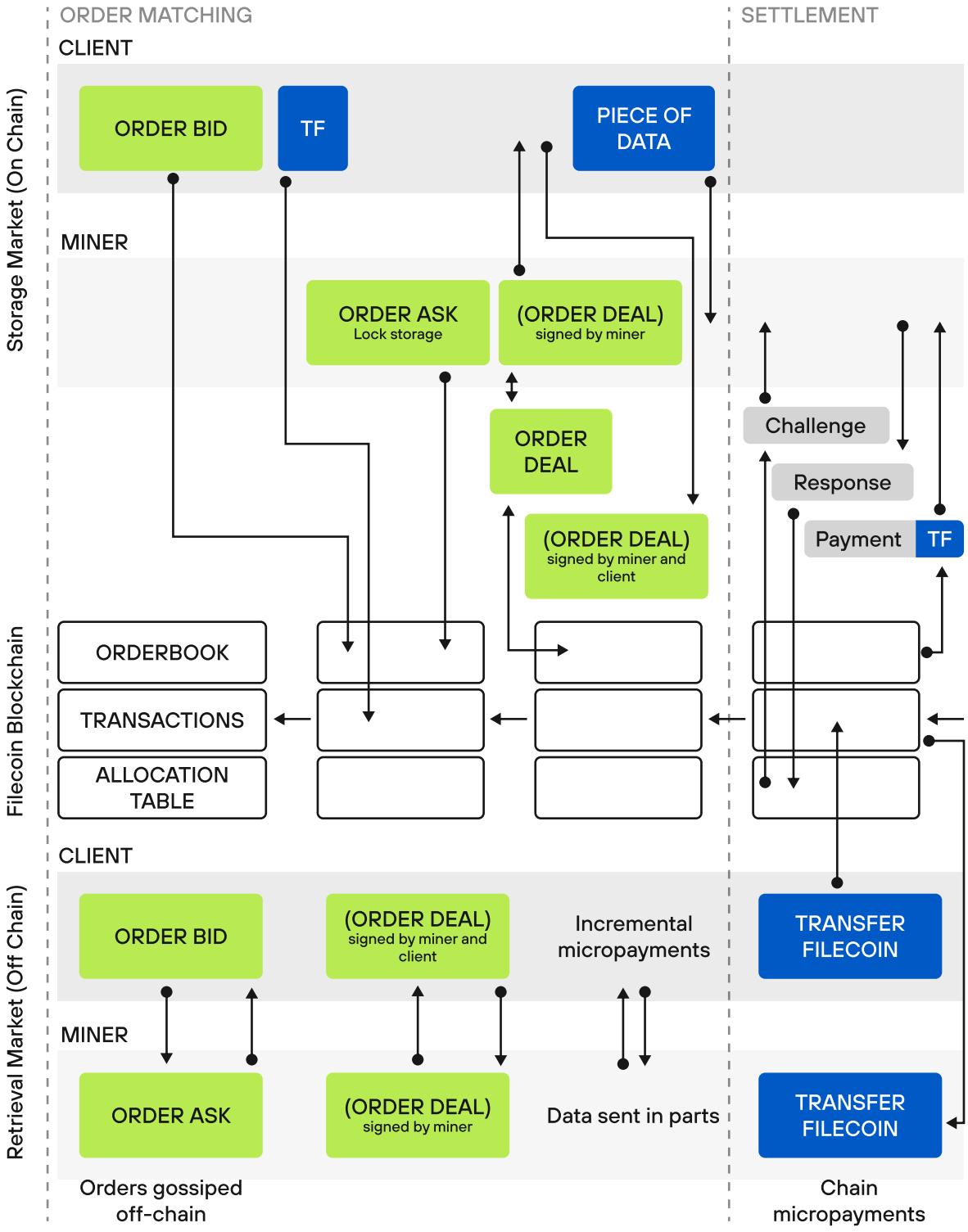
The main roles and components of the network are presented as abstractions that can be utilized depending on the user's needs. In the distributed storage paradigm, the basic unit is "Pieces", pieces of data in a special format that users upload to the decentralized Filecoin cloud by entering into Deals with Storage Providers.

> **THE STORAGE AND THE RETRIEVAL MARKETS**
>
> The Storage Market writes data, and the Retrieval Market reads it for distribution to retrieval clients. The Data Transfer Protocol handles Piece transfer during Deals, abstracting the data transport medium in Filecoin.

Filecoin High-level Architecture



Filecoin data storage sequence



FILECOIN MARKETS HAVE TWO TYPES OF DEALS:

Storage deals (on-chain and protocol-enforced) and retrieval deals (off-chain with micropayment channels). Deals must be posted on-chain with signatures and sufficient locked-up balances to be valid. The retrieval market involves off-chain negotiation between data providers and clients to serve stored data. Trust is built incrementally through payment channels for a retrieval deal.

Before being stored on the network, a "Piece" undergoes Sealing, a computationally intensive process that serves several purposes, including data replication, proof generation, and ensuring data integrity. After sealing, the data is placed in local fixed-size data units called "Sectors" (32GB or 64GB) by storage miners.

Sector's quality and utility are determined by factors such as the presence of real or verified data, reliability of storage, and compliance with network protocols, impacting its contribution to the miner's overall power and potential rewards within the Filecoin ecosystem.

Each Sector has a lifecycle that starts with the Sealing process, followed by a period during which it stores data under a Deal, and ends with either the deal's expiration or Sector renewal. If the data is no longer needed or the deal period ends, the Sector can be 'renewed' to store new data or 'released' if the miner no longer wishes to allocate that storage space to the Filecoin network.

> **THERE ARE TWO TYPES OF MINERS:**
>
> Storage and Block Miners. Block miners can also be Storage Miners, but not all Storage Miners are Block Miners. Leader Election is based on storage power. Storage Miners provide storage to clients in the Storage Market and get FIL for Deals. Block Miners mine blocks, secure the network, and could be Storage Miners.

Storage Miners on Filecoin earn rewards in FIL for securely storing data in Sectors and consistently proving they have a copy of the data. Conversely, they can face penalties like slashing for failing to provide reliable storage. All this is possible, thanks to Proof of Storage.

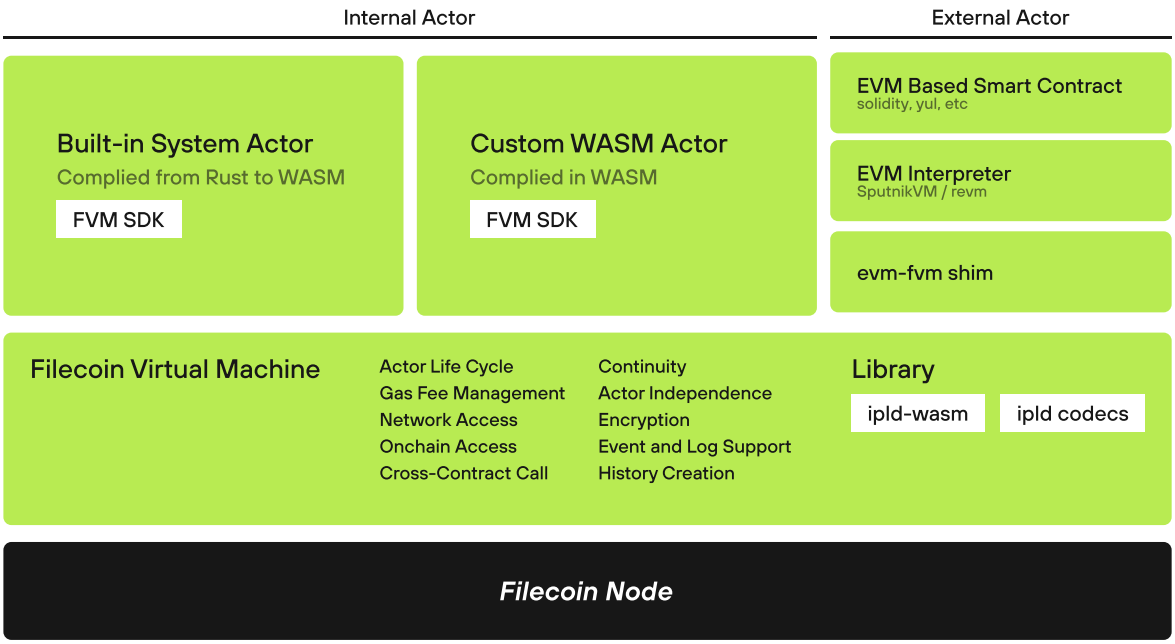
The Storage Mining System in Filecoin handles client data storage and proof generation for verifying miner behavior. Once a Sector is sealed, the storage miner must continually prove they reliably store the data they've committed to store. This is done through cryptographic proofs, such as Proof-of-Replication (PoRep) and Proof-of-Spacetime (PoSt).

The Storage Power Consensus (SPC) subsystem is crucial for Filecoin's state agreement. It manages storage miners' effective power in the Power Table and runs Expected Consensus, the underlying consensus algorithm. Block Miners can perform leader elections and create new blocks to update the system. The system sets a minimum miner size for consensus security.

> **FILECOIN VIRTUAL MACHINE (FVM):**
>
> Is a WASM-based multilingual executable VN for IPLD data (distributed system data) that includes support for Ethereum contracts. The FVM primarily allows the expansion of the number of business models that can be implemented on the Filecoin network. Concepts can range from new storage monetization and data management models to AMM, Lending/Borrowing protocols, and LST infrastructure for the FIL token.

> **ON-CHAIN AND OFF-CHAIN COMPONENTS:**
>
> Deals, proofs, and rewards are on-chain. Data is off-chain but generates verifiable CIDs and proofs for smart contracts on various networks like Ethereum, Polygon, and more, simplifying integration.

Filecoin FVM Architecture



Product updates

The year marked the debut of the Filecoin Virtual Machine (FVM), enabling smart contracts and user programmability. In 2024, we observed ecosystem growth and new business models, like data providers and DeFi protocols, probably some data and computing markets.

Last "Watermelon" network upgrade for Filecoin, allowed Storage Providers to extend Sector pledges up to 3.5 years, within a 5-year lifespan. This upgrade also let users make deals for the same duration and introduced synthetic proofs-of-replication, reducing disk usage and costs while increasing sealing efficiency.

The "Lightning" and "Thunder" upgrades also bolstered network security with new windowPoSt proofs that generate challenges independently of Sector order.

The Lotus client was significantly improved with features like SplitStore for discarding old chain data, reducing disk space and maintenance. Filecoin also added inspection tools, enhanced syncing, and other updates for SP.

Furthermore, the network upgrades enhanced efficiency by optimizing gas consumption for deal Sector onboarding, which cut down on execution costs and validation time.

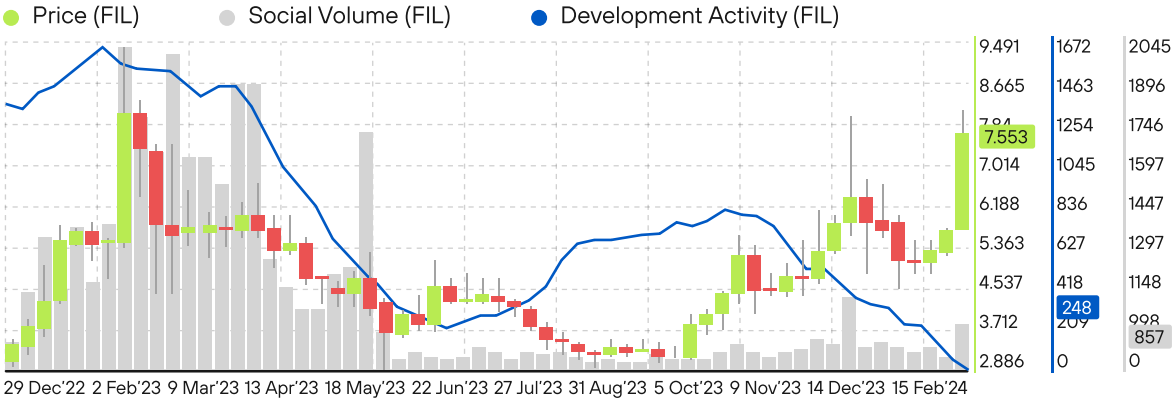
The Golden Gate Upgrade by the Decentralized Storage Alliance (DSA) for Filecoin introduces significant cost reductions in decentralized storage. This upgrade, involving advanced software and reference configurations, optimizes data onboarding, leading to a decrease in sealing server costs by up to 90% and an overall reduction in storage costs by up to 40%. This enhancement is set to improve performance and operational efficiency for Storage Providers.

In 2023, Filecoin also established itself as an L1 Compute Networks platform, notably with projects like Boost. Currently, the community is still actively working on a computing concept named Compute over Data (CoD).

In 2024 we're waiting for Filecoin's Inter Planetary Consensus (IPC) mainnet that offering features like recursively scalable subnets, compute workloads, and customizable runtimes. The IPC team targets a Mycelium Mainnet launch in late Q1.

Metrics

Filecoin (FIL) Santiment



Phase 3 of Filecoin's Master Plan began in Q1 2023 with the FVM launch. This period witnessed notable social and developer engagement. Now, the Filecoin DeFi ecosystem has 6,000 stakers and 800 Storage Providers actively involved in borrowing activities.

Filecoin Network Stats

2.8K
Unique contracts deployed on FVM

8.4 EiB
Raw byte capacity

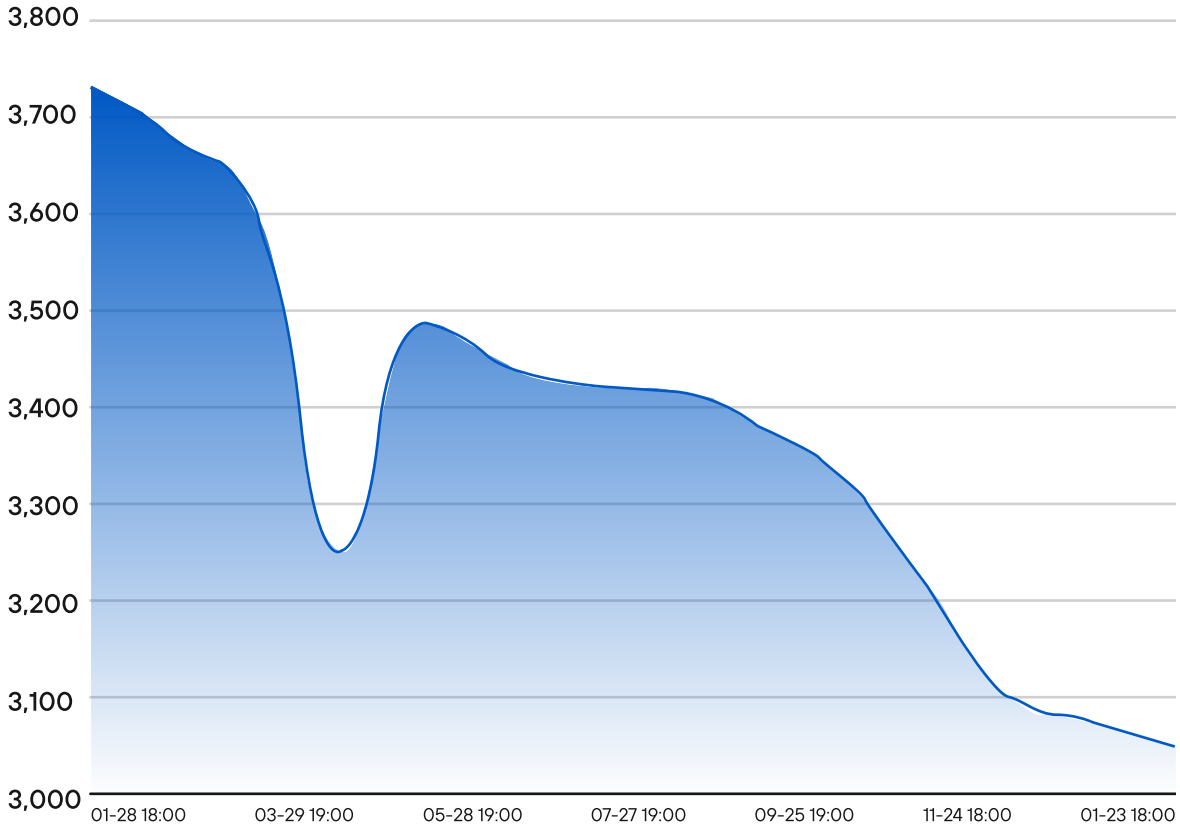
3,130
Storage Provider systems

8,695+
Developers & Founders

550+
Pre-seed projects & beyond

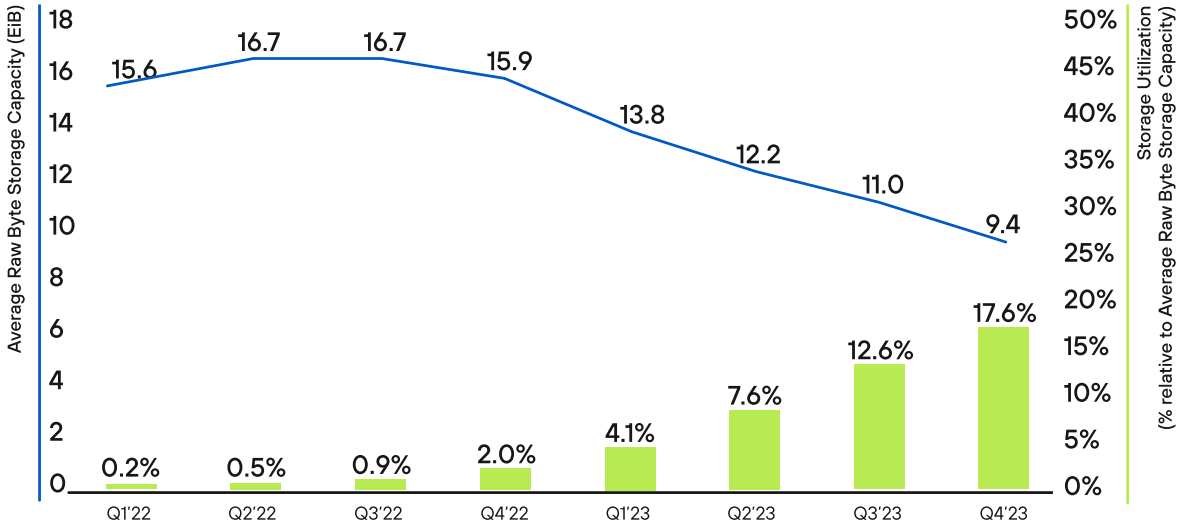
2.0 EiB
Data onboarded

Active Storage Providers

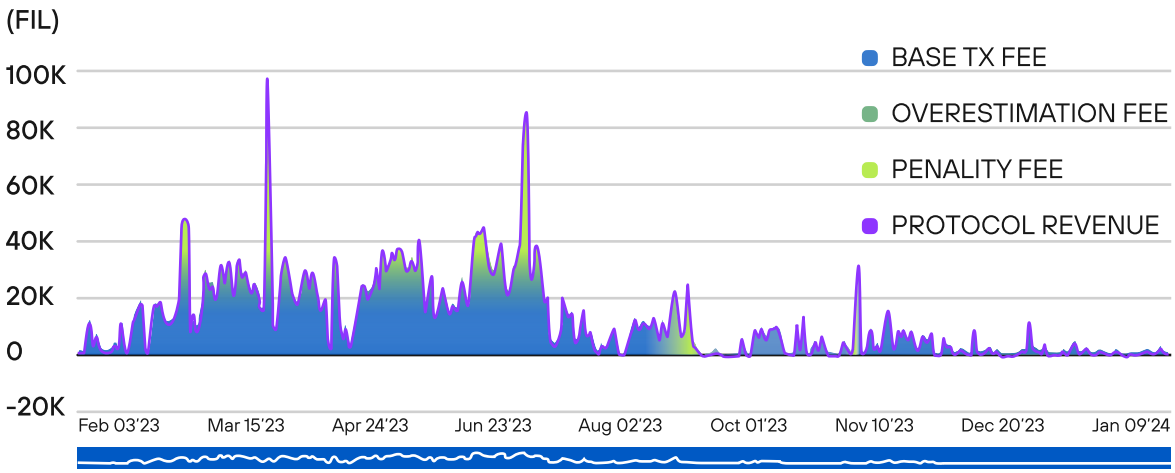


> In 2023, Filecoin reached 2 million terabytes of client data, quadrupling its capacity and expanding its user base. However, over the year, there was a decline in the number of Active Storage Providers, possibly driven by an overall reduction of FIL reward issuance due to the exponential decay model and the baseline minting model.

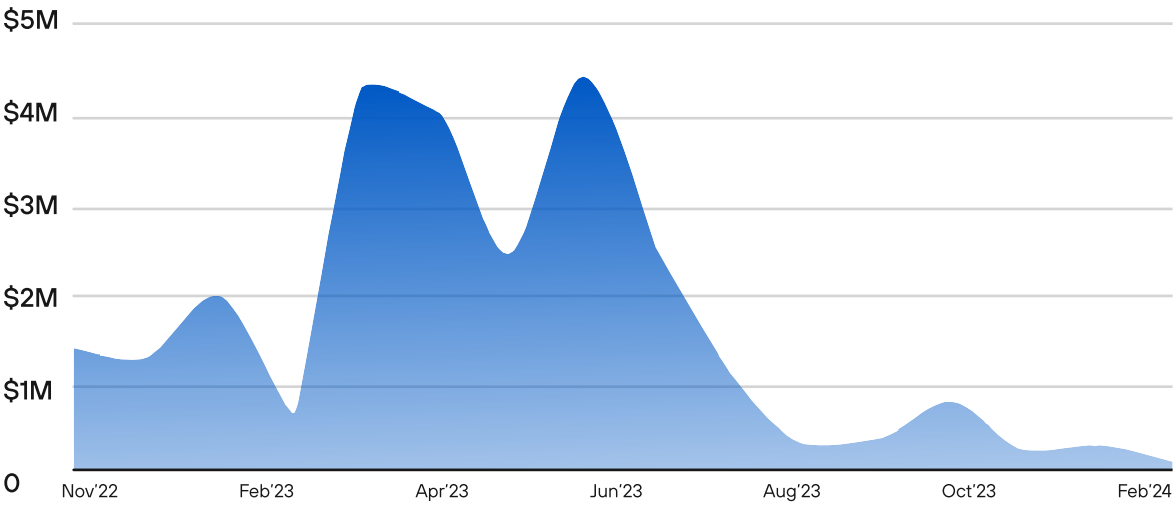
Filecoin utilization reached 17.6% of storage capacity in Q4'23



Protocol Revenue (FIL)



Onchain Revenue (USD)

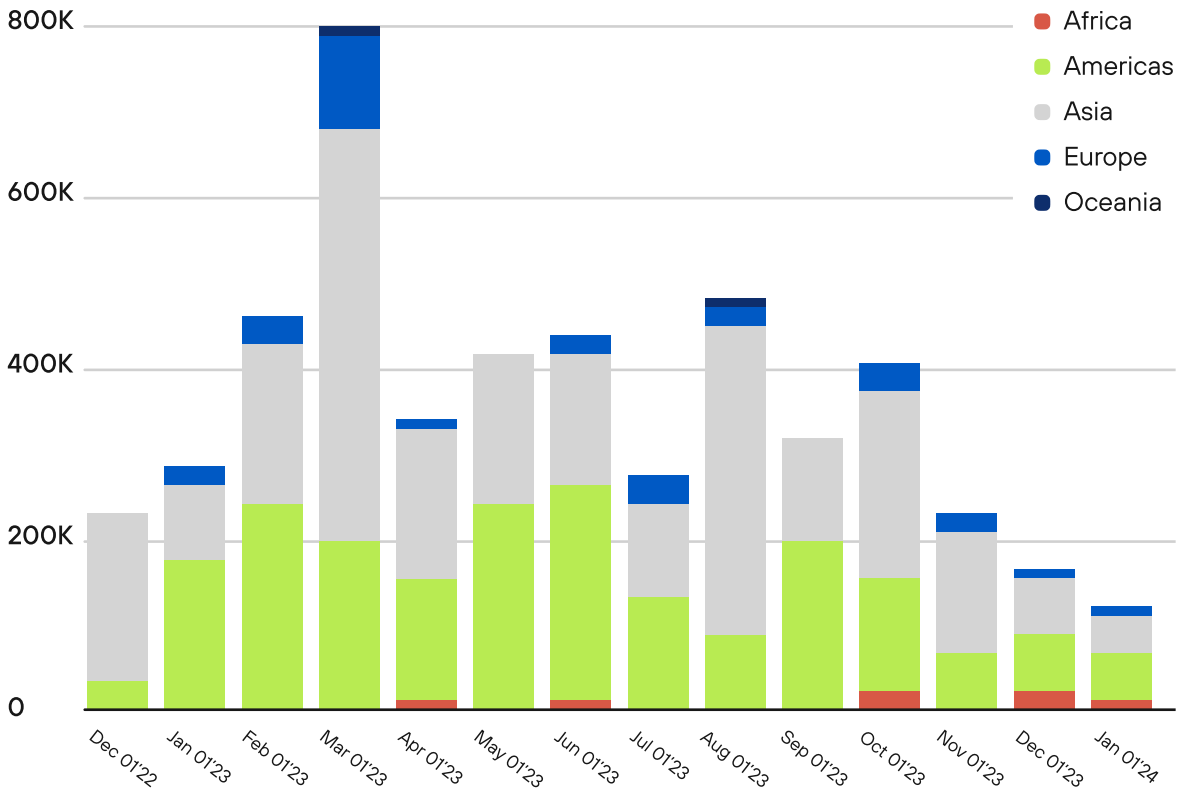


FINANCIAL STATEMENT	DEC 2023 Dec 1 — Dec 31	NOV 2023 Nov 1 — Nov 30	OCT 2023 Oct 1 — Oct 31	SEP 2023 Sep 1 — Sep 30
Income statement				
Fees	$334.62k -32.1%	$493.04k -10.8%	$552.56k +22.3%	$451.69k -56.2%
Revenue	$315.05k -34.6%	$481.73k -12.6%	$550.93k +25.9%	$437.46k -57.1%
Token incentives	$23.39m +13.3%	$20.64m +21.1%	$17.05m +2.6%	$16.61m -21.7%
Earnings	$-23.07m -14.4%	$-20.16m -22.2%	$-16.49m -2.0%	$-16.17m +19.9%

> Storage utilization on Filecoin experienced substantial growth in 2023, but revenue declined by 55-60%. This decline was primarily due to an 80% reduction in FIL fees and reflects a broader decrease in the market sector. Now, Filecoin Foundation is actively engaged in efforts to reduce data onboarding costs to improve the stat.

Ecosystem

Intended Verified Data Onboarding by Region



Filecoin primarily offers cold storage solutions with competitive pricing for archival and recovery services. This makes it an attractive choice for Web2 clients from the Americas and Asia regions. Leading industries are: IT Technology, Environment, Healthcare, and Others.

Diverse client base includes notable names like the City of New York, the USC Shoah Foundation, OpenSea and Solana. Notable use cases on Filecoin storing involve safeguarding research data from famous institutes and labs, archiving datasets, storing astronomical research, preserving genomics data and securing digital records.

400+

dApps

82 FVM

dApps

Filecoin Foundation share Grants of $50,000+ with projects that drive new Filecoin usage. Ecosystem consist of 400+ dApps and 82 FVM dApps, mostly from DeFi and Infra.

DeFi: In just 9 months, the Filecoin Network accumulated over 20M FIL tokens deposited across DeFi services. Notable platforms like Glif, stFIL, SFT Protocol, HashKing, FilFi, Filet Finance, MineFi, HashMix, mFIL DAO, and CollectifDAO have gained substantial traction.

CDN: In 2023, Filecoin unveiled projects like Boost, Lassie, and Station, all geared towards simplifying data retrieval and enhancing data retrievability within the Filecoin ecosystem. Also, this year was active for CDN Filecoin Saturn that now has more than 3000 nodes.

Computing: Bacalhau, incubated within Protocol Labs, addresses limitations in decentralized computing by co-locating storage and computation in decentralized infrastructures. It also incorporates advancements in GPUs, distributed job execution and consensus. Bacalhau introduces specialized network stacks for ML, media rendering, industrial edge intelligence, and other domains, enhancing connectivity while prioritizing privacy and user control.

Storage services: Active efforts and Perpetual storage are driven by various projects, including Banyan, Lighthouse, RIBS, Retriev, Seal, and Flamenco. These projects are committed to enhancing the Filecoin ecosystem. And to promote active usage through live deals, various storage services are being offered by NFT.Storage, Web3.Storage, Seal, Banyan, and Steeldome.

Lighthouse is a long-term file storage protocol utilizing a one-time subscription model for file registry. It integrates IPFS, Filecoin, and EVM-based smart contracts from networks like Ethereum, Polygon, and Fantom. The protocol's infrastructure is built on Cosmos SDK-based nodes, which channel client data to Filecoin for storage. Lighthouse enhances data security with BLS encryption and robust access control mechanisms to address concerns about the public accessibility of data on Filecoin and IPFS.

Tools: To support dApp development, FVM successfully integrated prominent 3rd-party tools like oracles (Tellor), DEXes (Uniswap, Sushiswap), cross-chain bridges (Axelar/Squid Router, Celer), subgraph services (TheGraph), and wallet services (Brave, Metamask, Coinbase f410 withdrawal support). Additionally, important tooling additions included 6 FVM block explorers and wrapped tokens (wFIL, celerFIL, axlFIL).

Events and Hackathons: Protocol Labs and the Filecoin Foundation are now part of the Universal Privacy Alliance (UPA), alongside Nym, Oasis, and Aztec. The UPA is dedicated to promoting "privacy by design" in technology and establishing a legal fund to support privacy-centric practices in the industry.

Also, FVM devs team had a strong presence in the developer community, participating in 18 hackathons and will be in ETHDenver, featuring lightning talks, tech demos in February 2024.

Arweave

02

Key Concepts

Arweave is a decentralized blockchain platform that offers permanent data storage and retrieval, ensuring security against unauthorized access. Arweave connects users with spare hard drive space to those needing permanent content storage. Its innovative consensus mechanism, known as "Proof-of-Access," motivates network participants to store and maintain data on the network, rewarding them with AR tokens.

Arweave, which guarantees permanent storage, prices its storage with a time horizon of about 200 years, making its upfront costs higher than its decentralized competitors. But when it comes to long-term storage and the new bandwidth option, the offering remains profitable and has its special benefits.

Currently, Arweave Storage has been implemented by several blockchain partners to store their data, such as Solana, Polygon, Avalanche, Polkadot, Cosmos, NEAR Protocol, and others.

INFRASTRUCTURE LAYER: NATIVE BLOCKCHAIN.

Arweave operates on a unique "pay once, store forever" model, where users make a single upfront payment to store their data permanently. This model unlocks various new applications and use cases, making it an attractive choice for long-term data storage needs. Also, it has interesting monetization cases like Atomic Tokens and Profit-Sharing Tokens.

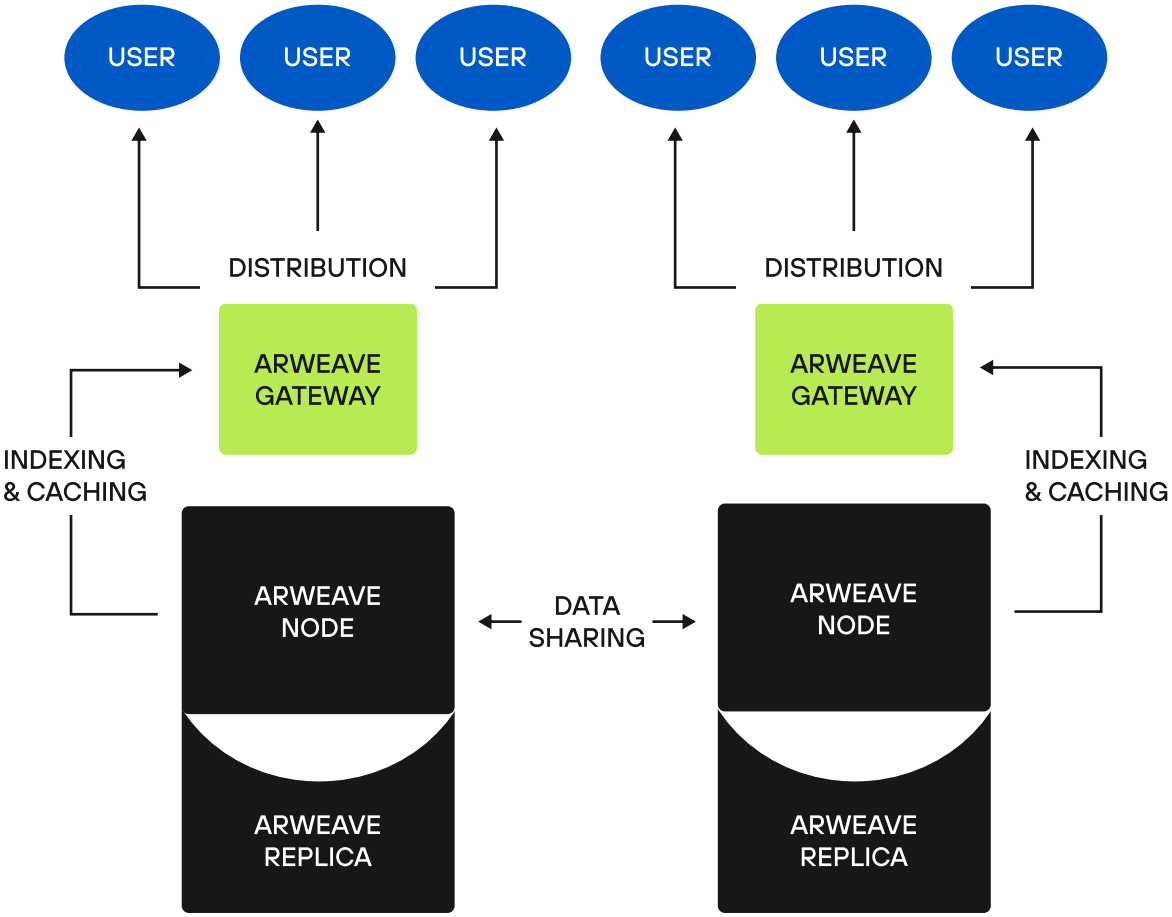
When users pay to store data on the network, 83.33% of their payment is allocated to Storage Endowment. This endowment is invested in a way that yields returns over time. The returns from this investment are used to pay miners for storing the data perpetually. This system is designed to cover the storage costs for many years, potentially indefinitely, ensuring that the data remains accessible and secure for as long as needed. Interestingly, since Arweave's genesis, no tokens have been withdrawn from the endowment.

> ***Atomic Tokens*** are used for transaction fees in Arweave for activities like data upload and smart contract execution. Profit-sharing tokens (PSTs), unique to Arweave, represent ownership in data archives. They are non-fungible, providing distinct properties and ownership rights, and entitle holders to a share of profits from the specific archive.

Blockweave, Arweave's foundational graph layer, is crucial for its infrastructure. In this system, miners engage in the SPoRA (Succinct Proof of Random Access) consensus mechanism. Here, miners validate their participation by producing cryptographic hashes matching randomly selected data blocks. Successful proof enables miners to earn block rewards.

SPoRA is strategically designed to boost the storage of diverse and less replicated data, thereby enhancing data availability and redundancy across Arweave. This approach effectively harmonizes the objectives of data permanence, distribution of mining incentives, and also contributes to the overall security and sustainability of the network.

Arweave Network Architecture



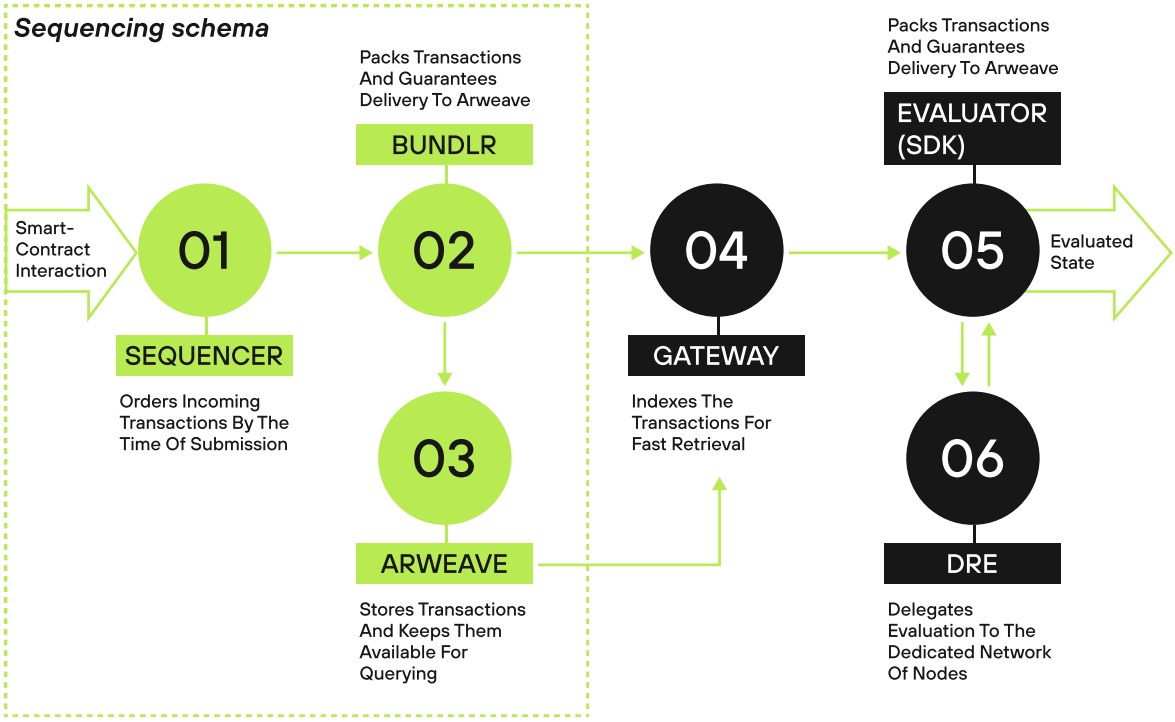
An essential abstraction built on Arweave's infrastructure is Permaweb – a new web network of decentralized protocols ensuring permanent web content storage. As traditional web content faces disappearance risks due to server shutdowns or unsupported applications, Permaweb addresses this by providing permanent content storage.

It uses ARNs (Arweave Resource Names), similar to URLs for locating and accessing data, and ARFs (Arweave Resource Formats) to define data formats. Permaweb ensures that web content remains permanently accessible, safeguarding against the typical risks of digital content loss.

Developers can utilize the toolkits with SQL-like language GraphQL, Gateways, and Servers that deliver content from Arweave to web applications, ensuring data accessibility. Modules like SmartWeave and 3em work like smart contract systems, allowing JavaScript, WebAssembly, or EVM programming languages to streamline the transaction managing process.

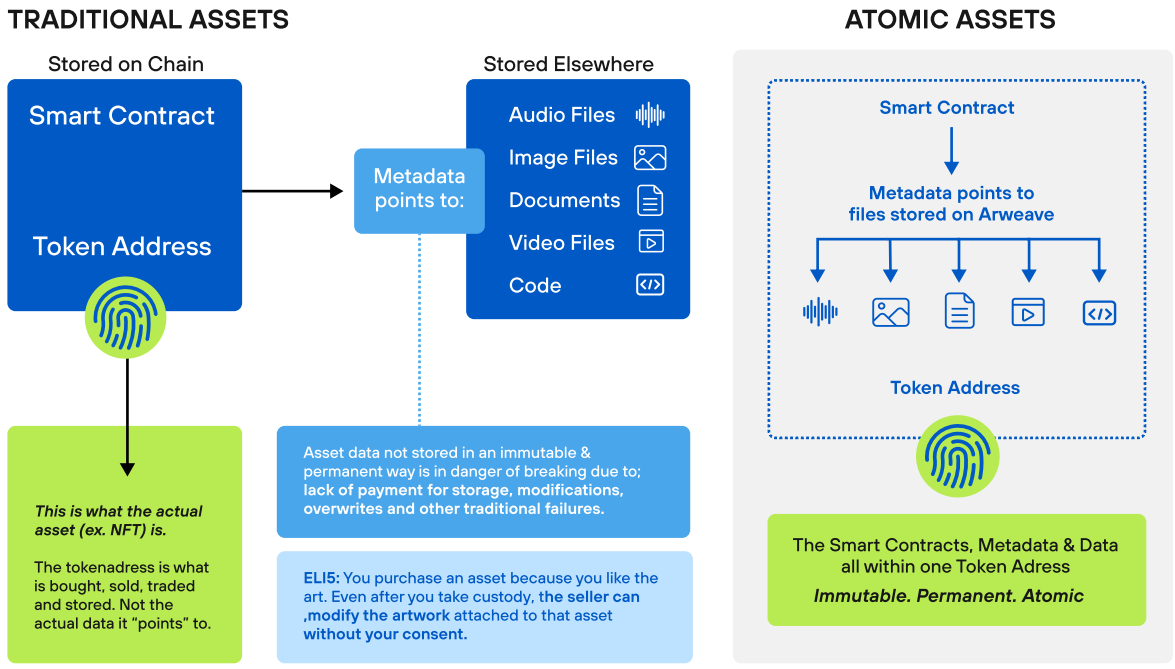
It begins with the Sequencer organizing SmartWeave interactions based on its timestamp and the Arweave network block height, adding security with its unique key. Irys (prev. Bundlr) takes these interactions, ensuring their finality and data reliability. Stored on the Arweave network, the transactions become readily accessible for queries. The platform's efficiency is enhanced by Warp's gateway, which ensures fast and reliable transaction loading while protecting against forks and corruption. Finally, transaction evaluation is flexible, done through Warp's SDK or a Distributed Execution Network (DEN), allowing for efficient and scalable processing. Contracts can be written in AssemblyScript, Rust and Go.

Warp transactions Lifecycle



Atomic Assets on Arweave are a novel integration of data, metadata and smart contracts under a single identifier, enabling modifications in ownership and metadata. They uniquely support fractional ownership, ideal for collaborative digital collectibles like art and music. Additionally, these assets leverage the Universal Data License protocol for customized content usage terms and the Universal Content Marketplace protocol for trustless trading, enhancing digital content tokenization.

Atomic Assets



Product updates

In Q1 2023, Arweave introduced significant updates of the Framework for Evolving Arweave as model for protocol evolution through forking. This framework facilitates permissionless innovation, allowing individuals to propose and implement protocol mutations. Each mutation is accompanied by a reward mechanism, incentivizing contributions. The community's role is to evaluate and adopt beneficial mutations. The framework ensures the preservation of all data and account balances across different iterations of the protocol. Additionally, it brings a structured approach to naming conventions for forks and restricts innovators to leading a single protocol evolution at a time, maintaining the ecosystem's focus and integrity.

Arweave offers a "generally onchain" approach for NFTs, where the token resides on a blockchain like Ethereum, while its art/metadata are stored on Arweave. The Arweave community has further developed Atomic Assets, a concept where the smart contract, metadata, and asset data of an NFT are integrated across different blockchains.

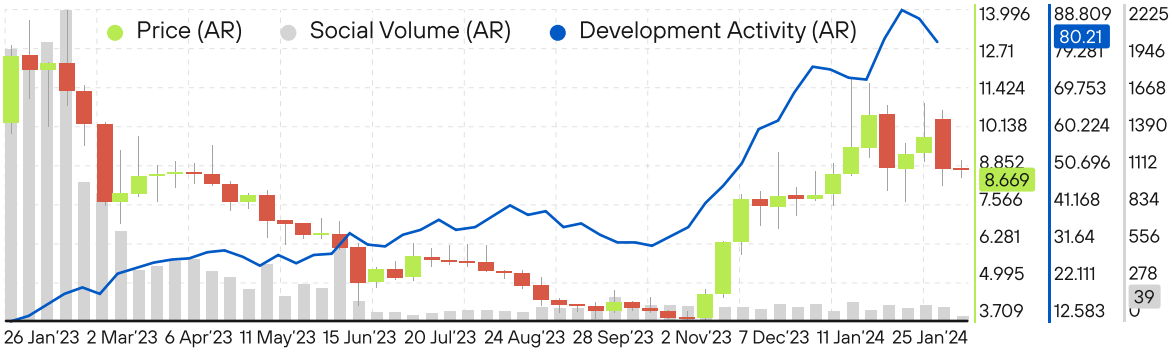
Product code updates included improvements in memory optimization for mining servers, which helps in reclaiming memory and reducing out-of-memory errors and introduced new configuration options. In Q3 2023, Arweave launched the 2.7.1 hard fork, enhancing block confirmation debugging and server selection. Additionally, plans are set to deploy a new price oracle model by Q1 2024.

The company also improved everPay services, a cross-chain token payment protocol built on Arweave's storage-based consensus paradigm, released updates aimed at improving user experience and product exploration. These updates included an upgraded and optimized cross-chain bridge, resolution of issues with VPN connections, and enhancements in the EverID (DID) cross-domain signature technology for better management of digital assets.

Metrics

Despite a noticeable decrease of social media interest metrics since early last year, Arweave is consistently exhibiting an increase in developer engagement and is successfully drawing in and integrating new initiatives within its ecosystem.

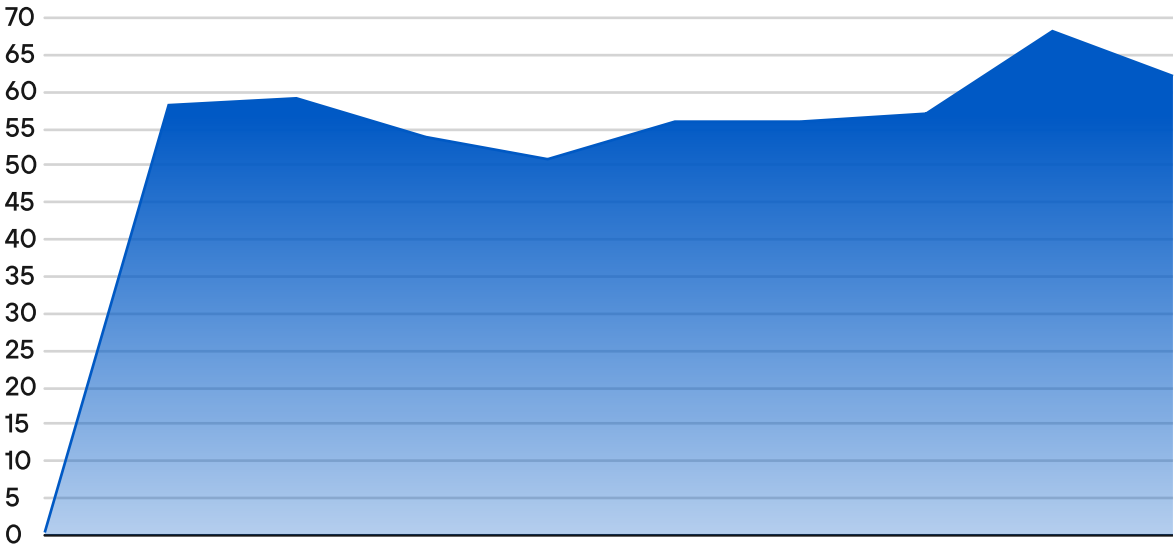
Arweave (AR) Santiment



STORAGE

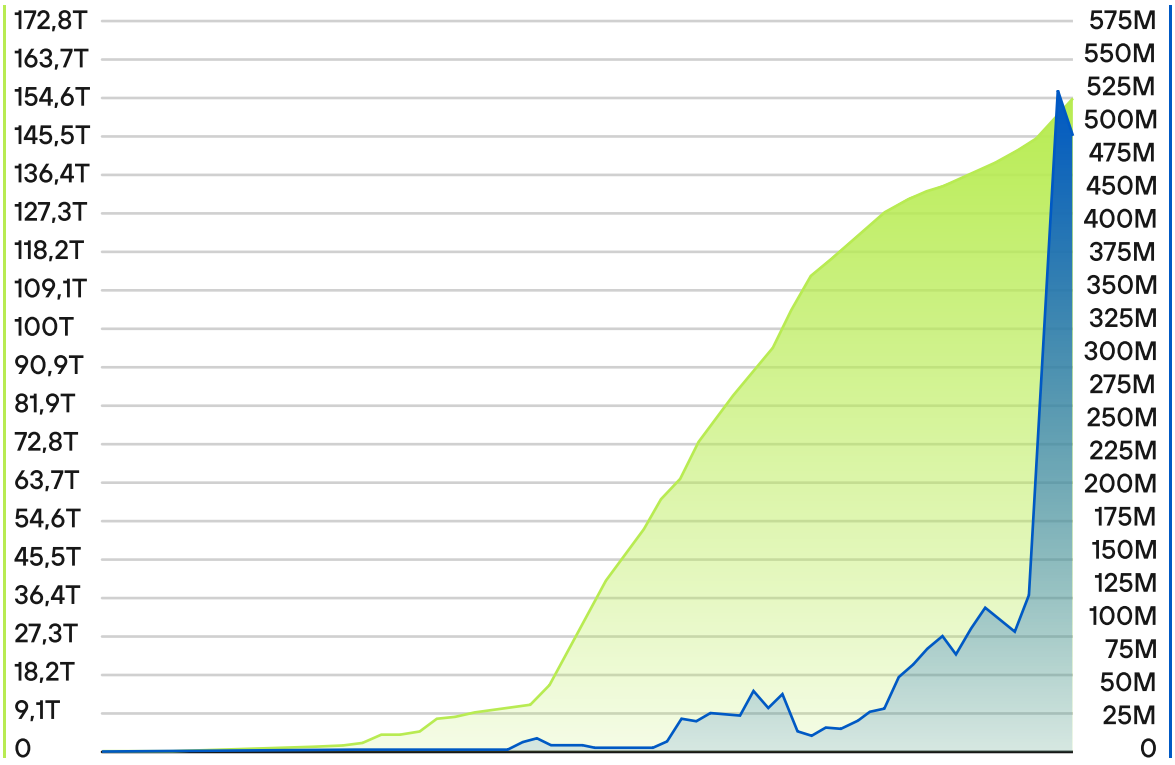
The interaction statistics with storage servers have noticeably increased this year, a positive development. The overall storage capacity, number of transactions, and data uploads in Arweave's network demonstrate significant improvement. The predominant content type throughout the year was images. Overall, 2023 was a productive year for Arweave in terms of product metrics. Unfortunately, specific revenue data is not available.

Node Count



67
Node Count
February 2024

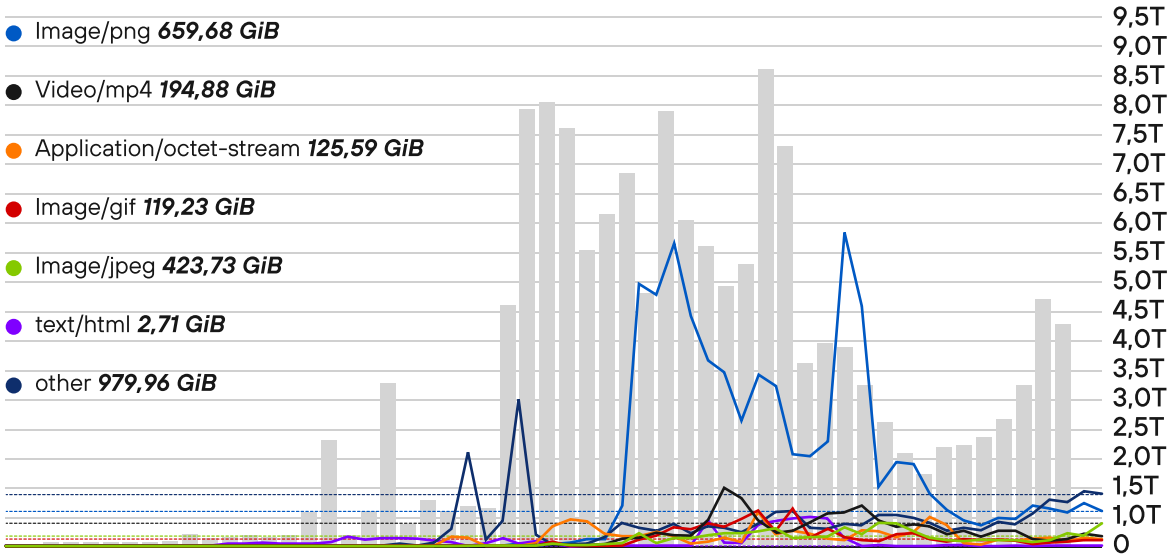
Arveawe Size and Transactions



151,54 TiB
Weave Size in
January 2024

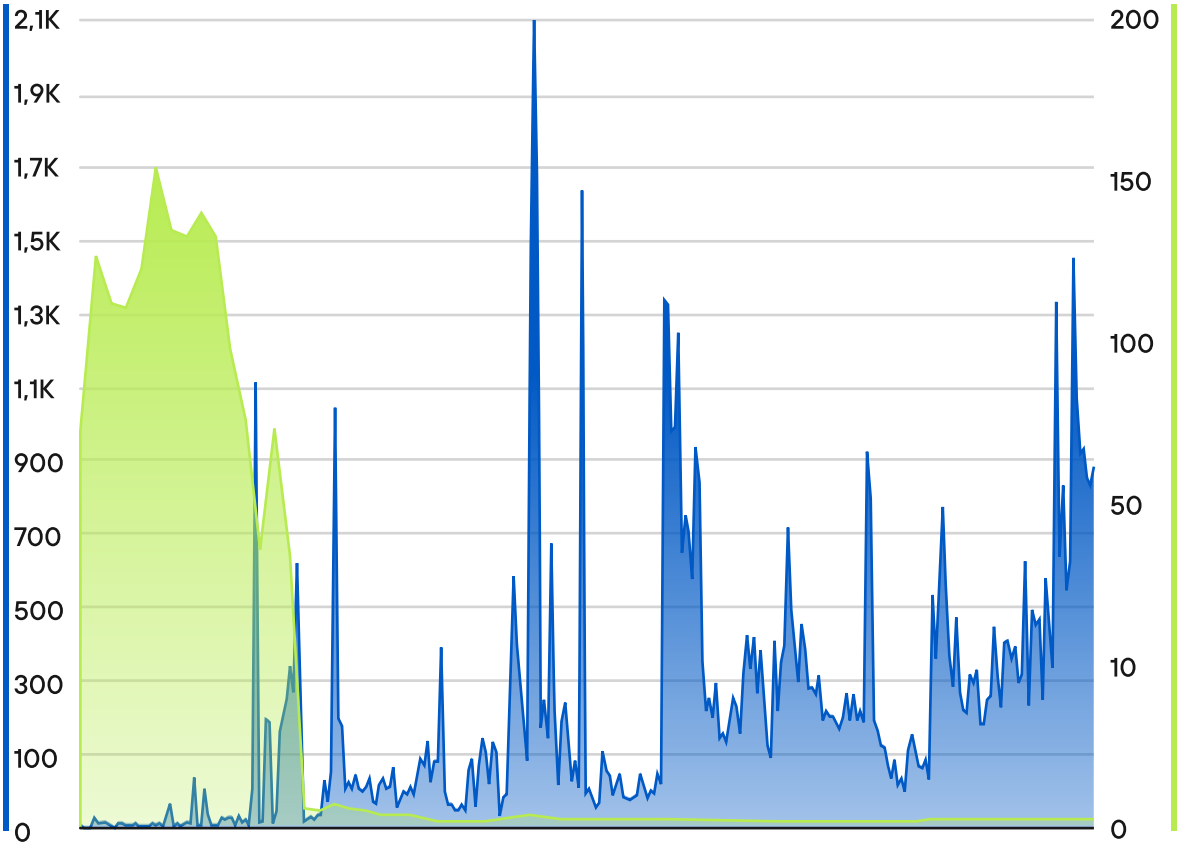
491K
Transactions in
January 2024

Data uploaded & Content type



> As of December 2023, Arweave stored over 152 TiB of data, witnessing a 30% annual growth in its Weave size. The network experienced a significant increase in activity, reaching a record 527 million transactions in a single month, while maintaining stable transaction fees, highlighting its scalability and capability to handle high transaction volumes efficiently.

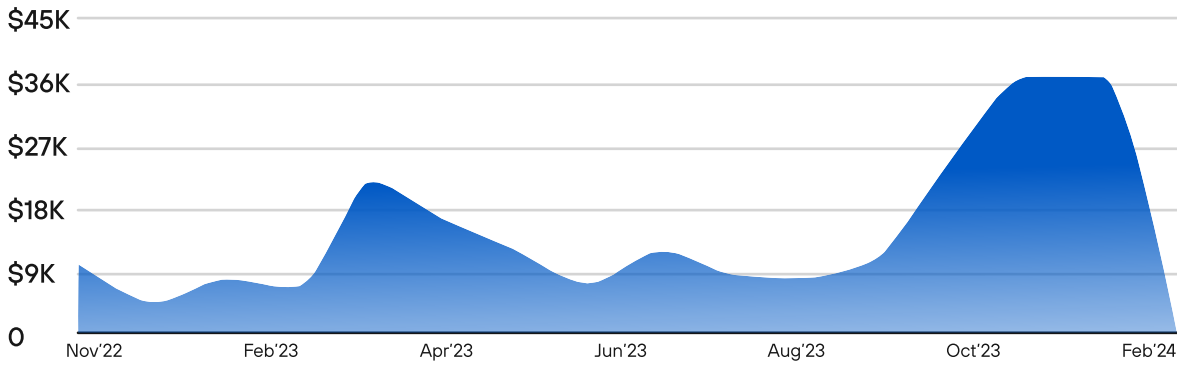
Transaction Fees and Storage costs



0,858 AR/GiB
Storage Cost in February 2024

944.5 AR
Transaction Fees in 2024

Onchain Revenue



Ecosystem

130+

dApps build on Permaweb

~90%

The Irys is responsible for bundling ~90% of all transactions

Arweave's storage layer has been adopted by several prominent companies, including Instagram, Meta, Lens Protocol, Metaplex, Paragraph and Mirror. By Q4 2023, the ecosystem boasted over 130 applications leveraging the Permaweb functionality. This growth included the introduction of over 30 new teams since the end of 2022, highlighting a dynamic expansion of the ecosystem.

The Arweave ecosystem encompasses a wide range of project categories, including news and publishing, social media, education, tooling and infrastructure, storage solutions, DeFi, analytics, NFTs and various ecosystem groups.

One of the most active dApps is the Irys, a significant transaction booster, responsible for bundling ~90% of all transactions. Its operation is analogous to Layer 2 solutions, where it aggregates individual transactions into a single bundle before submitting them to Arweave.

From built-in on-chain tools, SonAR enables use of smart contracts, while Viewblock acts as an Etherscan for Arweave, providing all activity and charts to see the network performance.

> PermaDAO is a community-driven initiative within the Arweave ecosystem. It serves as a collaborative platform where members can propose and work on tasks related to Arweave, fostering the development and growth of the ecosystem.

> Community Labs is a venture studio on Arweave that raised $30 million in Series A funding from Arweave. Community Labs accelerated such developer tools as Astatine, Demand Modulated Markets, Execution Machine and Foreign Call Protocol.

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> Digital History Association is the research department that operates within Core Arweave. Its purpose is to recommend improvements and incubate companies offering the best Arweave ecosystem solutions.

> Forward Research incubates the best builders and founders to create an entirely new class of web services on Arweave that respects users' rights.

> Permanent Ventures — fund focused on investing in decentralized applications which will exist forever and general dePIN infrastructure.

ArDrive is a Web2-like platform for decentralized, reliable, and cheap storage for any data. It's native Permaweb's gateway with its own backed Turbo bundler. With Turbo, ArDrive users can enjoy free uploads for files up to 500KB and can pay in fiat for permanent data storage on Arweave.

Likewise, for diverse storage needs, various solutions are available. Akord is ideal for a Web2 experience, offering private data sharing and Atomic NFTs, and it can be integrated as a module for extended functionality. Permapages is suitable for permanently saving web data, facilitating easy sharing even without technical assistance.

Notable new additions to the Arweave ecosystem in 2023 included projects like Bazar, Permaweb Cookbook, WeaveDB and Weavers. These projects aimed to enhance user experience and broaden the accessible use cases for permanent storage.

KYVE, a decentralized data lake solution, has partnered with Sei to enable efficient data feed and storage solutions. The collaboration involves KYVE nodes fetching data from the Sei blockchain and uploading it onto Arweave for permanent archival.

Fleek, a Content-Delivery Network (CDN) backed by Protocol Labs and Arweave, enhances content delivery with a decentralized node network, offering faster querying and data access than traditional networks. With $30M raised in two funding rounds led by Polychain Capital and Coinbase, Fleek is expanding its functionality, aiming to launch mainnet in Q2-3 2024.

$100k

Arweave Foundation invests
up to $100k in ecosystem projects

The Arweave hackathons offer a significant prize pools exceeding $25,000, distributed across over ten separate bounties. Additionally, there is an opportunity for up to $100,000 in investments for promising projects or teams, potentially attracting further investor interest. Beyond the prize money, the hackathon presents numerous employment opportunities within the ecosystem, with potential salaries and benefits amounting to over $500k.

Storj

Key Concepts

Arweave is a decentralized blockchain platform that offers permanent data storage and retrieval, ensuring security against unauthorized access. Arweave connects users with spare hard drive space to those needing permanent content storage. Its innovative consensus mechanism, known as "Proof-of-Access," motivates network participants to store and maintain data on the network, rewarding them with AR tokens.

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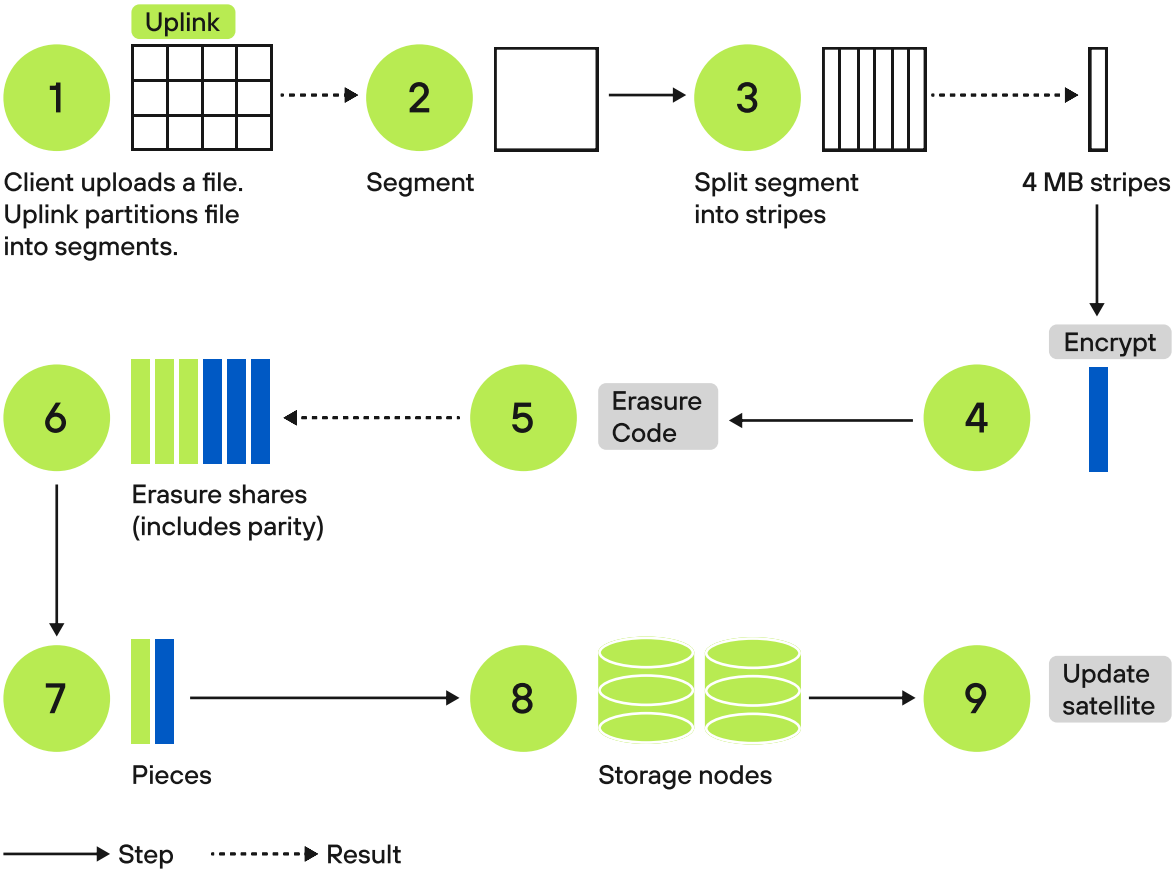
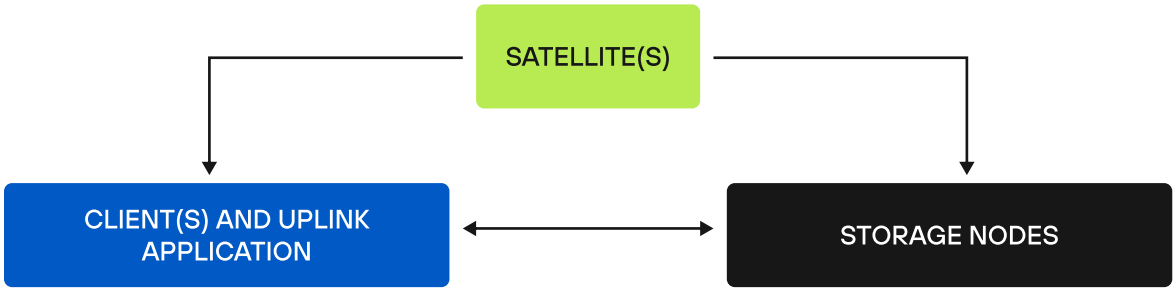
- **INFRASTRUCTURE LAYER: ETHEREUM.**

Storj offers open-source software enabling various users – from individuals with NAS devices or always-on desktop computers to businesses and data centers – to share unused disk space and bandwidth with its network.

Storj data storage sequence



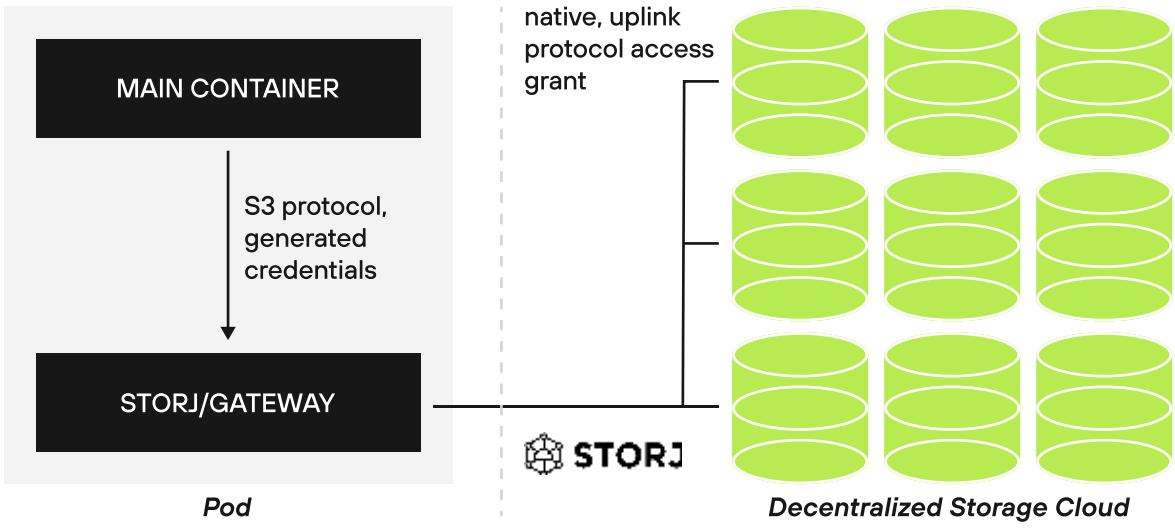
Storj architecture



The Storj network comprises of three main components: Storage Nodes, Uplink Clients and Satellites. Storage Nodes provide data storage and bandwidth, securing client data through encryption and erasure coding. Uplink Clients offer developers encrypted and erasure-coded storage solutions, distributing files across diverse nodes for enhanced security and performance. Satellites handle access and API management, metadata, node reputation, data audits and repairs, alongside billing and payments. Storj Labs operates these satellites under the Storj brand, ensuring a comprehensive and secure decentralized storage service.

The STORJ token plays a crucial role in maintaining the network's security, scalability, and data storage capabilities. It facilitates the leasing of computer power, where providers "farmers" earn rewards, and users "lessees" access storage services. Fixed pricing provides more familiar pricing for node runners and users.

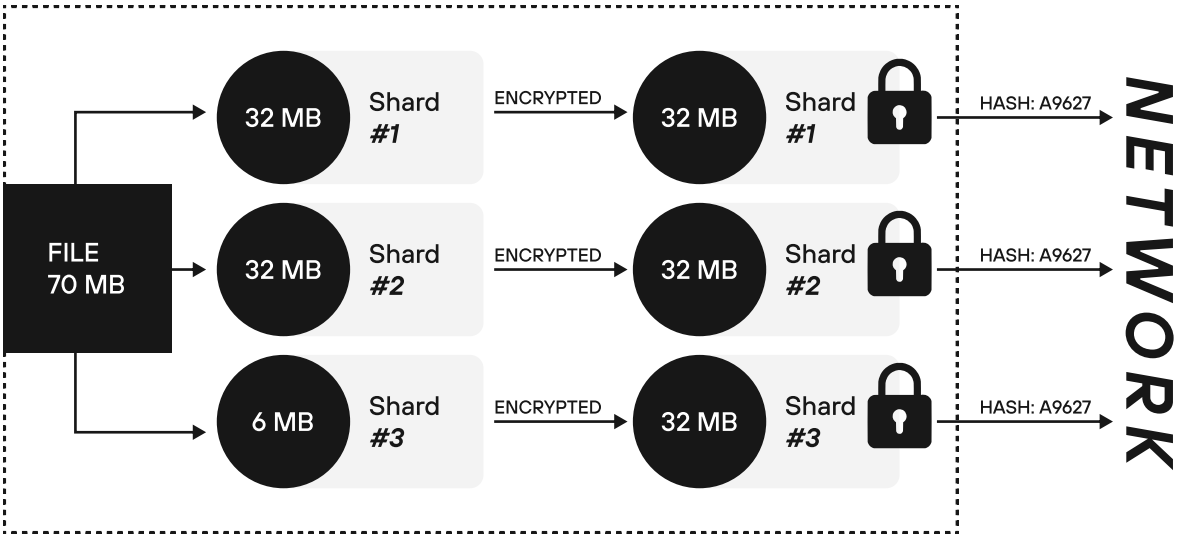
Gateway



> When a file or segment is erasure coded, it's divided into 80 pieces, and any 29 of these can recreate the encrypted file. Each Node Operator only receives one piece, and the metadata doesn't reveal which segment the piece is from or the location of the other pieces. For files larger than 64MB, they are split into 64MB segments, each encrypted with a different key and further divided into 80 pieces. For example, a 1GB file would be broken into 16 segments and 1,280 pieces.

The Storj network employs regular audits and monitoring to ensure data integrity and reliability. Storage nodes are periodically checked to verify that they are storing data correctly and meeting the required service levels.

Data Fragmentation and Encryption



Client Machine

Creating a restricted Access Grant in Storj through the Satellite Admin Console or a Uplink client automatically generates an API and Encryption Key. These keys are created with specific restrictions in place, aligning with the scope of the Access Grant. This feature ensures that access and encryption are appropriately limited according to the defined parameters of the Access Grant.

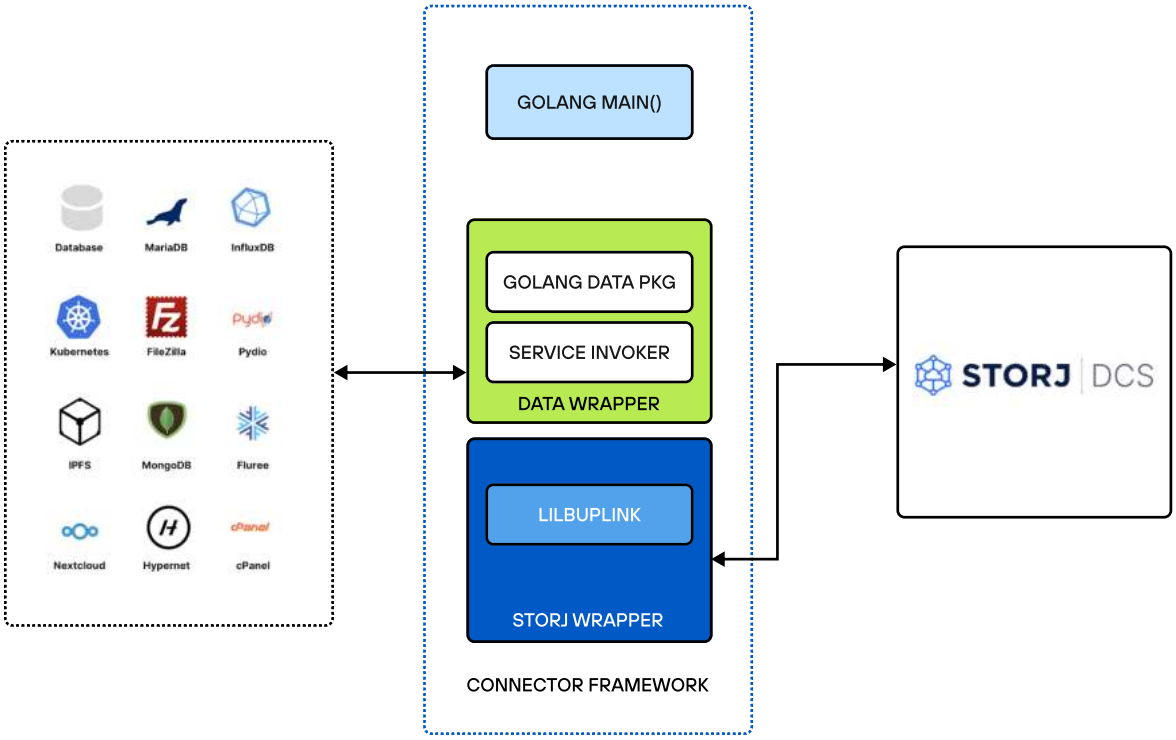
When uploading, the Uplink client encrypts and erasure-codes the file, breaking it into pieces, with only a fraction needed for reconstruction. It then uploads these pieces to selected Storage Nodes. For downloading, the process reverses, with the Uplink client retrieving enough pieces from Storage Nodes to reconstruct and decrypt the file.

On Storj, data and metadata are secured using hierarchically deterministic encryption keys. Each object is encrypted with a unique key, enhanced with a pre-set salt. Paths and these unique keys are further encrypted using the user's passphrase, employing robust algorithms like AES 256 GCM or Secretbox.

> In Storj DCS, file availability remains unaffected even if a Storage Node fails or leaves the network prematurely because retrieving a file requires only 29 out of the 80 distributed pieces. But, if you lose your encryption keys, you have lost the ability to decrypt your data rendering it useless.

Storj connectors are application integrations that allow decentralized cloud storage usage in consumer software. They help Satellites in the Storj network to track and attribute data volume in storage buckets. Storj DCS leverages Erasure Coding to distribute parts of files across nodes in various geographic locations worldwide. Also, Storj has the usual Free and PRO subscription model with clear account limits. Its standard limits can be raised by adding a credit card as a payment method or by a separate ticket with additional STORJ payment.

Connector Framework



Product updates

Due to the challenging external economic environment and broader crypto market, Storj made a difficult decision to reduce its full-time staff by 12.5% in the beginning of 2023. This was part of a broader strategy to ensure long-term stability and growth under adverse economic conditions. But, at the same time, they have shown a 226%YoY revenue growth in the end of 2023.

The network made strides in enhancing the speed and efficiency of its distributed cloud storage. Research from the University of Edinburgh showcased that Storj's transfer performance speeds for large datasets were 2-4 times faster than before. Additionally, Storj's use of underutilized capacity in its distributed cloud storage was shown to generate up to 83% less carbon per terabyte than traditional cloud storage providers.

Storj introduced a new feature called perpetual storage and community satellites. This update allows for an economically sustainable model where network participants can be rewarded for depositing STORJ. This model aims to make enterprise storage viable for all and incentivizes broader participation in the Storj ecosystem.

They already implemented zkSync Era Support for Storage Node Operator Payments with faster and more secure payment system on the Storj network, and now still working on support for Storj DCS Customers and StorjScan. As Storj is fully compatible with Ethereum L1, its potentially could be one of the most convenient data storage integration for Layer 2 solutions.

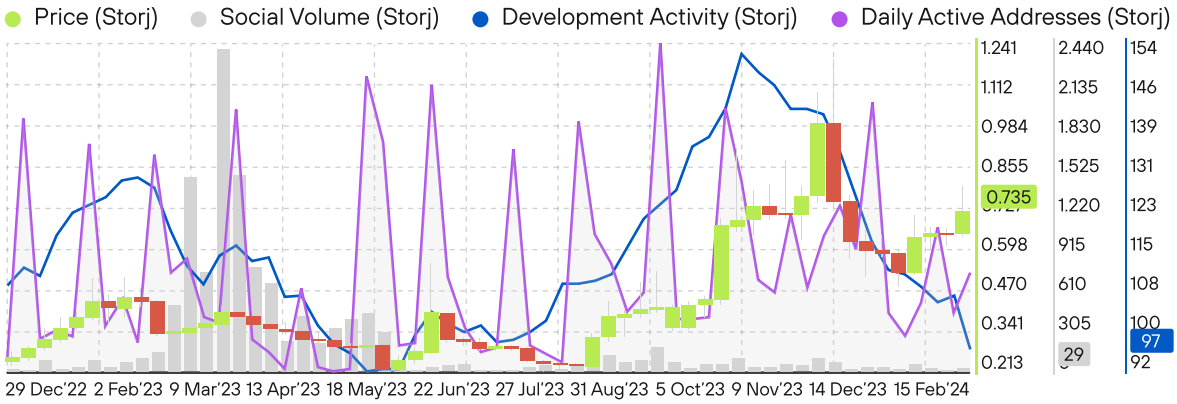
In Q3 2023, Storj introduced Storj Select package that enhances the basic functionalities of Storj by adding features specifically designed for compliance and security. Storj Select gives additional customization for compliance requirements. It allows users to specify security frameworks for data buckets, ensuring storage on nodes that meet specific compliance criteria like SOC2, GDPR, and HIPAA. Storj Select thus caters to organizations with sensitive data, offering more targeted and secure storage solutions tailored to specific regulatory needs.

Metrics

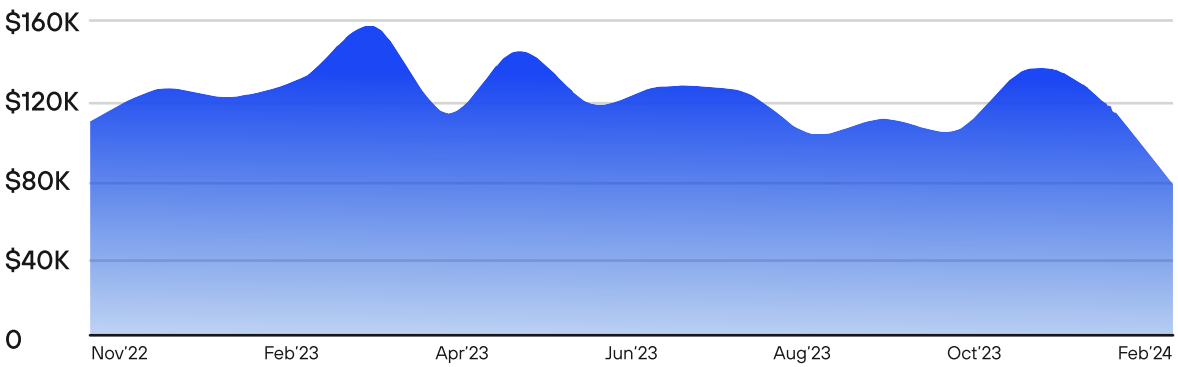
Storj's network saw substantial growth, expanding from 13,000 to 20,000 nodes. This expansion reflects a 40x increase in network use, underscoring the rising popularity of decentralized solutions among Web2 firms due to increasing storage costs on centralized platforms.

The one of the general 2023 growth triggers could be the Storj upgrade of the billing and payment system and possibility to generate fixed Ethereum addresses for Storj accounts. Smart-contract-based EVM apps can interact with decentralized storage using the STORJ token that enables a wide range of new use cases.

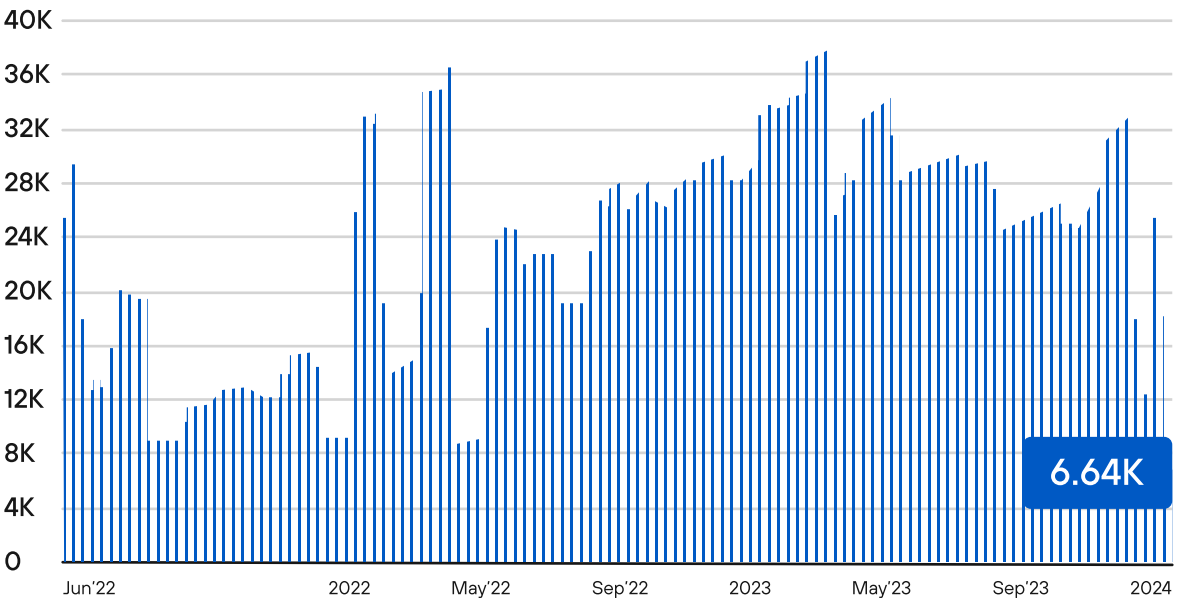
Storj (STORJ) Santiment



Storj Onchain Revenue



Storj Demand-side Protocol Fees

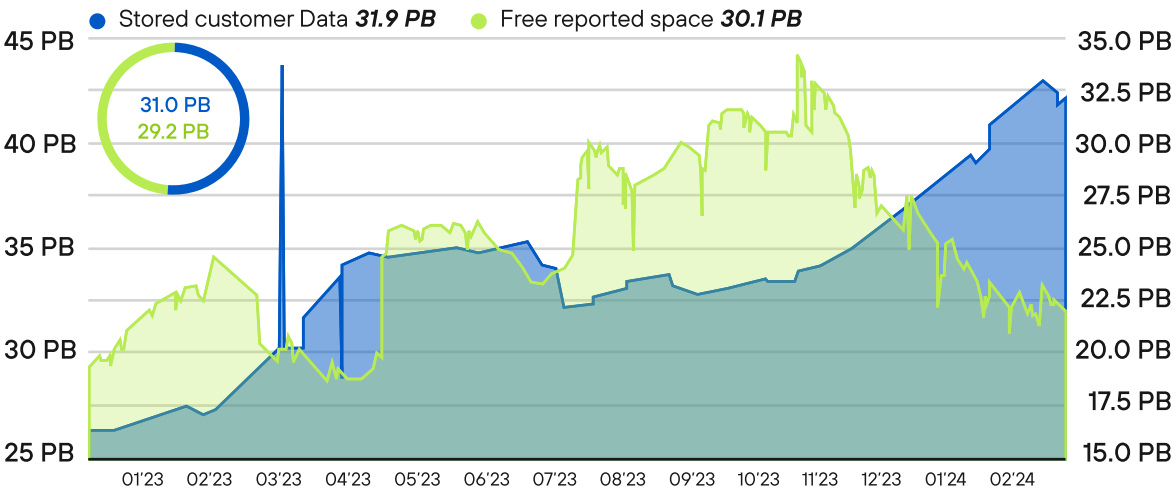


$71 889
30d Fees

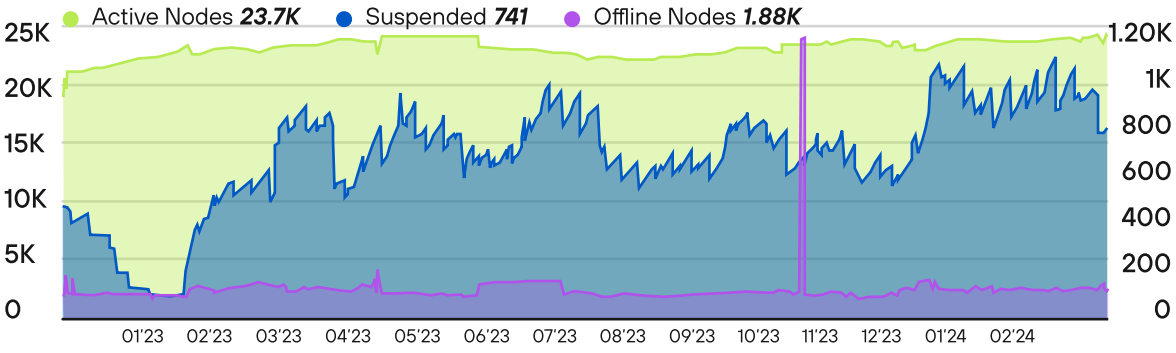
$307 719
90d Fees

$3 779 017
Total Fees

Accumulated Datausage over all Satellites



Nodestatus over all Satellites (max)



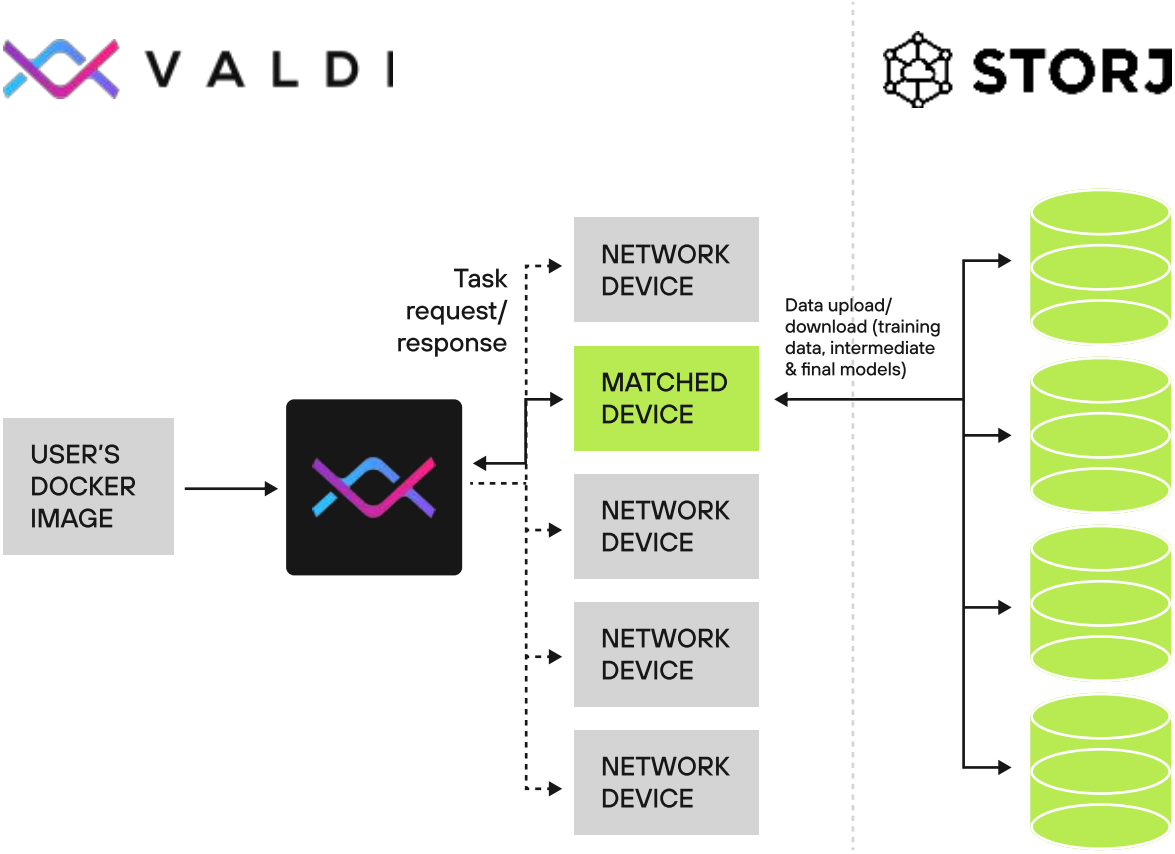
Ecosystem

The Storj ecosystem encompasses about 30 integrated partner solutions across various sectors including content delivery, backup debugging, file management, science and cloud technologies.

First 2023 use case was for video post-production company Atempo, that finished as a reduction of its costs for development compared to centralized platforms. Storj integrated Acronis' services. Acronis, known for its backup and recovery solutions, integrates Storj's distributed storage technology, offering clients more robust and secure data storage options.

Another important collaboration was with Valdi, that utilized Storj network to enhance its AI/ML operations. Storj's network supports Valdi by providing storage for training datasets and models used in AI/ML training.

Storj for AI/ML



In 2023, Storj also integrated industry-leading applications such as Adobe Premiere Pro. This movement was particularly significant as it brought new levels of efficiency and scalability to Storj's decentralized storage solutions, making it more appealing for use in media and entertainment, AI, backup and disaster recovery. And among new institutional partnerships added is CloudWave, a leading provider of healthcare data security solutions, partnered with 300 hospitals across six countries. CloudWave selected Storj Select as its data storage provider.

Storj's enterprise-grade, globally distributed cloud object storage solution won the "Cloud Computing and Storage" category in the 2023 NAB Show Product of the Year Awards. Also the team are one of the main speakers at data storage topics on various events around the world.

Sia

Key Concepts

Sia is a decentralized cloud storage network that combines a Proof-of-Work blockchain with a contract-based storage model. It facilitates a global data storage marketplace by connecting storage providers (hosts) with underutilized hard drive capacity to storage consumers (renters). Renters specify data volume, storage duration and pricing, ensuring clear terms for data storage services.

When entering storage contracts on Sia, both users and providers deposit Siacoin (SC) into escrow. Providers prove they're hosting the data as agreed. Upon contract completion, providers receive most of the escrow funds, with a portion allocated to Siafund (SF) token holders, who earn SC from completed contracts, incentivizing Sia's financial ecosystem.

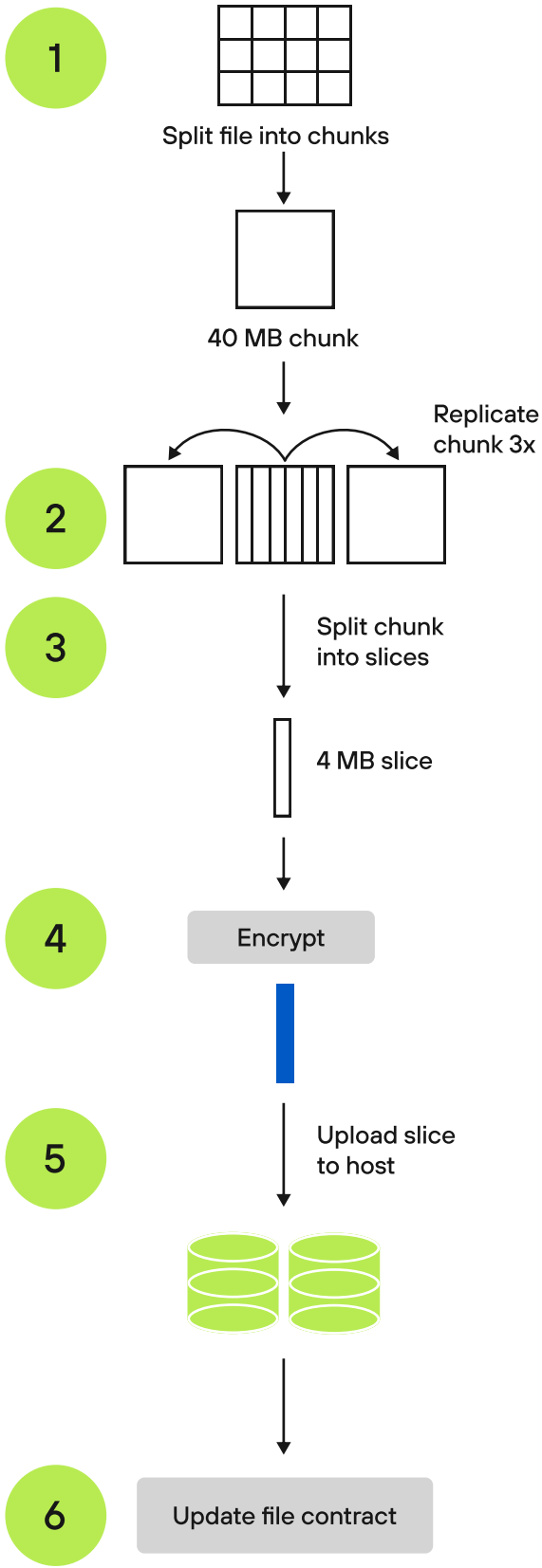
INFRASTRUCTURE LAYER: NATIVE BLOCKCHAIN.

Launched in 2015 by Nebulous Inc., Sia underwent a reorganization, leading to its division into the Sia Foundation and Skynet Labs.

Renters pay various fees to initiate and uphold a storage contract. These fees are calculated based on the volume of data uploaded, the contract duration, and the set price in SC per terabyte per month. This structure ensures that the costs are directly related to the usage and terms of the storage service provided.

Sia creates a global data storage marketplace, linking hosts with spare capacity to renters. Transactions use Siacoin for fees, services, and collateral, rewarding miners for block creation. On the Sia network, uploaded files are divided into 30 pieces, or shards, distributed further across different hosts. To reconstruct the original file, only 10 of these shards are needed. If a host goes offline, the system automatically creates new copies of the shards and redistributes them to maintain data availability and integrity.

Sia data encoding and storage sequence



Initially using Proof-of-Storage, Sia switched to a Proof-of-Work consensus due to challenges, incorporating storage contracts into its model. Data security is ensured through ChaCha20 encryption and Reed–Solomon Erasure Coding, with file redundancy for reliability. This system emphasizes privacy and data recovery, requiring only a portion of file shards to reconstruct the original data.

Sia facilitates a global data storage marketplace by connecting storage providers (hosts) with underutilized hard drive capacity to storage consumers (renters). Siacoin can be used to pay for gas on the Sia blockchain and as the medium of exchange for the storage market for gas payments, storage services, collateral, and fees. Also, SC is rewarded to Sia miners for creating new blocks.

Sia is positioned within the hot storage market, primarily appealing to developers seeking a decentralized solution. It offers privacy and rapid data retrieval, making it a preferred choice for those prioritizing secure and efficient access to their stored data.

Product updates

> After a successful hard fork in 2021, the Sia Foundation was established, being funded by an SC token subsidy. Despite Nebulous rebranding to Skynet Labs and its subsequent shutdown in November 2022 due to funding issues, Sia continues under the Sia Foundation.

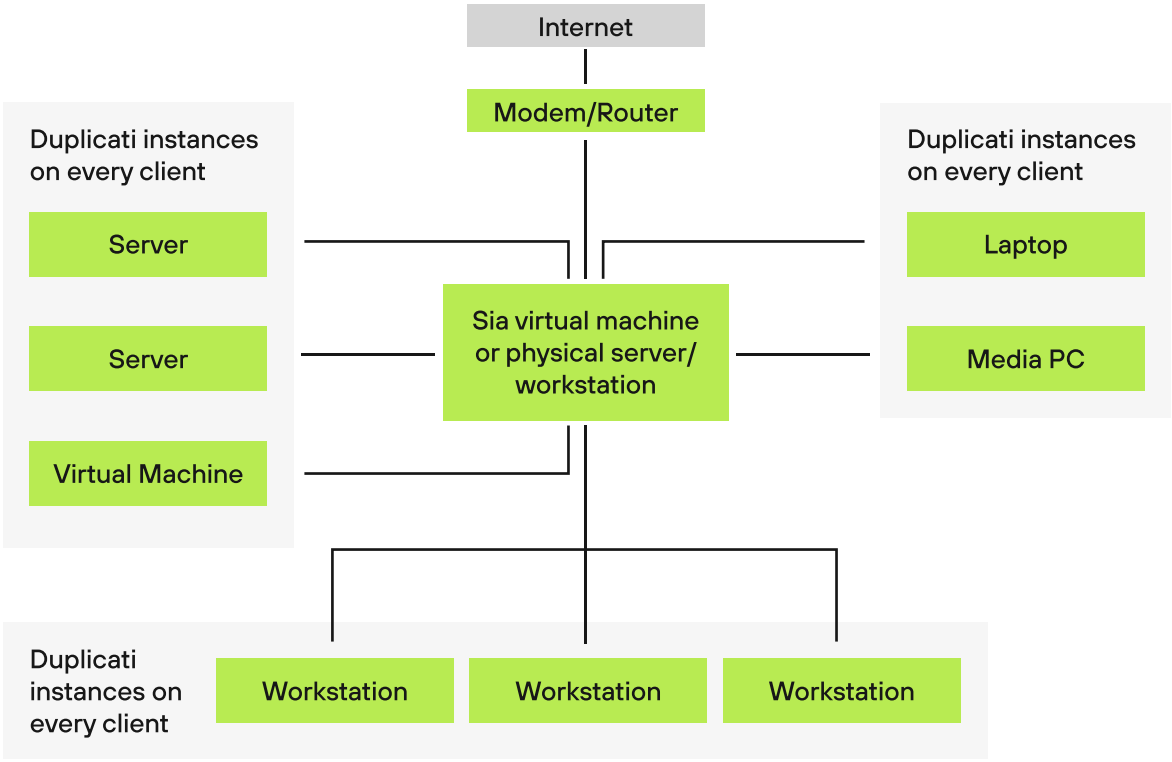
> The Foundation supports the ecosystem through grants, with $122,000 allocated in Q1 2023 and $260,000 in Q2, aiming to enhance user-owned data systems and the Sia ecosystem, involving both Foundation and community members in the grant committee.

> Sia has launched the official versions of its core software modules for renting (renterd) and hosting (hostd) to enhance network usability for storage providers and users. The renterd interface allows users to easily create storage contracts on the Sia network. The V1 release signifies Sia's strategic transition to its newly developed core renting software.

> Additionally, integration with Duplicati offers advanced backup features like encryption and de-duplication. Also, the new Hostd version provides a more user-friendly interface and API for storage management, including a web UI for remote operations. The release of Sia's beta version of the renting interface (renterd) in Q3 made the network more accessible to renters.

> New integration of the S3FS, a FUSE-based solution, enables mounting an Amazon S3 bucket as a local filesystem, converting file operations into S3 API calls for seamless interaction. Integrating S3FS with Sia allows organizations to enjoy decentralized storage benefits in conventional filesystem environments without needing application rewrites or staff retraining, bridging traditional and blockchain-based storage solutions.

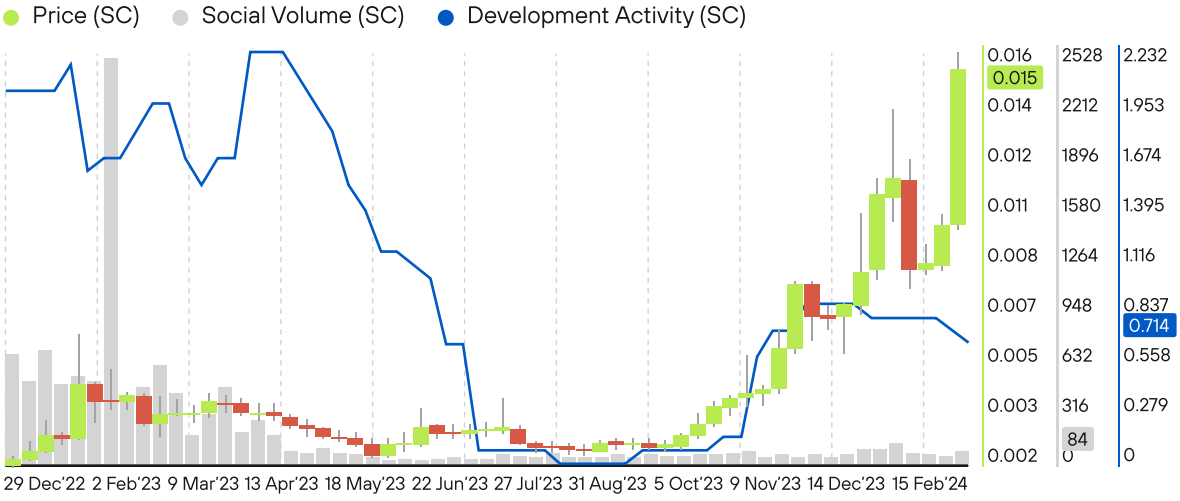
High-level, Sia backup gateway appliance model



Metrics

> In 2023, Sia showcased remarkable growth in the number of new Storedge contracts (92% YoY) and transactions (87%). Post hard-fork developments aim to make Sia more user-friendly than before. But it is still a long way to achieve the former level of storage-contracts activity.

Sia (SIA) Santiment



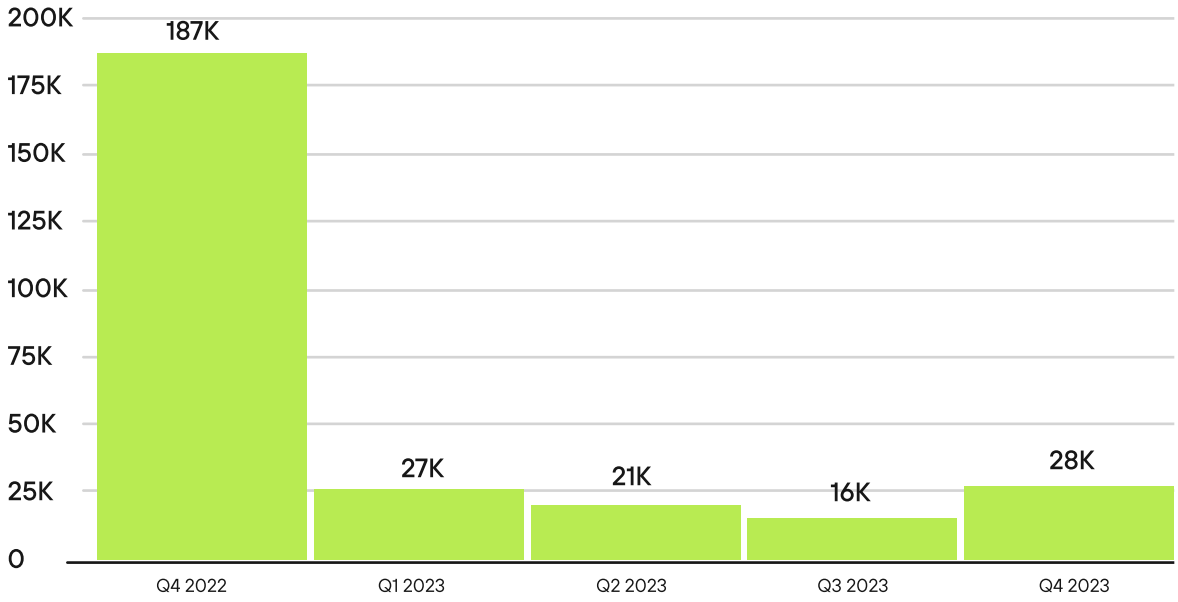
STORAGE

Sia saw a 72% QoQ increase in active storage contracts during Q4

456,400
Blockchain Height

1.45 PB
Storage Utilization

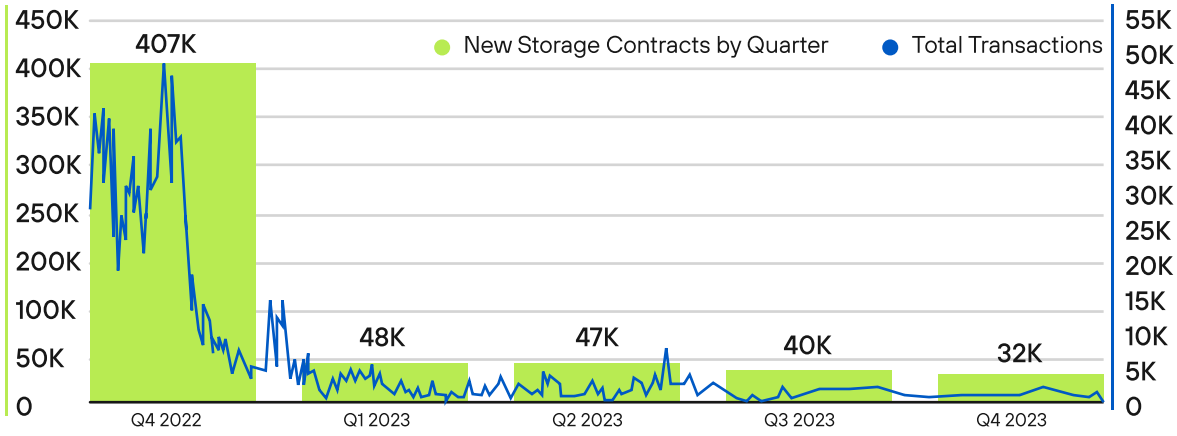
439
Active Hosts



Sia's used storage saw a 25% QoQ increase, pushing storage utilization from 24% in Q3 2023 to a yearly high of 29% in Q4 2023.

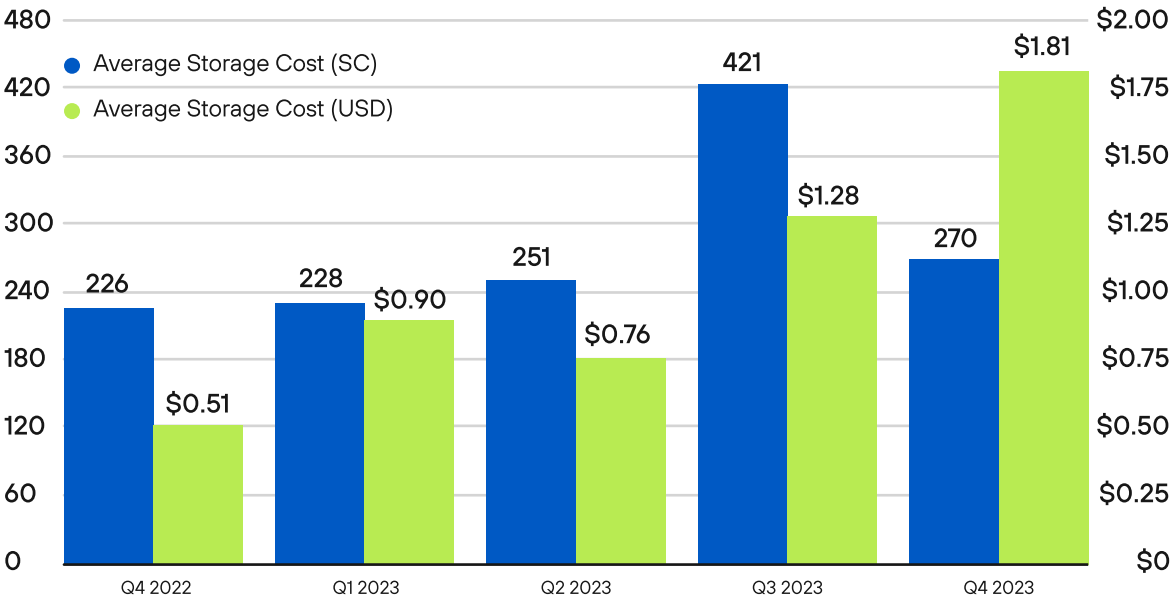
Despite a 20% QoQ decline in new contract issuance on Sia, active storage contracts surged by 72%. This indicates a trend towards longer contract terms or increased end-of-quarter activity, reflecting changes in user behavior and contract utilization within the network.

New contracts fell by 20% QoQ and transactions fell by 12% QoQ



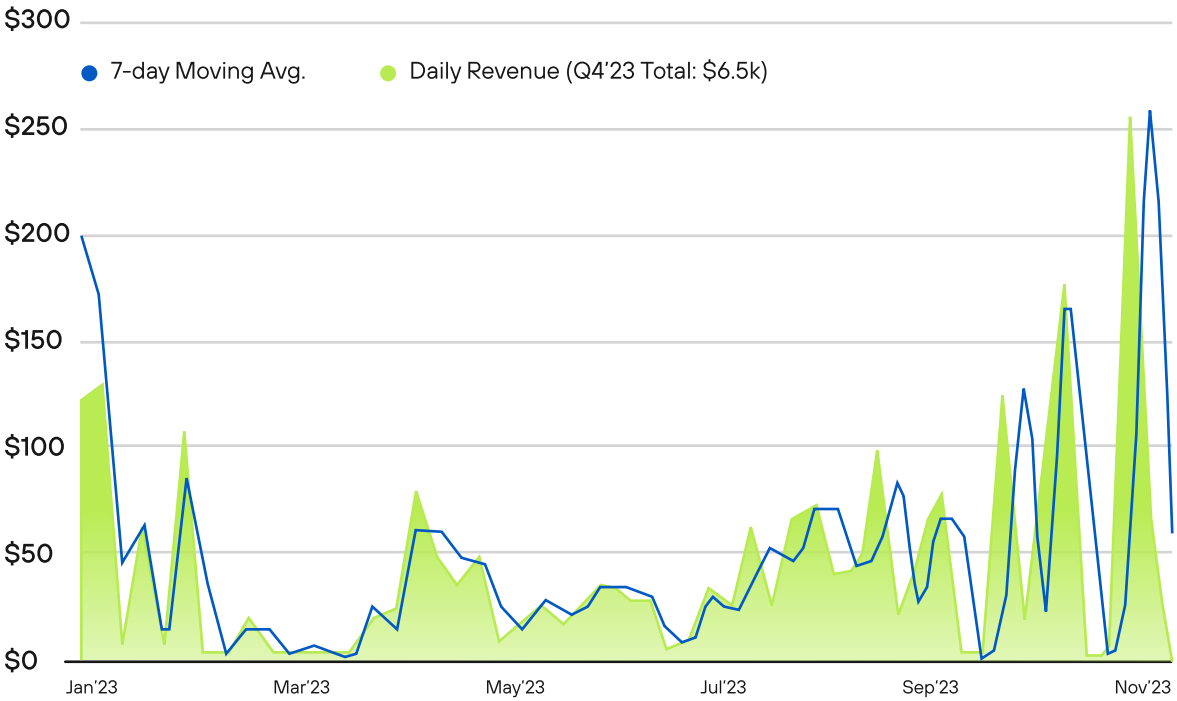
The significant increase in upload and download bandwidth costs by 64% (USD) and 161% respectively, reflects the impact of Siacoin's 119% QoQ price increase.

The 119% QoQ jump in SC price led q-end storage prices to rise 42% QoQ in USD



> Sia generates revenue for hosts, miners and Siafund (SF) holders through a combination of host payouts, Siafund fees, miner fees, and burned collateral. The burning of SC, by making it scarcer, theoretically increases its value for SC holders, thus contributing to the network's overall revenue.

Sia revenue grew 66% QoQ, from $3.9k to $6.5k, largely due to the rise in SC price



Ecosystem

In Q4 2023, the Sia Foundation approved 14 grants totaling $436,000, contributing to a cumulative grant allocation of approximately $1.4 million since the program's start. These grants cover a broad spectrum of projects from development to research. The grants committee, comprising three Sia Foundation employees and three community members, convenes biweekly to evaluate proposals.

The Sia Foundation has allocated $100,000 to Komodo Platform and Van Ketting to incorporate HTLC functionality into Sia's Komodo DeFi Framework (DEX) protocol, facilitating atomic swaps. This initiative, stemming from a feasibility study by the same team, aims to enable peer-to-peer SC trading via Komodo Wallet DEX through HTLC atomic swaps, enhancing the protocol's capabilities and user experience.

$82,000

The Sia Foundation has granted $82,000

The Sia Foundation has granted $82,000 to A-Z Computer Solutions for creating a cloud backup module tailored for Proxmox backup systems. This project aims to replicate Proxmox backup data onto the Sia network, potentially increasing the network's data volume by terabytes. The proposal is backed by a feasibility study conducted by A-Z Computer Solutions in Q3, laying the groundwork for this development.

Proxmox

Integrated Proxmox backups are integral to the Proxmox Virtual Environment (PVE)

Integrated Proxmox backups are integral to the Proxmox Virtual Environment (PVE), facilitating snapshots and backups of virtual machines, containers, and the host system itself. This ensures data integrity and recovery from potential data loss or hardware failures.

$79,000

The Sia Foundation has allocated

The Sia Foundation has allocated $79,000 to Hammer Technologies for the development of Lume, a web application designed for accessing decentralized content. Utilizing Sia as its storage backbone, Lume Web aims to promote data ownership, ensure open access without permissions, and safeguard against censorship.

BNB Greenfield

Key Concepts

BNB Greenfield supports all basic CRUD operations, authorization, and membership management, allowing users to manage data by creating, reading, updating, and deleting objects, buckets, and folders. It also facilitates group creation and membership assignment, enabling precise control over access permissions and privileges.

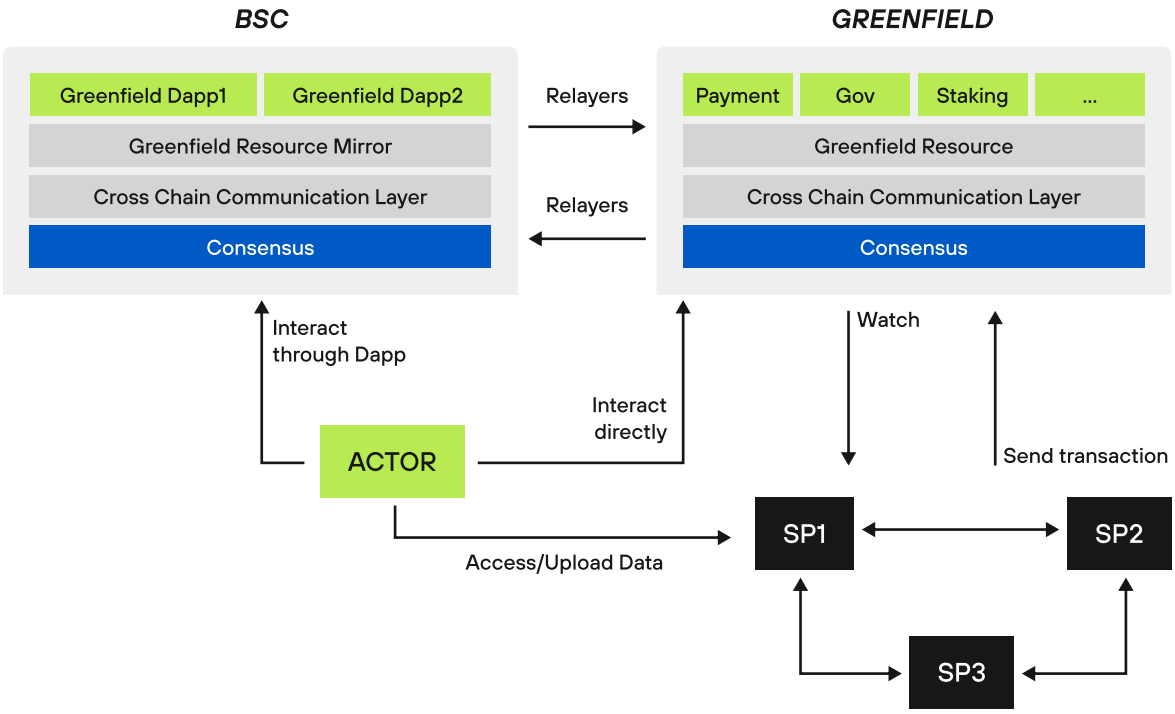
INFRASTRUCTURE LAYER: NATIVE BLOCKCHAIN, BNB SMART CHAIN.

The BNB Greenfield Blockchain serves as a ledger for user data and storage metadata, utilizing BNB for gas and governance. Storage Providers (SP), comprising individual or organizational infrastructures, act as data custodians and user access gatekeepers. This ecosystem supports dApp development and implementation from the BSC side, leveraging Greenfield's infrastructure for various DeFi integrations via a cross-chain bridge.

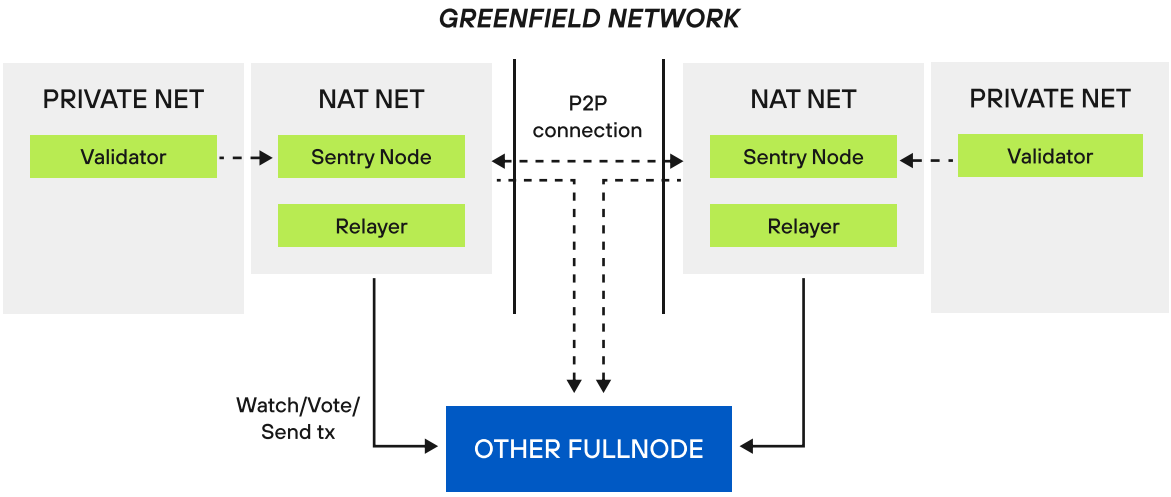
The Challenge Verifier is an off-chain service ensuring data availability and integrity within BNB Greenfield by monitoring and challenging storage providers. It penalizes providers for failing to meet quality standards, thus maintaining network reliability. Providers must respond to challenges like data storage or timely responses to prove their reliability.

> The BNB Greenfield blockchain employs a Proof-of-Stake based on Tendermint. BNB acts as the staking token, initially validators' staked BNB being locked on the BNB Smart Chain. Greenfield Governance is also derived from the Cosmos and has the same structure.

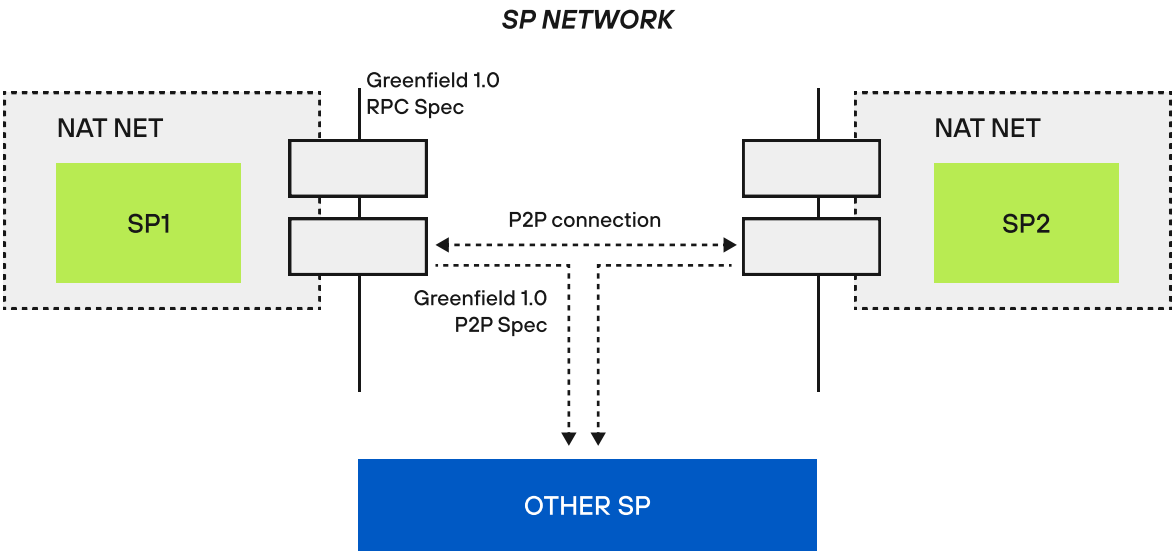
BNB Greenfield Architecture



Greenfield Network



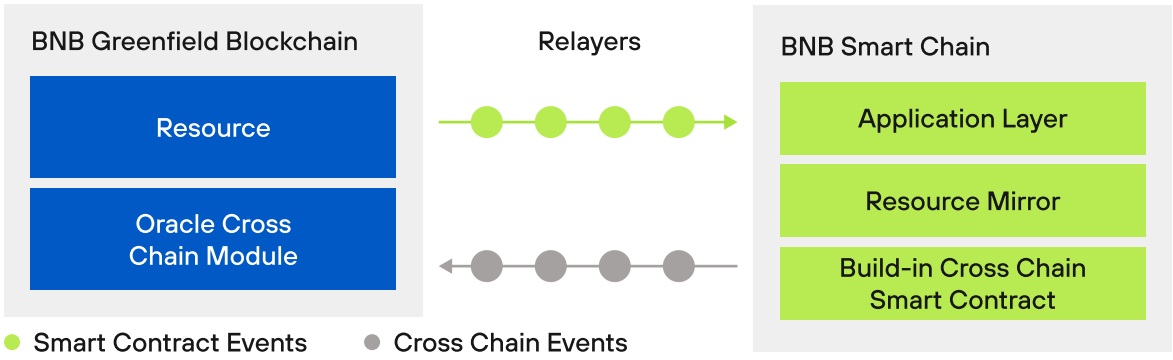
SP Network



The interaction between BNB Greenfield and BSC involves three layers, facilitating secure and verified data exchange through a specialized communication layer. A Resource Mirror Layer reflects Greenfield's resources onto BSC, allowing for smart contract interactions and efficient asset management. Above this, an Application Layer enables the development of BSC smart contracts to utilize these mirrored resources and provide full EVM compatibility. This structure supports the creation of Greenfield's dApps with cross-chain functionalities.

Validators are tasked with achieving consensus on cross-chain events and relaying cross-chain packets to Greenfield and BNB Smart Chain. The Validator operates a relayer with a BLS private key, whose address is recorded on-chain. This relayer signs a confirmation message, or "vote," with the BLS key once cross-chain events reach finality. This vote is then shared with other relayers via a peer-to-peer network, ensuring verified cross-chain communication. After gathering enough votes, the relayer compiles a cross-chain package transaction containing all necessary data and instructions for executing the cross-chain event.

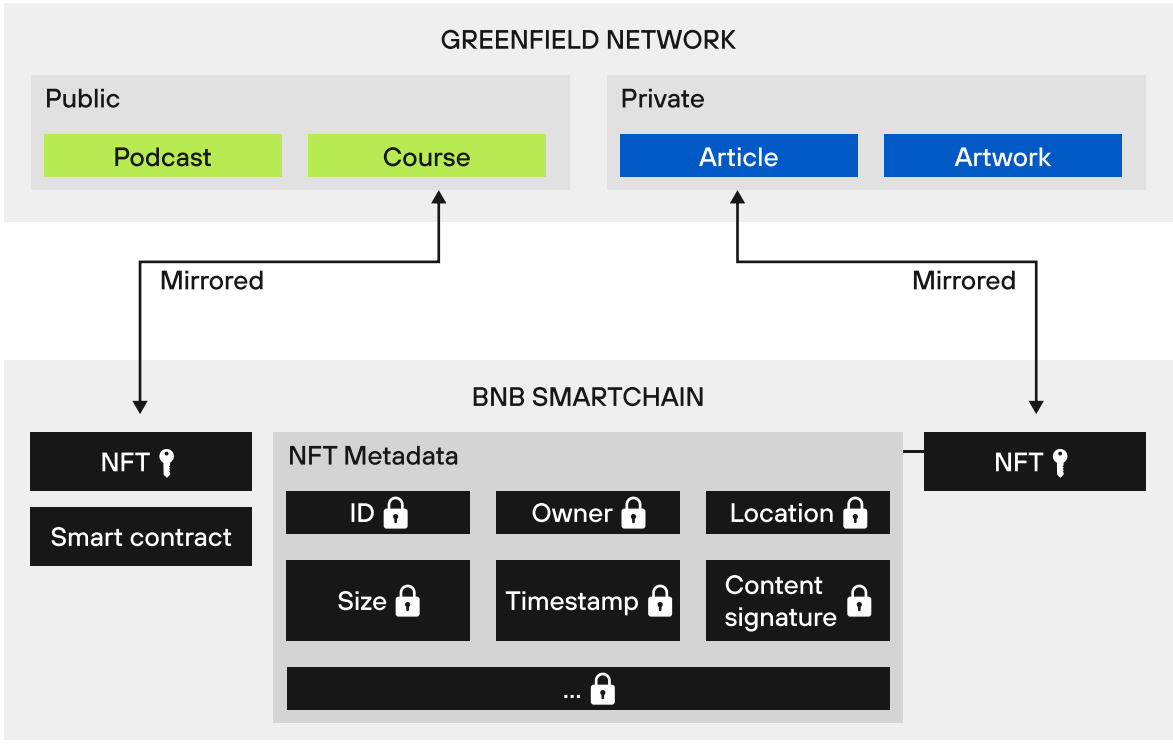
File Management Bridge



> Mirroring in BNB Greenfield involves transferring control of objects to BSC smart contracts without duplicating actual content, enabling on-chain object management on BSC. This process doesn't impose a size limit and allows for metadata attribute changes. BNB Greenfield resources become manageable as NFTs on BSC, adhering to the ERC-721 and ERC-1155 standards for objects and authorization, respectively. Thus, changes made on BSC directly affect the corresponding data on BNB Greenfield, enhancing interoperability and control.

It ensures smooth migration of mirrored objects across storage providers without affecting the mirroring process, maintaining seamless operation and data integrity throughout the transition. However, mirroring leads to actions on messages waiting until the sender's block is finalized. This requirement for block finality in sending and replying messages can impact performance, as operations depend on block finalization speed.

Data Management Process



In Greenfield, users incur two types of fees: gas fees for transactions and storage service BNB fees charged by Storage Providers (can be bridged from BSC). The storage fee depends on the file size and replications. Also, users have a limited free data download and read quota, with the option to purchase additional bandwidth.

Payments are made from the object owner's Greenfield address or designated payment accounts, which, if depleted, may result in downgraded service or even data loss. Also, there is a trust bottleneck among users and SPs that can be switched and provide separate download billing. From the SPs side, rewards withdrawals from the Global Virtual Group work with no private key access to the validator tax pool.

> While BNB Greenfield aims for decentralization, it maintains certain centralized aspects, though not specifically regarding data management and verification, indicating a nuanced approach to compromises within its architecture.

Product updates

> In Q2 2023, BNB witnessed significant Luban updates with the BEP-126 deployment, introducing Fast Finality to eliminate block reorganizations. Additionally, BEP-174 was implemented to enhance cross-chain asset transfer security via a new relay management mechanism, particularly improving the BSC Bridge's safety. BEP-221 further streamlined block validation, simplifying the process. These updates significantly bolster Greenfield's cross-chain interaction efficiency, enhancing block production time and bridge security.

> The BNB Greenfield mainnet, launched on October 17, 2023, undergoes regular updates and hardforks that do not affect account balances or object accessibility. Presently, the network is operating under the Hulunbeier Hardfork, which includes code debugging and enhancements for Storage Providers (SPs) and Validators modules.

> BNB Greenfield is positioned to be the pivotal Data Availability (DA) layer for opBNB, aiming to reduce opBNB gas prices to ten times cheaper. This approach not only benefits opBNB but also holds the potential to serve as the DA layer for other EVM-compatible chains.

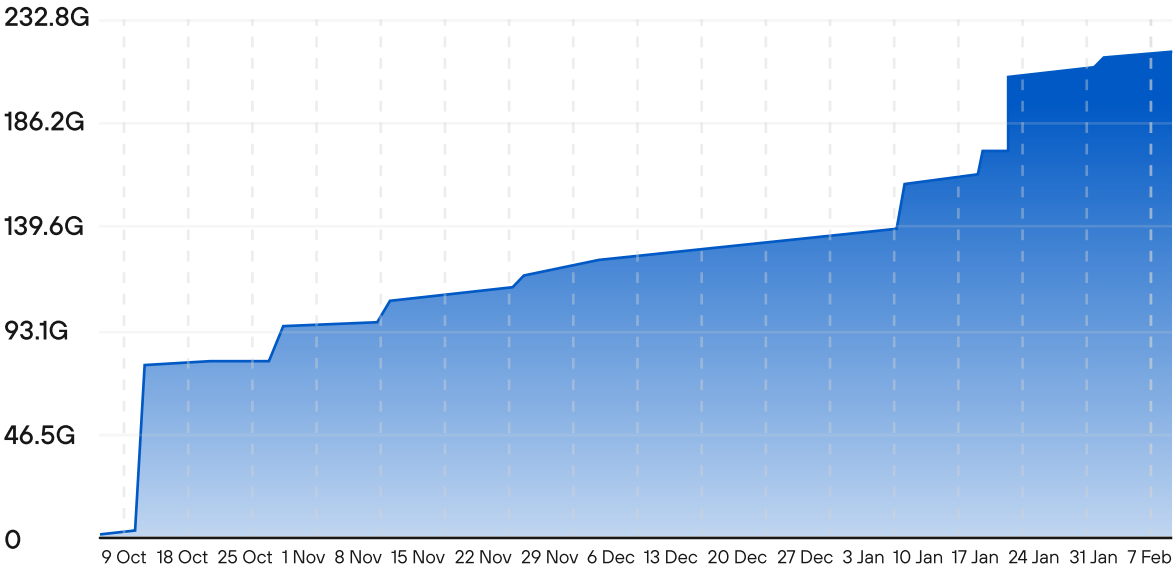
> One of the forthcoming developments involves improving smart contract functionalities, specifically enabling smart contracts to act as 'resource owners.' This enhancement aims to provide better permission control on BSC and opBNB.

> For 2024, the team is focusing on enhancing account abstraction (AA) through improvements to Greenfield Paymaster and boosting the bandwidth performance of Storage Providers (SPs). Also, they want to implement a native Bundle Service for Efficient Data Handling.

Metrics

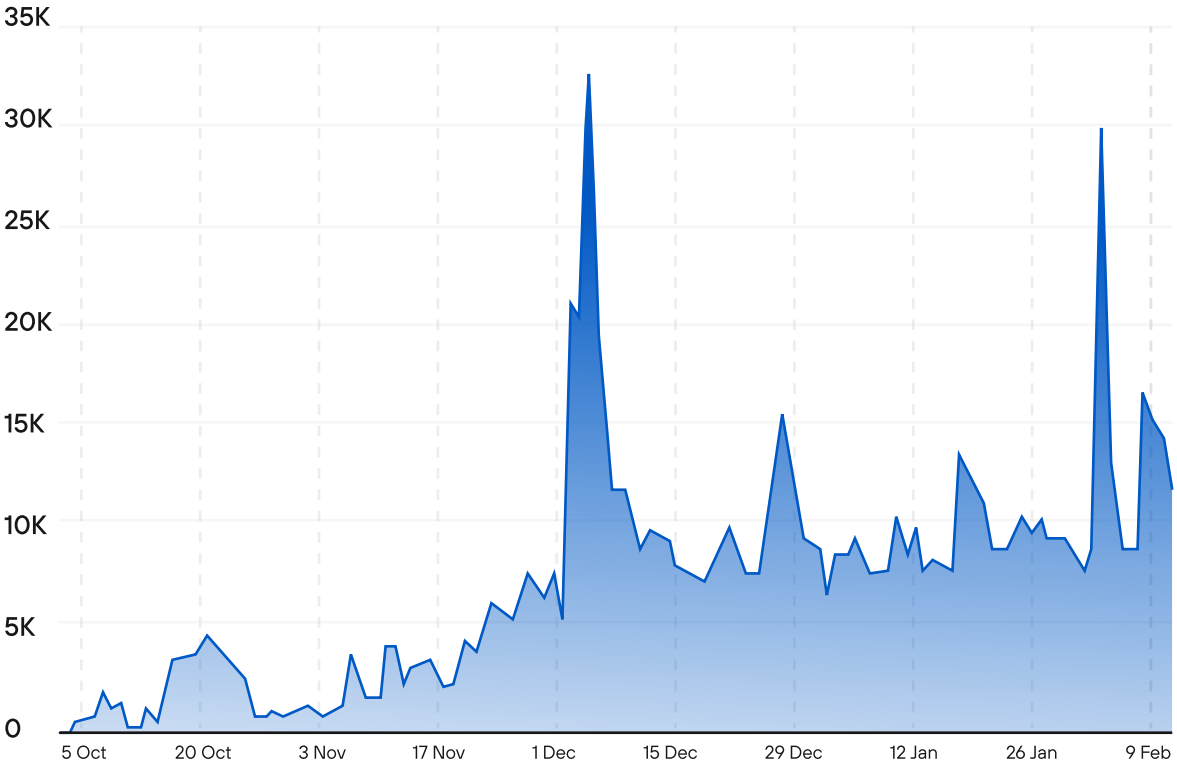
> Currently, the upload speed is about 2MB/s, and the download speed is about 20MB/s. There're 1,300 total address and 10 active storage providers.

Greenfield Network Storage Data Size



216.71GB
Network Storage Data Size

Daily Transactions



11,821
Daily Transactions

Ecosystem

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BNB Greenfield

as a DA layer for opBNB

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AA and Bundle Service

For 2024, the team is focusing on enhancing account abstraction (AA) through improvements to Greenfield Paymaster and boosting the bandwidth performance of Storage Providers (SPs). Also, they want to implement native Bundle Service for Efficient Data Handling.

ZUS
(formerly 0Chain)

06

Züs offers a decentralized, high-performance multi-cloud storage solution emphasizing strong security and freedom from vendor lock-in. It distinguishes itself by allocating the responsibilities of consensus formation, block storage and data storage across three distinct roles: miners, sharders and blobbers. Notably, blobbers handle data storage and do not engage in mining activities.

This division of responsibilities alleviates the workload on miners, leading to faster blockchain transactions. Miners are responsible for ensuring the integrity of data storage performed by blobbers. Blobbers must validate the fidelity of their storage by presenting stored data, system metadata, and client-signed confirmations when challenged.

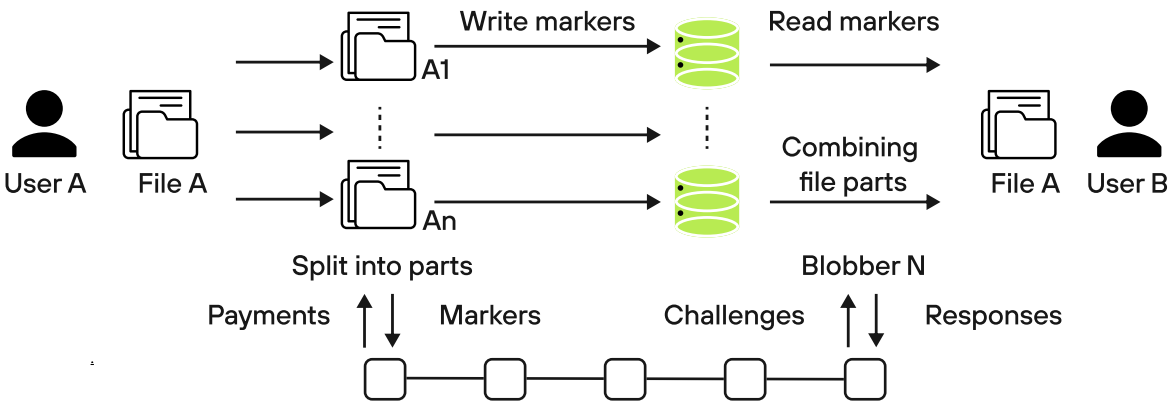
The setup ensures fair compensation for blobbers while enabling clients to receive the storage they've paid for. Blobbers' compliance with these requirements directly impacts their compensation or penalties through a smart contract mechanism.

Züs strengthens data security with a tri-layered approach to safeguard digital assets in a decentralized environment. The first layer, Fragmentation, involves breaking down data into smaller pieces and distributing them across multiple locations, preventing a single point of failure and enhancing protection against data loss or theft. The second layer, Proxy Re-Encryption, ensures secure and private data sharing between parties, maintaining information integrity during access or transfer. The third layer, Immutability, enables users to set their data as immutable, meaning once stored on the Züs platform, it cannot be altered, thus preserving its originality and integrity.

> Züs marked its presence as one of the pioneering decentralized storage crypto-startups by successfully raising $39M through an ICO in 2018.

> In a significant milestone, Züs launched its mainnet in December, swiftly processing 10 million blocks within the initial 20 days. The next development phase involves a second Hard Fork, "Ares," which aims to optimize Blobber's mechanics and enhance overall blockchain statistics.

ZUS Architecture



4EVERLAND

STORAGE

4EVERLAND is a Web3 cloud multi-platform for storage and computing, with RaaS and network capabilities. First, you can use it for dApp hosting services or as a bridge between IPFS and Arweave, Filecoin and BNB Greenfield for dual backups with one click.

Additionally, it has integrated with major public chains like Ethereum, Polygon, Solana, ZkSync, Opbnb, BNB Chain, Linea, Arbitrum, ZetaChain, and Scroll. The platform has also formed deep partnerships with decentralized domain names, including ENS, SpaceID, .bit, and Bonfida.

4EVERLAND provides Rollup-as-a-Service (RaaS) solution and the 4EVER Rollup Stack, which offers various Data Availability (DA) options (Celestia, Arweave, etc). This feature allows users to choose their preferred data storage solution tailored to their specific needs.

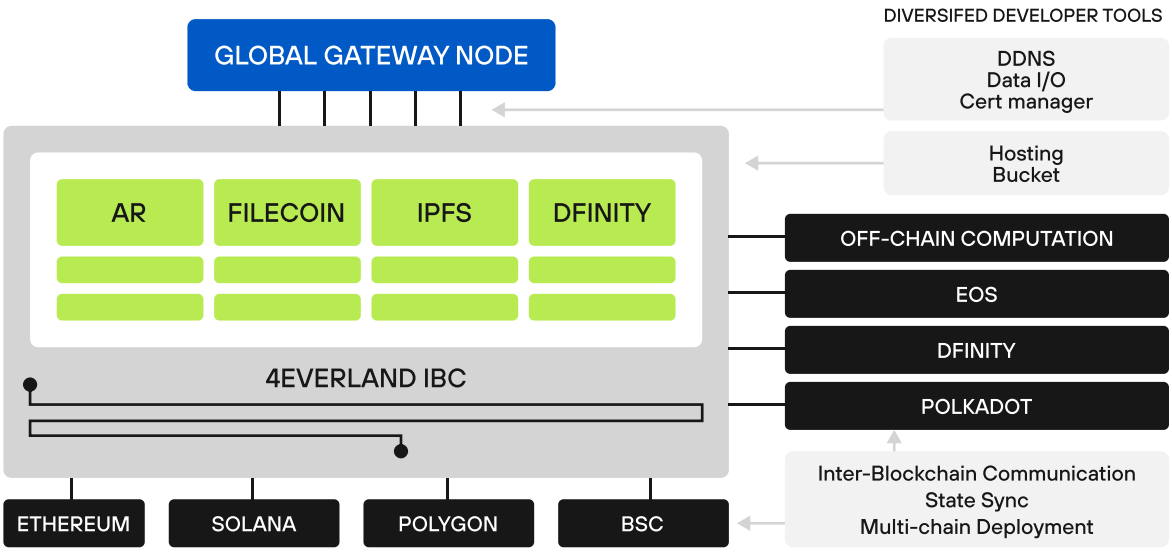
> Nowadays, 4EVERLAND is the second-largest packaged storage infrastructure within the Arweave ecosystem. But it also stands as one of the main node providers for BNB Greenfield.

> Recently, they announced new own-backed file management and shared Moss system and the Base Name Service (BNS) support. BNS is a native naming service built on Base that simplifies user interactions by mapping human-readable names like "bob.base" to various types of addresses and identifiers.

> The company has successfully completed two investment rounds, raising a total of $3.5 million. This funding was sourced from notable investors including Fenbushi Capital, FBG Capital, Bixin Ventures, Mint Ventures, Random Number Capital, Arweave, WaterDrip Capital, Bing Ventures, Forward Research, Web3.com Ventures, Arweave SCP Ventures, GTS Ventures, Hillstone, among others.

Also, the team has garnered grant support from multiple ecosystems including Polygon, Protocol Labs, Dfinity, and Arweave, and has been selected as the second-place winner in the BNB Chain Zero2Hero Incubator.

Overall Technical Design of 4EVERLAND



CESS

(Cumulus Encrypted Storage System)

08

CESS is a blockchain-powered decentralized storage and content delivery network (CDN) designed specifically for the Web3. Through its decentralized object storage services (DeOSS), CESS has made significant strides in enhancing and expanding its product offerings. This includes the development of DeShare, an online file-sharing tool, and the provision of public chain snapshot storage services, further enriching the CESS network's ecosystem.

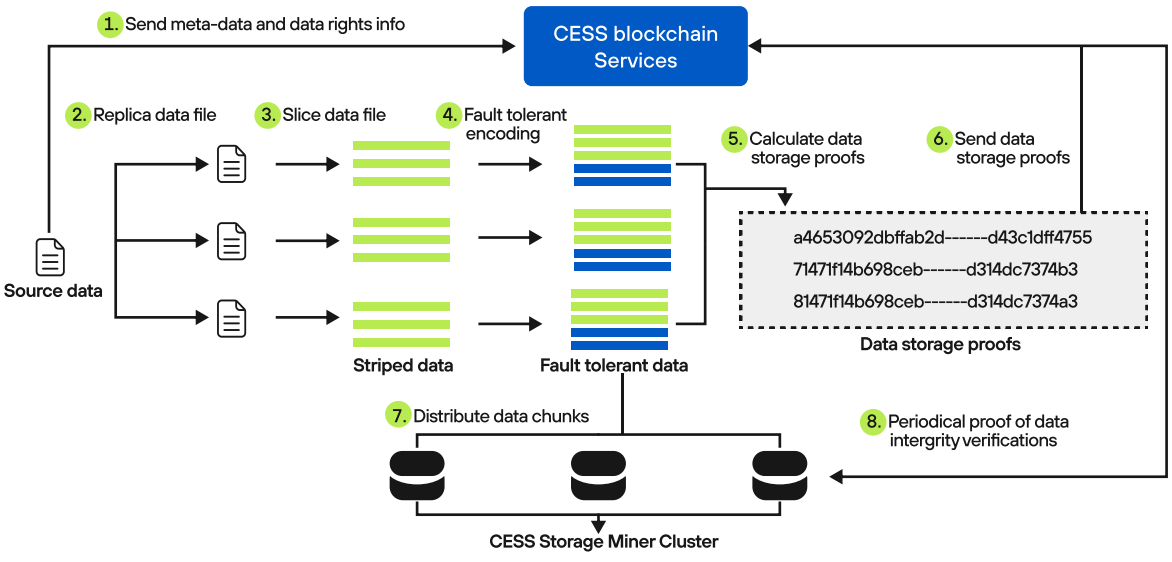
The architecture of the CESS network is meticulously organized into four distinct layers: the Blockchain Layer, the Distributed Storage Resource Layer, the Distributed Content Delivery Layer, and the Application Layer. At the heart of its operation lies its own R^2S consensus mechanism, which is crucial in managing network resources and optimizing load distribution. This mechanism is pivotal in ensuring data security and integrity, employing state-of-the-art technologies such as Proof of Data Reduplication and Recovery ($PoDR^2$), Multi-format Data Rights Confirmation (MDRC), and decentralized proxy re-encryption. Together, these technologies form a solid foundation for a secure and resilient network infrastructure.

> The company has raised $8 million in Series A from HTX Ventures, Infinity Ventures Crypto, DWF Labs, Mentha Partners, Vespertine Capital, Web3 Foundation, Singchain Investment, 7 O'Clock Capital, SolrDAO, FishDAO, OneBlock+, Winkrypto and Polkadot Ecology Research Institute.

> A key feature of CESS is its compatibility with EVM and WebAssembly (WASM), significantly enhancing its utility across the blockchain landscape. Leveraging the Substrate development framework, CESS facilitates cross-chain applications, enabling smooth interactions and integrations with various blockchain networks.

> The CESS network is currently in its testnet phase, showcasing 11 consensus nodes and 913 storage nodes. It boasts a verified storage capacity of 155.79 PiB and a total storage space of 3.14 PiB, demonstrating its potential to significantly impact the decentralized storage market.

CESS Data Storage Workflow



STORAGE

OORT

(formerly Computecoin Network)

09

OORT is a decentralized cloud technology, leveraging the Proof-of-Honesty (PoH) consensus and ZKP to offer a storage and Web3 hosting solution that emphasizes privacy and cost-efficiency. Its flagship service, OORT Storage, provides a decentralized object storage platform that ensures secure and accessible data storage and retrieval from anywhere.

The OORT ecosystem manages data using "buckets" and "objects." Buckets act as containers for storing objects, which are essentially files along with any associated metadata. Users can easily store data by creating a bucket and uploading objects. Once stored, objects can be accessed, downloaded, or copied as needed, with the option to delete unnecessary objects or buckets to manage storage efficiently.

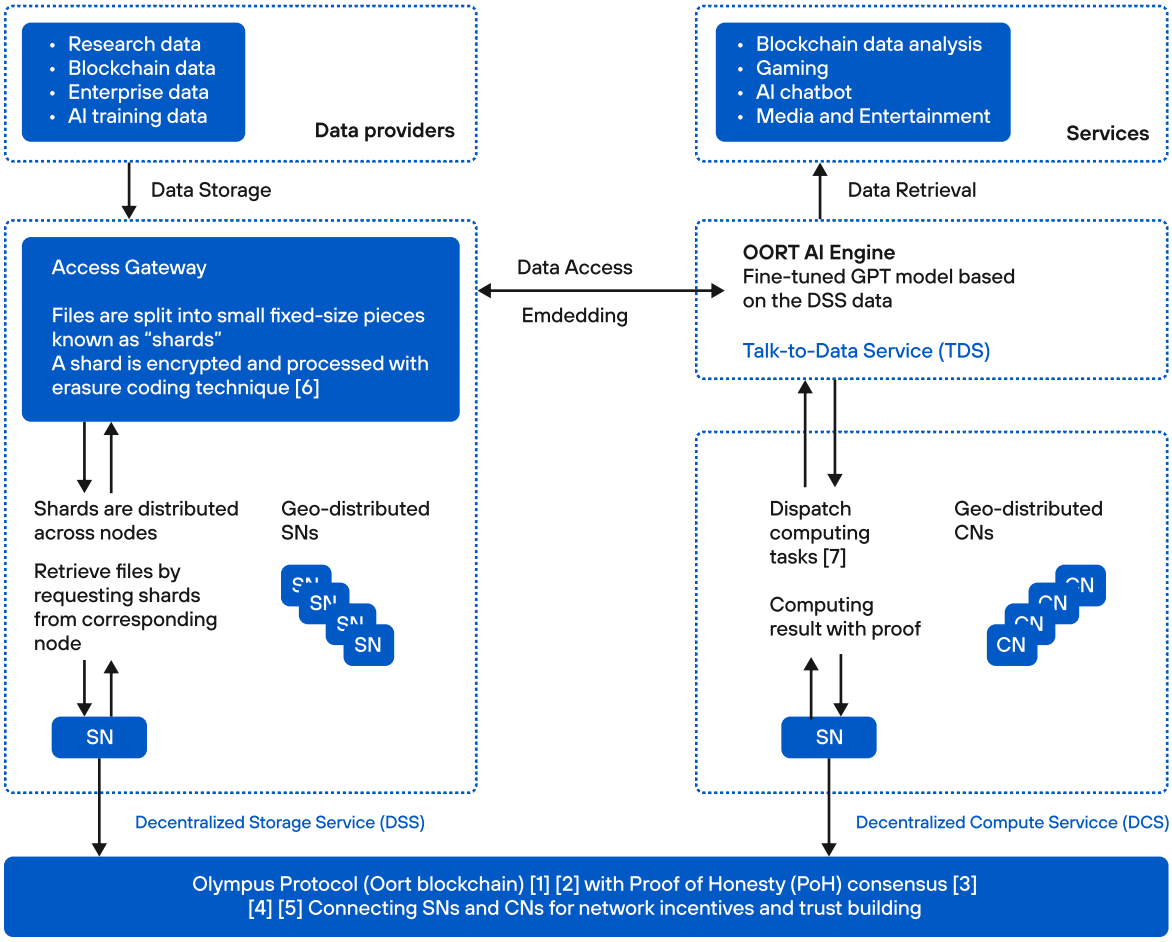
A key feature of OORT Storage is the ability to set specific storage classes for objects. These classes determine the object's durability, accessibility, and cost, making it imperative to select the most suitable class for each use case. Additionally, setting a default storage class for buckets simplifies adding new objects, as they automatically adopt the predetermined class, allowing users to concentrate on other priorities.

Based on users needs, this cloud provider offers variety on nodes, like Super nodes, Edge Nodes (small devices just for OORT), and Backup nodes (multi-network storages) OORT extends its capabilities beyond storage, integrating global compute and storage resources to offer AI solutions that can significantly enhance business operations. With OORT AI, powered by inbuilt LLM, businesses can develop customized AI agents tailored to their needs.

> The technological advancements and solutions provided by OORT are protected by US patents and supported by academic publications. OORT's strategic partnerships and client base, including collaborations with over 40 projects and companies like DELL Technologies, Tencent Cloud, and Emurgo, as well as connections with over 20 leading universities in the U.S. such as Harvard, MIT, and the University of Chicago, underscore its influential presence in the industry.

> OORT has raised $16.2M in total after two early funding rounds from Aves Lair, Emurgo and Sanctor Capital, Taisu Ventures, RedBeard VC, Hike Ventures, and Optic Capital. Currently, the OORT network consists of 30k+ nodes covering over 107 countries.

OORT for Storage and AI



SN: Storage Node CN: Computing Node

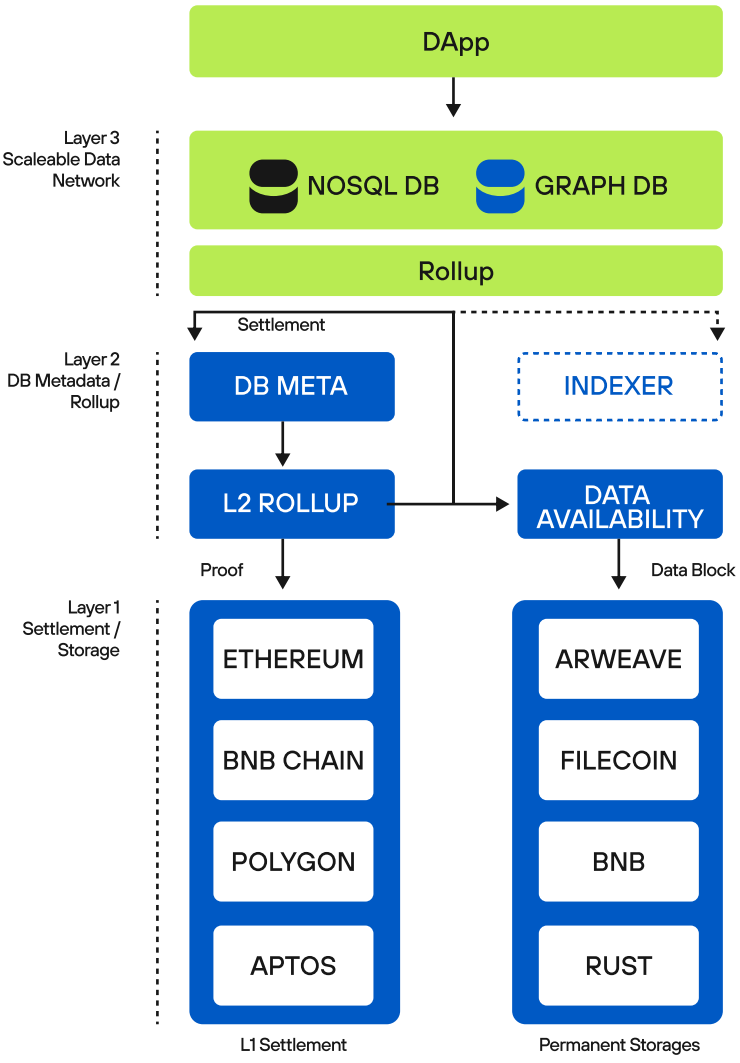
GlacierDB

STORAGE

Glacier is a Layer 2 data network designed to improve DApps' utilization of decentralized databases (DDB) with ZKP implementation. With a vision to enable DApps to integrate with decentralized databases effortlessly, Glacier offers cutting-edge programmable data composability solutions. These solutions are enhanced by L2 roll-up technology, allowing the handling of large datasets through the native NoSQL GlacierDB, which is integrated with various storage solutions, including IPFS, Arweave, Filecoin, and BNB Greenfield.

Glacier's infrastructure is designed to support the vast data needs of production-level applications, optimizing the use of on-chain data to deliver superior data services. The network's emphasis on modularization and decentralization is underscored by its implementation of ZK-rollup technology. This approach allows developers to create and manage their databases in a permissionless environment, fostering an ecosystem where Web3 developers can access and utilize data with minimal costs and maximal efficiency. Recently, the company has shown Glacier DeVector - the 1st Decentralized Vector Database built for AI.

Architecture



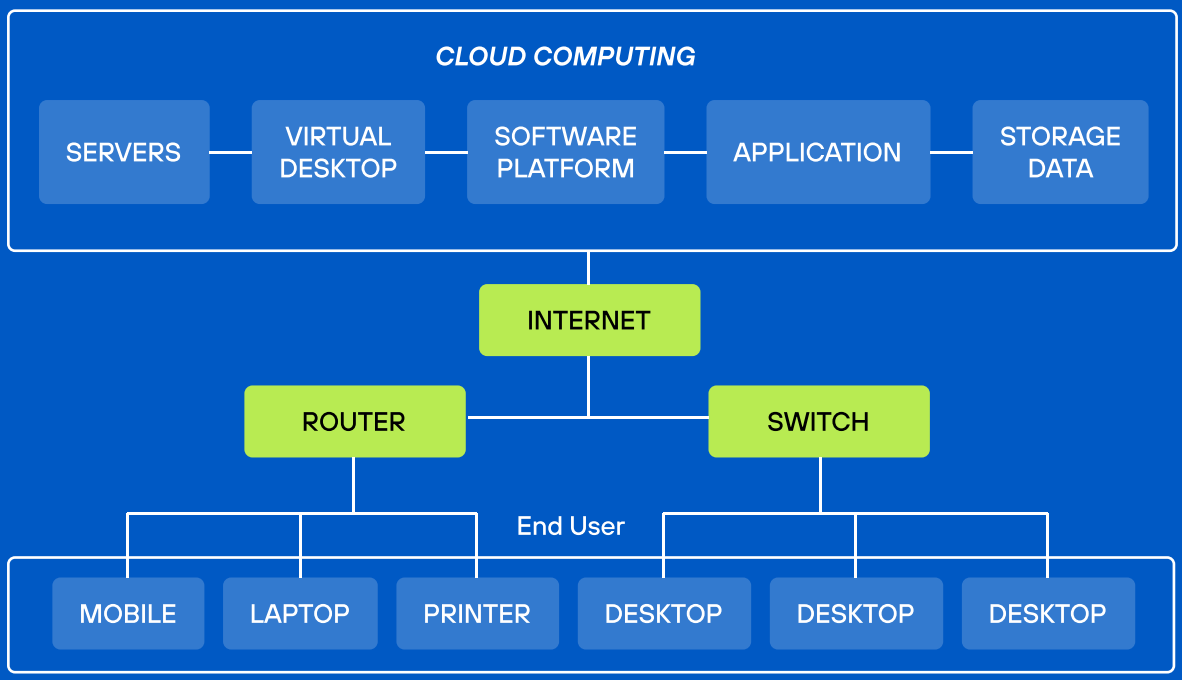
The company has attracted a $2.9 million Seed funding round supported by ForesightX, UOB Venture Management, Signum Capital, Cogitent Ventures, and Gate Labs. Additionally, Glacier has garnered recognition and support from the broader blockchain community, receiving grants from entities such as PermaDAO in the Arweave ecosystem, the Boundless Hackathon at Stanford, the Foresight X Accelerator Cohort, and the Aptos Grant Dao.

Glacier Network's Mainnet Alpha version was launched in November. This initial deployment across Arweave, BNB Greenfield, and Filecoin has already seen considerable activity, with over 3,1M on-chain CRUD Txs, 720k collections, 654k datasets, and 673k addresses.

COMPUTING

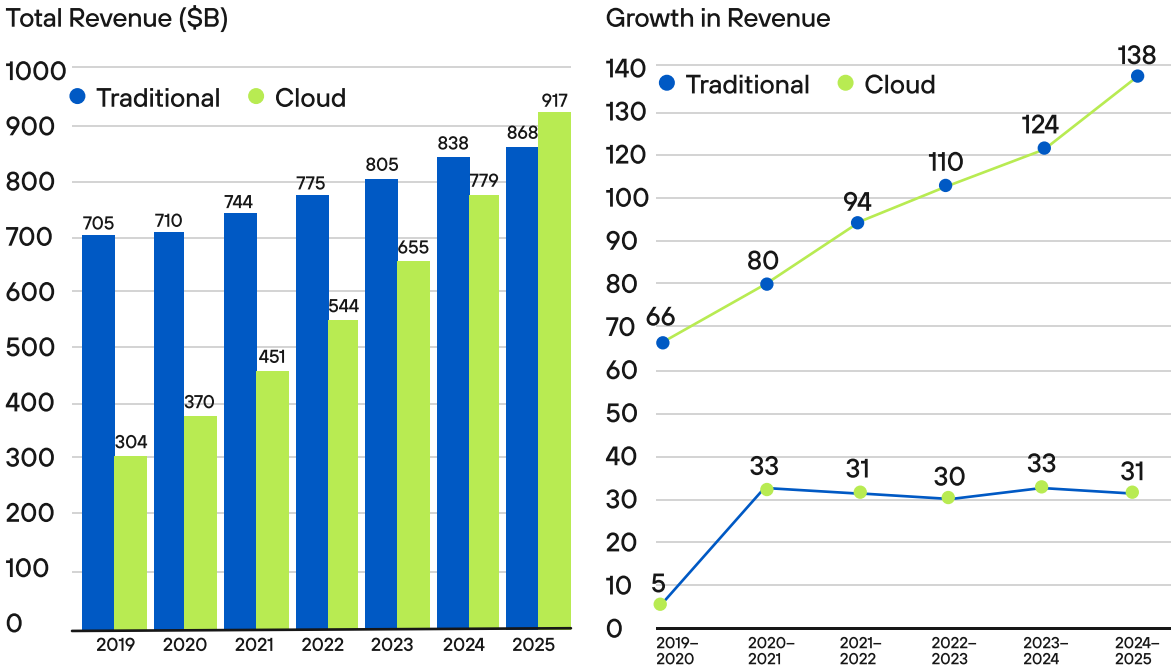
Cloud computing has changed the way we store and access data, making it possible to use online services for computing needs instead of relying on personal computers or in-house servers. This shift means businesses and individuals can use the internet to access computing resources anytime, anywhere, without investing heavily in physical hardware.

Cloud Computing Architecture



> Looking at the trends toward the end of 2023, a few key points stand out. More industries have started to see the value of incorporating decentralized computing into their operations. And the cloud computing implies growth expanding from $304B up to $917B since 2019.

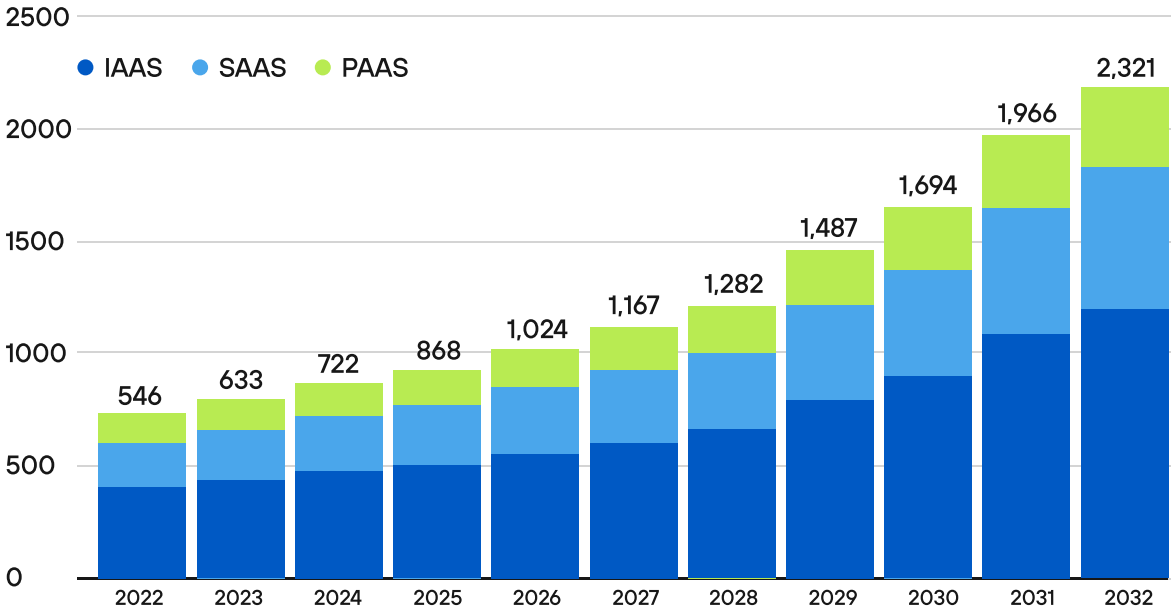
Sizing Cloud Shift, Worldwide, 2019-2025



Likewise, the technology behind cloud computing networks is getting better, making systems more scalable and easier to use across different platforms. Also, there's a growing focus on making cloud computing more sustainable and energy-efficient, which is becoming increasingly important to users and developers alike.

Global Cloud Computing Market

Size, by Service, 2022-2032 (USD Billion)



The cloud computing industry has the potential to overcome the classical computing industry, but with the rapid development pace, the cloud computing networks have also faced some challenges.

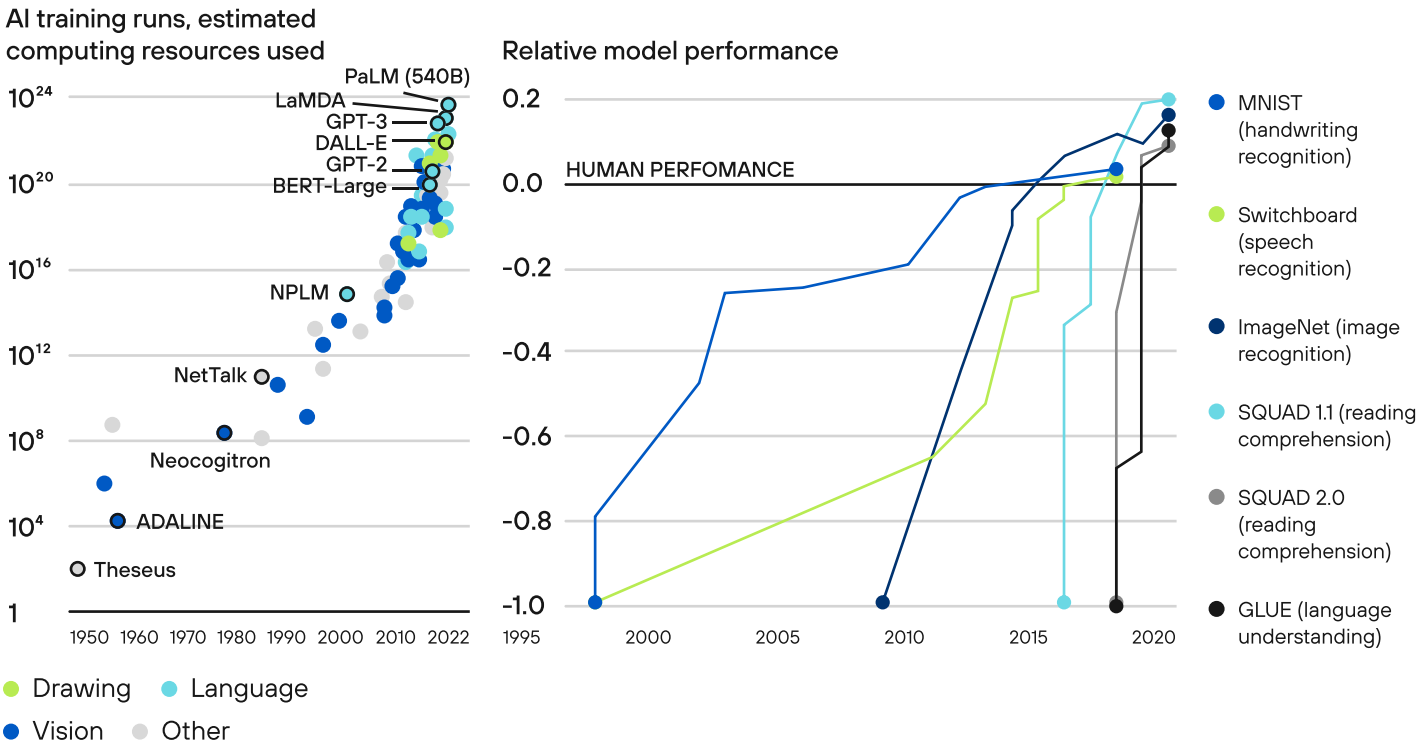
Mainly, cost has been an issue for all sectors i.e. SMB, Enterprises, and other organizations. Security problems also arise when the user interacts with the cloud service provider. That, combined with a lack of expertise as an addition, cloud computing networks may help ease the next big problem.

Top Cloud challenges

	ALL ORGANIZATIONS	ENTERPRISE	SMB
Managing cloud spend	1 82%	1 82%	1 80%
Security	2 79%	3 78%	2 73%
Lack of resources/expertise	3 78%	2 80%	47%
Governance	71%	71%	67%
Compliance	73%	72%	3 71%
Managing software licenses	72%	75%	61%
Cloud migration	66%	71%	42%
Central cloud team/Business unit responsibility balancing	67%	71%	52%
Managing multi-cloud	66%	2 80%	47%

Scalability issues of classical computing easily explain the rise of the computing market, but as a new market field, cloud computing is weak. There is an emergent need to provide the computational power to train AI and ML models. With exponential growth in AI performance, the need for computational resources has risen through 2023.

AI model exponential performance growth



By comparing the GPU hourly rates between traditional and decentralized of cloud computing providers, we can say that there is a cost disparity that challenges the recently obtained status quo of cloud computing economics. Traditional cloud services, represented by industry giants such as Amazon AWS, Microsoft Cloud, and Google Cloud, exhibit higher prices across various GPU models when compared to decentralized alternatives.

> The difference in prices shows that traditional cloud computing has problems with handling large-scale needs affordably. Decentralized computing platforms, not only offer more competitive rates but also promise enhanced computational speeds, thereby addressing both the cost concerns and performance bottlenecks.

As AI and ML models become increasingly complex, requiring more substantial computational resources, decentralized computing emerges as a compelling solution, offering lower costs and higher processing capabilities, as evidenced by the more attractive rates for GPUs like the NVIDIA A100 and RTX series.

We're going to look closely at the main players in decentralized computing and also check out some of the new projects that are just starting to make their mark in this area. We'll see who's leading the way and what new ideas are coming up. This will help us understand who's who in this field and what might be coming next.

04
DEPIN ECOSYSTEM PROJECTS:
COMPUTING

	RENDER	THETA	AKASH	HOLO	LIVEPEER
BILLING MODEL	Multi-Tier Pricing model	Subscription based on the amount of CDN, ingest, and transcoding service usage	Reverse auction mechanism	Pay for P2P on-demand access to	Subscription Based on the transoding, delivery, and storage service usage
AMOUNT OF PROCESSING UNITS	3,000+ GPU utilized	Processing Power that is equivalent to 2,500 GPU utilized (NVIDIA A100)	13,370 CPU utilized 149 GPU utilized	Each user can provide value P2P	70,000+ utilized processing units
INFRA LAYER	Solana (PoS)	Native L1 (PoS)	Cosmos (PoS)	Native L1 (Consensus-free validation)	Arbitrum (PoS)
USE CASES	Any request from 3D Models to AI	dApps deployment, AI, Video streaming	dApps deployment, AI, ML	hApps deloyment. P2P requests, Agents	Transcoding, encoding and streaming
NODE AMOUNT	600 Nodes	12,285 Nodes	77 multi-node providers (each provider can have different amount of CPUs/GPUs)	Each user is a node that operates in its own chain	70,000+ Nodes
USERS / DAA (DAILY ACTIVE ADDRESSES ATH)	2,802 DAA	15,456 DAA	N/A	14K spike, 4k 2nd spike, 150-200 DAA on average	35K spike, 19k 2nd spike, 150 DAA on average
FUNDRAISING	$47.24M	$134M	$2.8M	$20.39M	$51.85M

COMPUTING

	GOLEM	IO.NET	DYNEX	GENSYN
BILLING MODEL	Pay-as-you-use model	Hourly rate for each GPU	Marketplace with specific jobs	Pay for P2P on-demand access to a cluster of devices
AMOUNT OF PROCESSING UNITS	6,452 GPU/CPU Cores utilized	10,496 GPU will be utilized (NVIDIA RTX3090)	165,452 Utilized processing units	Each user can be added to a cluster and provide value
INFRA LAYER	zkSync (DPoS)	Solana (PoS)	Native L1 (Proof of Useful Work)	L1 Protocol (Trustless consensus mechanism)
USE CASES	Any request from 3D Models to AI	AI Models and applications	Any Sci job on native marketplace	AI/ML
NODE AMOUNT	661 multi-node Providers (each provider can have different amount of CPUs/ GPUs)	N/A	23,909 Nodes (Miners)	N/A
USERS / DAA (DAILY ACTIVE ADDRESSES ATH)	1.9K spike, 1.3k 2nd spike, 200-300 DAA on average	Enterpsise oriented	N/A	N/A
FUNDRAISING	820,000 ETH in 2016	$30M Series A	$27M	50.6M

Render

01

Key Concepts

The Render Network is a decentralized platform leveraging blockchain technology, which positions itself as a provider of distributed GPU rendering services. But with its upgrader modular architecture, Render is more than a GPU provider; it is a general-purpose computing provider that can work with AI, ML, and more. Its decentralized nature aims to democratize access to high-quality rendering and computational resources, making it more accessible to a broader range of creators and innovators. It connects users requiring rendering/computing power with those with idle GPU/computing resources.

> **INFRASTRUCTURE LAYER: SOLANA.**

Transactions are facilitated using RENDER Tokens, which function as the medium of exchange within the network and the rewards for node owners, with the network taking a percentage for its services. RENDER utilizes smart contracts on the Solana blockchain for automated and robust operations. Users create Ethereum-linked accounts to engage in rendering services, with transactions executed via smart contracts. Key roles include Creators, Node Operators, and Dual Use users who provide and use rendering services.
Key components of the Render Network include:

> ***Node Operators:*** Individuals or entities providing GPU power to the network. They receive RNDR tokens in exchange for their services.

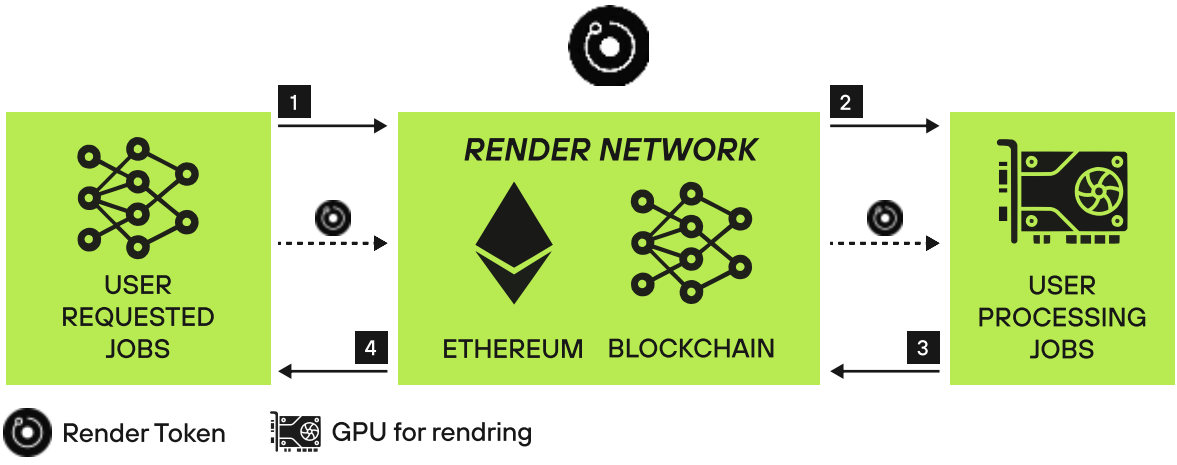
> ***Content Creators:*** Users who require rendering services for their projects. They purchase RNDR tokens to pay for these services.

> ***Job Matching:*** A mechanism that pairs rendering jobs with available GPU resources, ensuring efficient allocation and utilization.

> ***Economic Model:*** The Render Network's economic model balances the supply and demand of rendering power and RENDER tokens, aiming for a sustainable ecosystem.

> ***Integration with Existing Tools:*** The platform is designed to integrate seamlessly with popular rendering software and tools, facilitating ease of use for content creators.

Render System Flow



Product updates

Render Network transitioned from the Ethereum blockchain to Solana, through governance proposal RNP-002.

Also, the Solana transition included change from RNDR to new SPL token, RENDER.

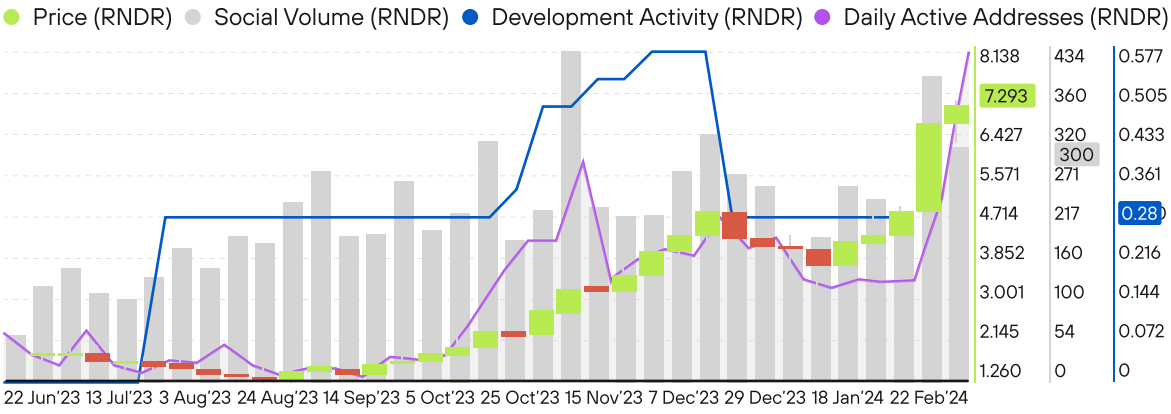
Throughout 2023, Render Network introduced a points-based incentive system for users participating in the network's token transition. It was proposed in RNP-006.

In the next 2 proposals, RNP-007 and RNP-008 Render introduced 2 new compute clients - FEDML and Nosana.

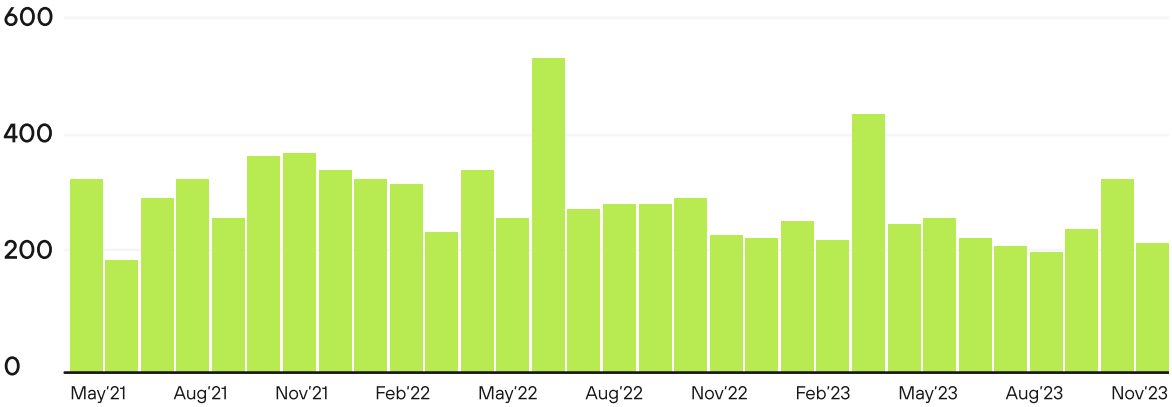
By the end of 2023, the community developed and approved the mechanism for distributing rewards among the nodes that are supporting new compute clients. To be eligible for rewards in the Render Network, Compute Client Nodes must be on the approved GPU model list, have joined the waitlist with a valid Solana wallet for reward deposits, be actively operating within a cohort using io.net's or other compute client, and maintain an average download speed of over 100Mbps and an upload speed of over 75Mbps.

Metrics

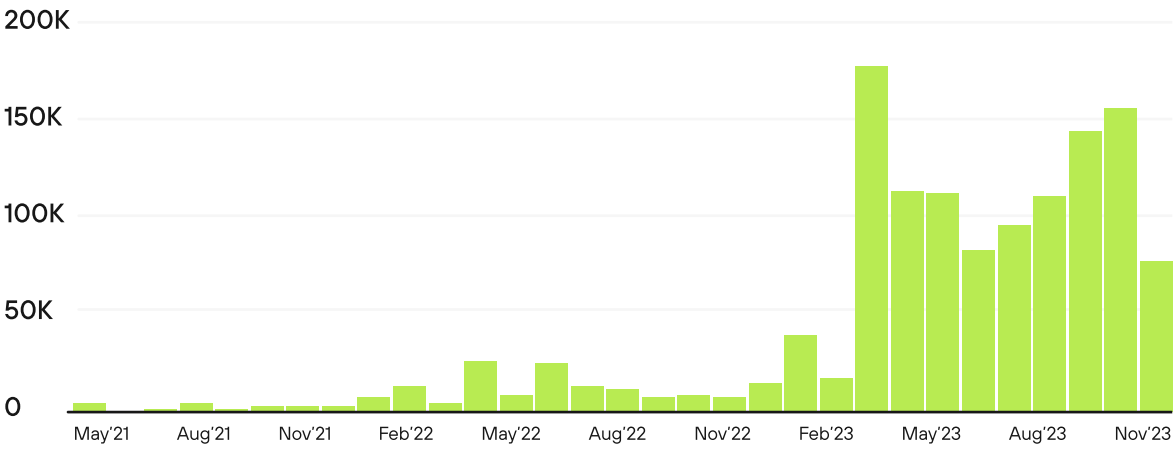
Render (RNDR) Santiment



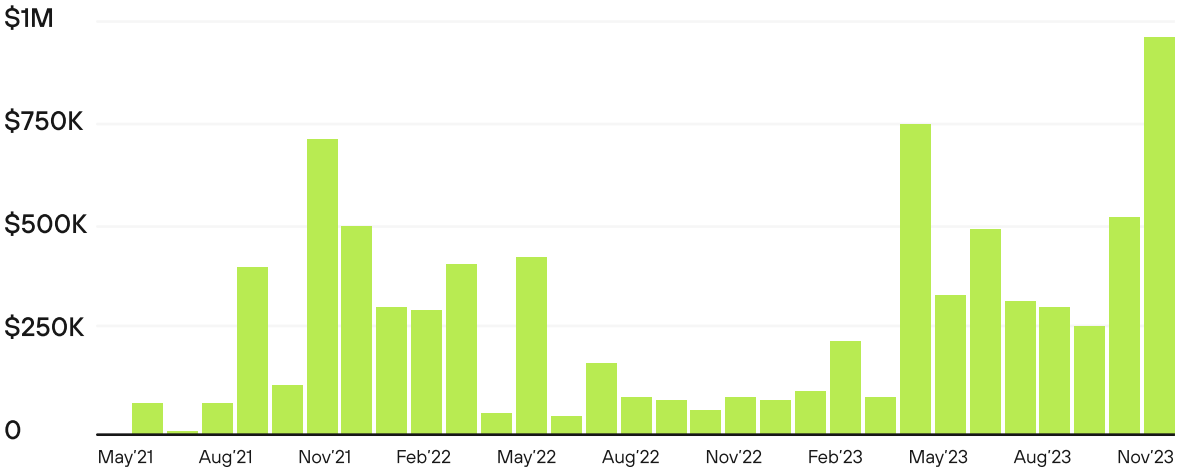
Node Operators



Monthly Rendered Scenes



Monthly Payments to Render Node Operators in USD



Ecosystem

The Render Network has proposed the integration of two new compute clients, FEDML and Nosana, to its existing pool which includes IO.NET and Beam. These additions aim to enhance the network's capacity for supporting AI LLM services through specific technical enhancements and resource optimizations.

FEDML is introduced as a compute client with a focus on facilitating the interoperability between AI applications and computational resources. Its role within the network is to improve the efficiency of resource allocation for AI-driven computational tasks, thereby expanding the network's capability to support a wider range of AI workloads.

Nosana is proposed as another compute client, targeting three specific challenges: mitigating GPU shortages, addressing the underutilization of computational resources, and reducing dependency on high-cost public cloud services. By leveraging the decentralized GPU network of the Render Network, Nosana aims to improve resource availability, optimize compute utilization, and lower the financial barriers to accessing computational power for AI inference tasks.

Theta

02

Key Concepts

The Theta Network is a decentralized video streaming service. Its primary objective is to enhance streaming quality and reduce operational costs through a distributed network that leverages user-contributed bandwidth and computing resources.

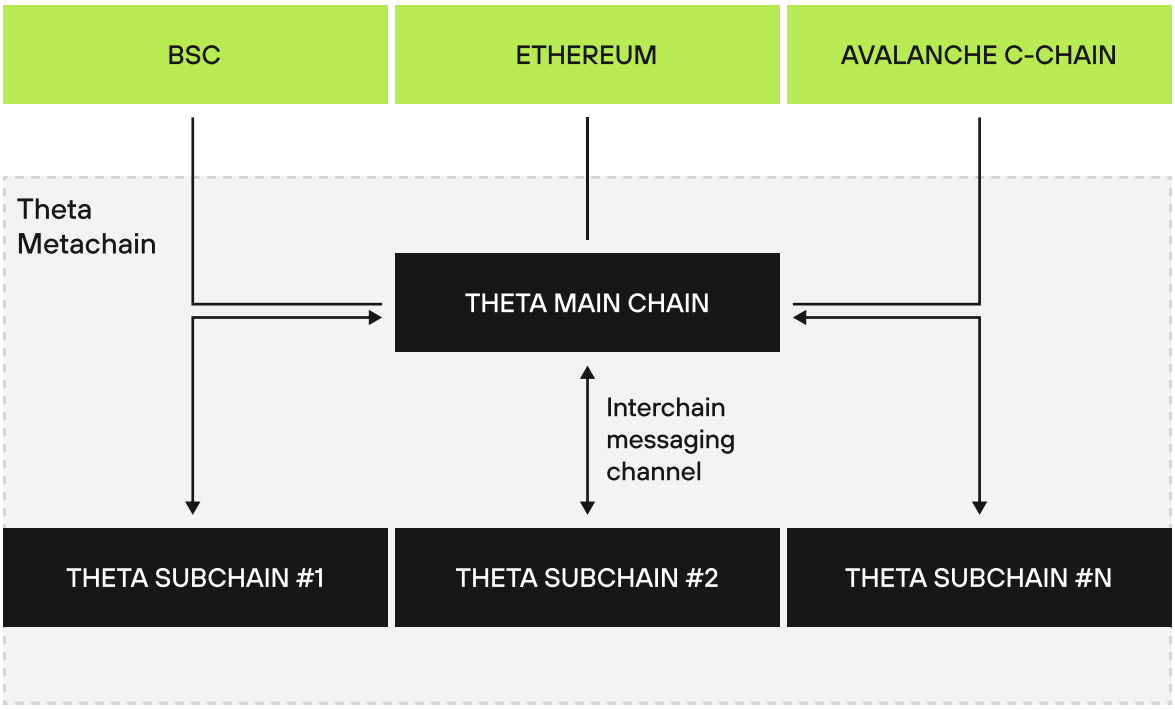
At the core of Theta are Edge Nodes, which decentralize the streaming process by distributing video content across the network. This method aims to increase bandwidth availability and improve streaming quality. The network's design includes a multi-level Byzantine Fault Tolerance (BFT) consensus mechanism, comprising high-performance validator nodes for block production and Guardian Nodes for blockchain ledger finalization, ensuring transaction throughput and network security.

The network architecture utilizes two distinct tokens: THETA, which is designated for governance, so anyone can stake these tokens to participate in network decision-making. TFUEL, on the other hand, is used for transactional processes within the network and incentivization for sharing bandwidth and resources.

- **INFRASTRUCTURE LAYER: NATIVE BLOCKCHAIN.**

Theta Network also incorporates EdgeCast technology, enabling decentralized video streaming end-to-end, thereby eliminating reliance on centralized servers. The architecture supports interoperability with other EVM-Compatible blockchains, facilitating various applications and use cases.

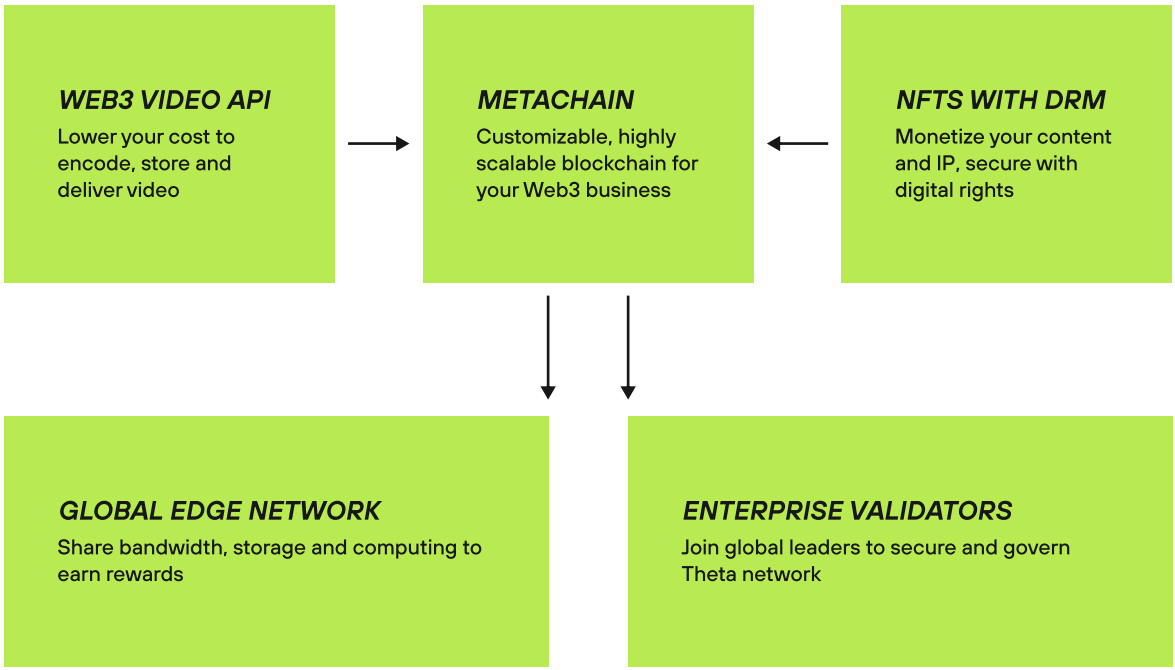
Theta Metachain



Metachain is a central component of Theta's architecture, and coordinates multiple subchains, each dedicated to specific video streaming and content delivery tasks. The network also integrates NFTs with Digital Rights Management (DRM) for content creators, allowing tokenization of digital assets and securing intellectual property rights through blockchain authentication.

Theta's network security is reinforced by a consortium of Enterprise Validators, consisting of major entities and industry leaders responsible for validating transactions and blocks, thus contributing to the network's stability and governance integrity.

Theta Video Infrastructure



Product updates

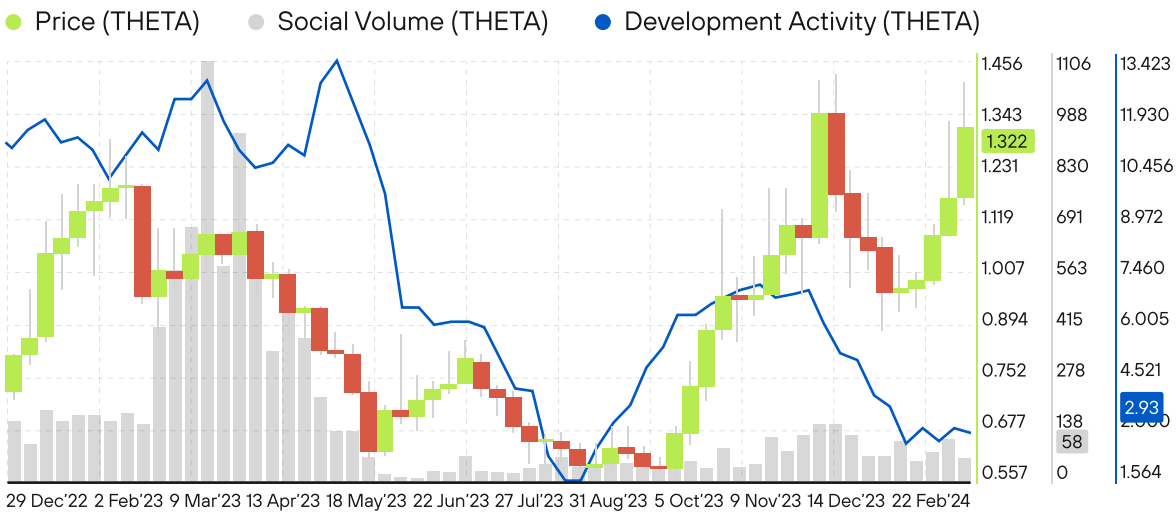
> Announcement of Theta EdgeCloud: The 1st hybrid cloud computing platform built on a fully distributed edge architecture designed to serve the computing needs of video, 3D rendering, AI, and more. Theta EdgeCloud is set to launch new phases in 2024.

> The Guardian Node program represents Theta's network security and governance approach, allowing token holders to participate in the consensus process. This decentralized governance model contributes to the network's overall security and operational integrity.

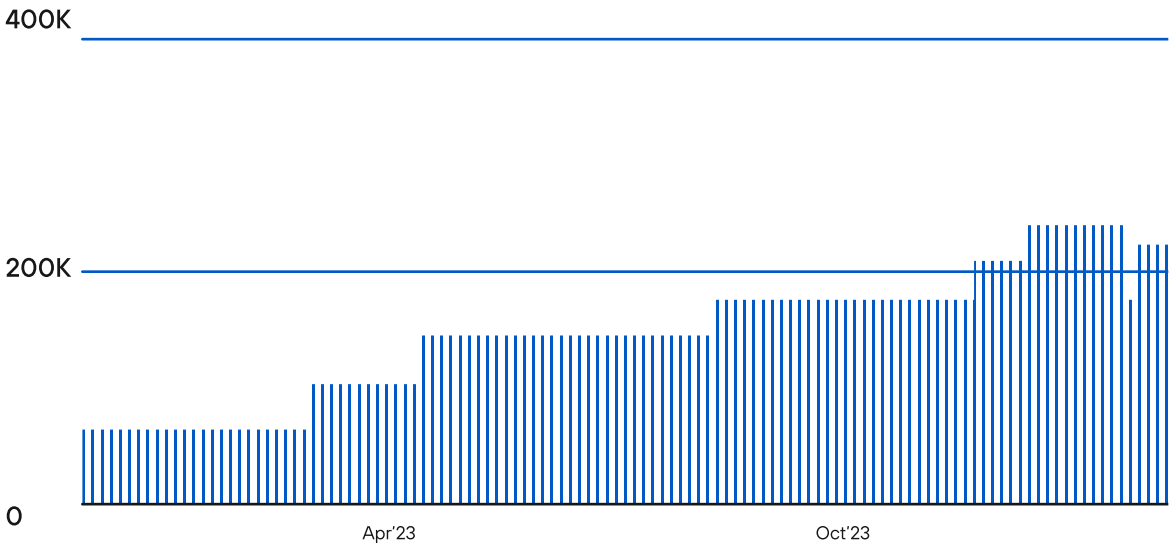
> Theta Labs has partnered with POG Digital to create the POG subchain on Theta Network. This subchain, known as POGCHAIN, will feature TNT20 tokens and NFT, based on the popular 90s game POG. These collectibles will be available exclusively through the Theta-patented POG Collector platform.

Metrics

Theta Network Santiment



Theta Metachain Tansaction History (1 Year)



12,779 /16,106
24H Blocks / Transactions

3,407,109
Total Onchain Wallets

14,323
Daily Active Wallets

Theta Nodes Statistics

9 780	3 000	29
Active Edge Node	Guardian Node	Validator Node

Ecosystem

50+

projects

50+

partnerships

NFT Collection

for World Poker Tour

As of Q4 2023, the Theta Network ecosystem comprises a network of 50 projects and 50 more partner entities.

Content delivery on Theta Network is facilitated through partnerships with entities such as Samsung VR and G Fuel, utilizing Theta's blockchain for streaming video content. In the esports and gaming sector, collaborations with platforms like SLIVER.tv aim to enhance viewer experiences via decentralized streaming mechanisms.

DeFi: The introduction of ThetaSwap, the network's decentralized exchange, signifies Theta's entry into the DeFi space. There are three more projects in the DeFi field that are currently built on Theta.

NFTs: In the NFT domain, Theta has engaged with the World Poker Tour (WPT) to issue NFT collectibles. The NFT sector is the biggest in the Theta Ecosystem, comprising 22 projects.

Tools: To support the ecosystem development and expansion, Theta Network has 14 Tool-apps that help create and validate apps on the Theta Chain. These include Thetaboard and ThetaScan for discovering new apps and activity inside the network, ChainSmith for Subchain deployment, Name Services, Passport providers, Node support such as Guardian Monitor, and more. Among Streaming Resources, there are Theta Video API and Theta.tv.

Games: Games on Theta have their space too, as there are 3 of them + an Animation and Web3 Entertainment studio - IEL. Theta also features ThetaLands as its metaverse project, Clan Wars TCG - an NFT-based trading card game and Fuse Wars, a 3rd-person shooter.

The AI/ML sector includes FedML and Lavita. FedML is an ML platform designed to train, deploy, monitor and improve models, while Lavita is closer to DeSci as it provides private health data through a marketplace powered by AI.

Akash

03

Key Concepts

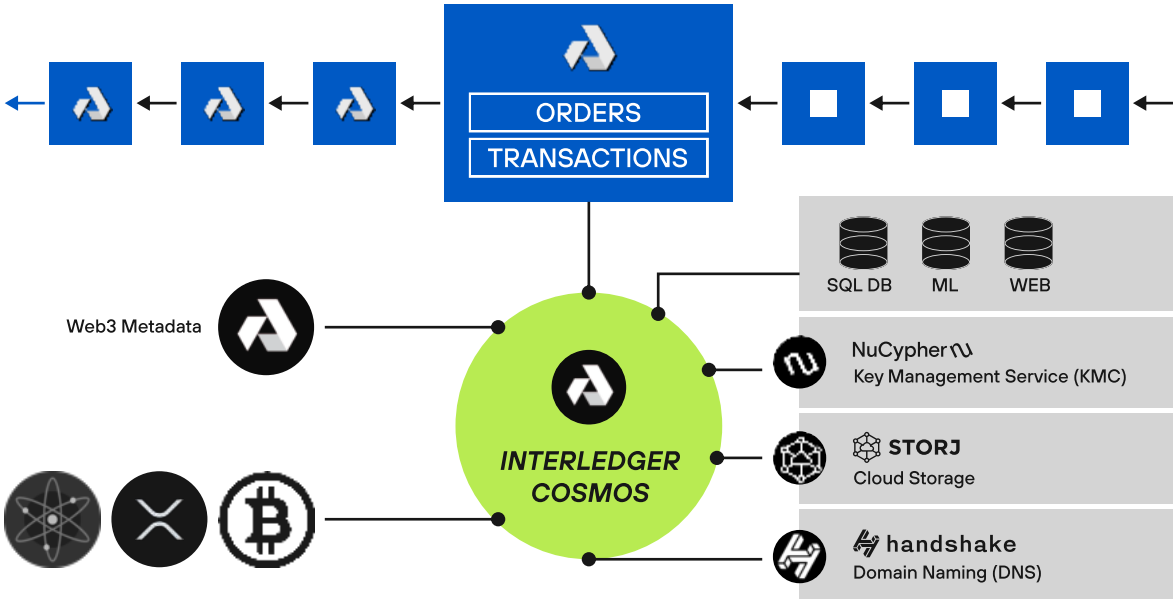
The Akash Network is a decentralized cloud computing platform anchored by a blockchain-based marketplace. This marketplace transparently connects those needing computing resources (tenants) with providers offering spare capacity, from individual computers to data centers, including unique Supermini servers for home use. The network's decentralized structure democratizes cloud resource access and enhances resilience.

INFRASTRUCTURE LAYER: COSMOS.

The network's technical foundation is built on container technology, which encapsulates applications in a standardized environment that includes all necessary dependencies. This ensures that applications can operate consistently across different computing environments. Containers facilitate the deployment process by isolating the application from the underlying infrastructure, making it easier to manage and scale applications across the decentralized network. For governance and security, the network uses a staking and delegation system with its native AKT token. Participants can stake tokens as a security measure, which helps to ensure compliance with network protocols. The delegation feature allows token holders to entrust their tokens to others, extending their participation in network governance. Governance operates through a DAO, wherein AKT token holders vote on proposals, directing the network's development based on collective decision-making. This setup is intended to align network evolution with the preferences of its user base.

Interoperability within the Akash Network is achieved through the Inter-Blockchain Communication (IBC) protocol, enabling the network to exchange data and value with other blockchain systems. This feature is critical for enhancing the network's capacity to support various applications and services, contributing to its scalability and flexibility.

Akash High-level Architecture



Product updates

In Q4 2023, Akash Network updated its infrastructure to support the growing demands of large language models (LLMs) and other applications.

Akash Network executed three mainnet upgrades to enhance its Supercloud for AI and compute-intensive tasks: Mainnet 7 increased deployment sizes, Mainnet 8 streamlined GPU access for developers, and Mainnet 9 improved bid validation on multi-service deployments.

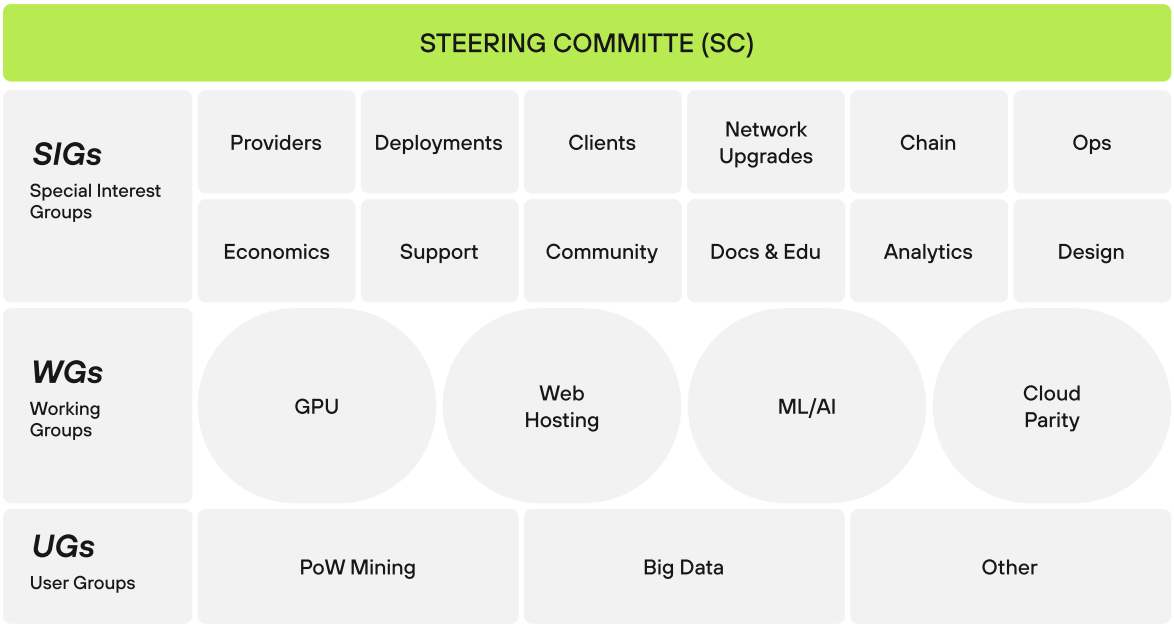
In collaboration with Thumper.ai, Akash facilitated re-training a Stable Diffusion model on a permissionless network, a first of its kind, utilizing significant GPU resources for open sharing.

This demonstrated versatility in GPU usage for AI tasks, enabling a more comprehensive range of open-source and permissionless AI applications without relying solely on top-tier GPUs.

Two significant improvements were marked in the network's development: open-sourcing the entire Akash codebase to resemble a DAO structure and enhancing network capabilities with support for GPUs, initially NVIDIA and subsequently expanding to AMD.

The community-centric development of Akash, inspired by Kubernetes and the DAO framework, created a new open organization. This system relies on Special Interest Groups (SIGs) and Working Groups (WGs), which meet regularly in public sessions, with the Steering Committee overseeing projects.

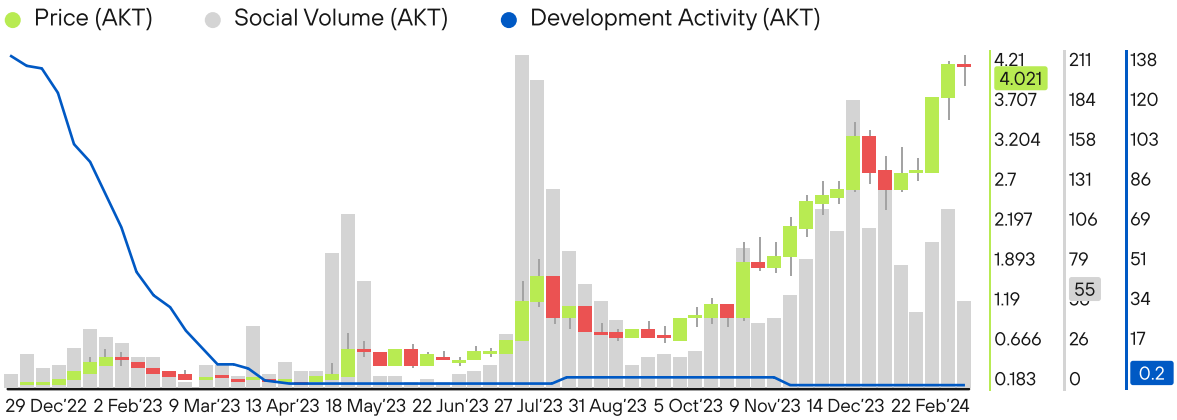
Akash Community Organization



(NOT an exhaustive list. may change over time)

Metrics

Akash (AKT) Santiment

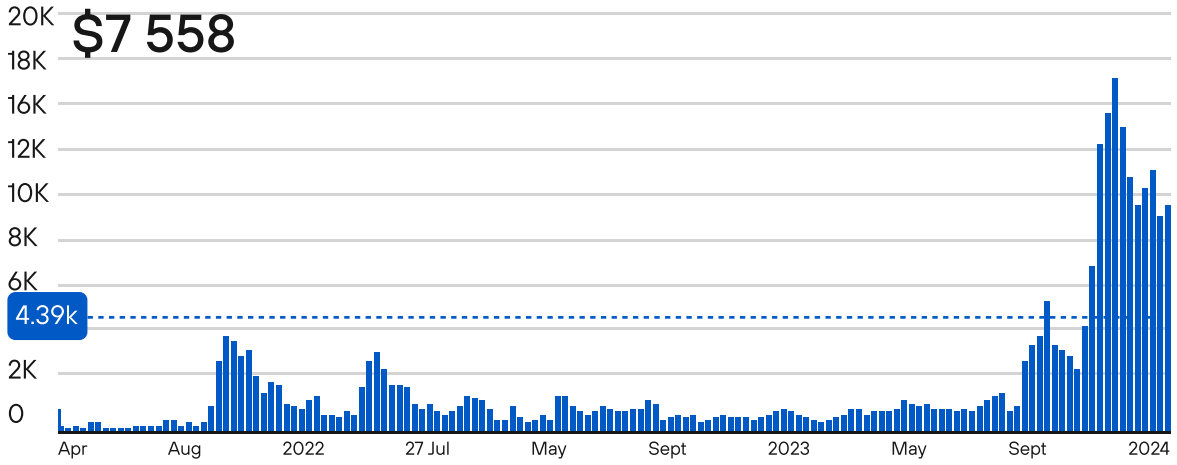


Demand-side protocol fees (7d)

$45 192
30d Fees

$143 795
90d Fees

$273 736
Total Fees



Akash Network Statistics

TOTAL RESOURCES LEASED

ACTIVE LEASES	COMPUTE	GRAPHICS	MEMORY	STORAGE
2 037	6 745,27 CPU	53 GPU	16,11 TB	327,32 TB
+78 ▲ 3,98%	+362,8 ▲ 5,68%	+2 ▲ 3,92%	+370,4 GB ▲ 2,35%	+18,65 TB ▲ 6,04%

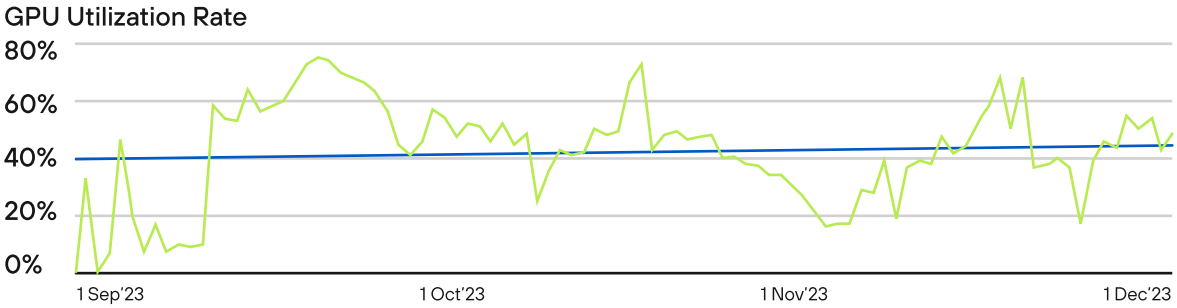
NETWORK CAPACITY

ACTIVE PROVIDERS	COMPUTE	GRAPHICS	MEMORY	STORAGE
75	12 538 CPU	190 GPU	64,56 TB	918,63 TB
+2 ▲ 2,6%	+72 ▲ 0,57%	+1 ▲ 0,53%	+293,98 GB ▲ 0,45%	+1,08 TB ▲ 0,12%

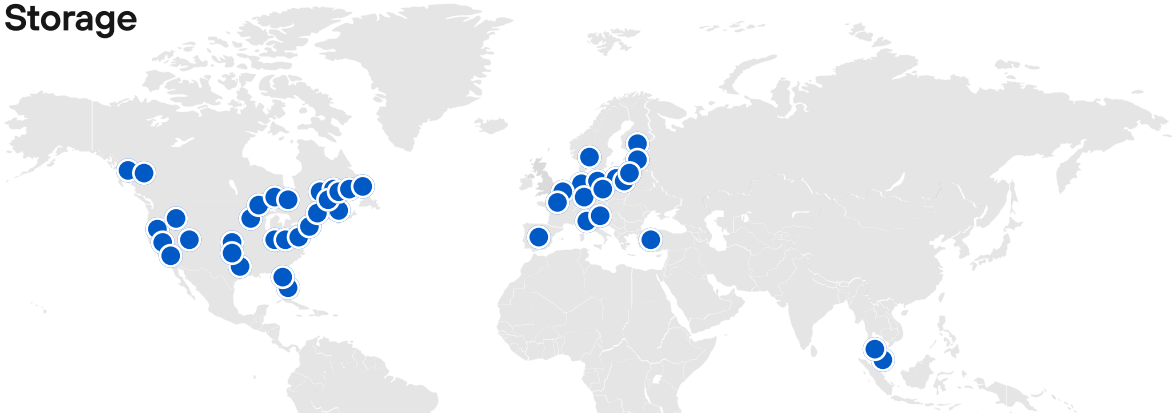
CPU Capacity

10 846,9

Daily Average GPU Utilization Rate on the Akash Network

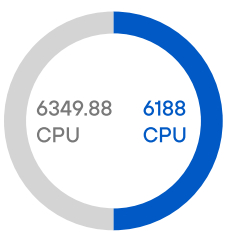


Geographical Distribution of CPU, GPU, Memory and Storage



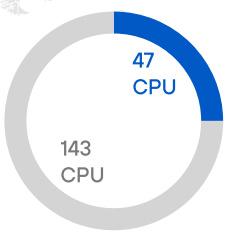
CPU

6188 CPU / 12538 CPU



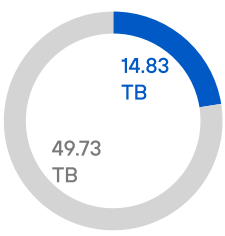
GPU

47 GPU / 190 GPU



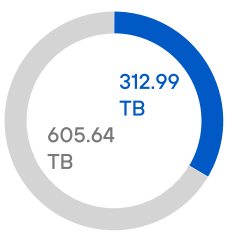
Memory

14.83 TB / 64.56 TB



Storage

312.99 TB / 918.63 TB



HOLO

Key Concepts

Holo, powered by Holochain, is a distributed platform for hosting peer-to-peer applications. It operates through a combination of technological components and economic mechanisms, as outlined below:

1. Holo Hosting Network: Similar to Airbnb's model for space rental, Holo allows users to share computing capacity for hosting distributed applications, emphasizing community empowerment.
2. HoloFuel: The micro-currency for the Holo network, HoloFuel is used by app publishers to pay hosts for services, designed for high-volume microtransactions.
3. HoloToken (HOT): An ERC-20 token, HOT is convertible to HoloFuel during a specified period and remains available on exchanges afterward.
4. Holochain Framework: Holochain is an open-source, agent-centric framework for building dApps, offering users autonomy over their data and interactions.
5. Reserve Accounts & Currency Swap: These accounts manage Holo credits' supply, dynamically responding to market demand by correlating with external currencies.
6. HoloPorts: Specialized hardware devices, like HoloPort and HoloPort+, enable users to efficiently host applications with varied capabilities.

INFRASTRUCTURE LAYER: NATIVE BLOCKCHAIN.

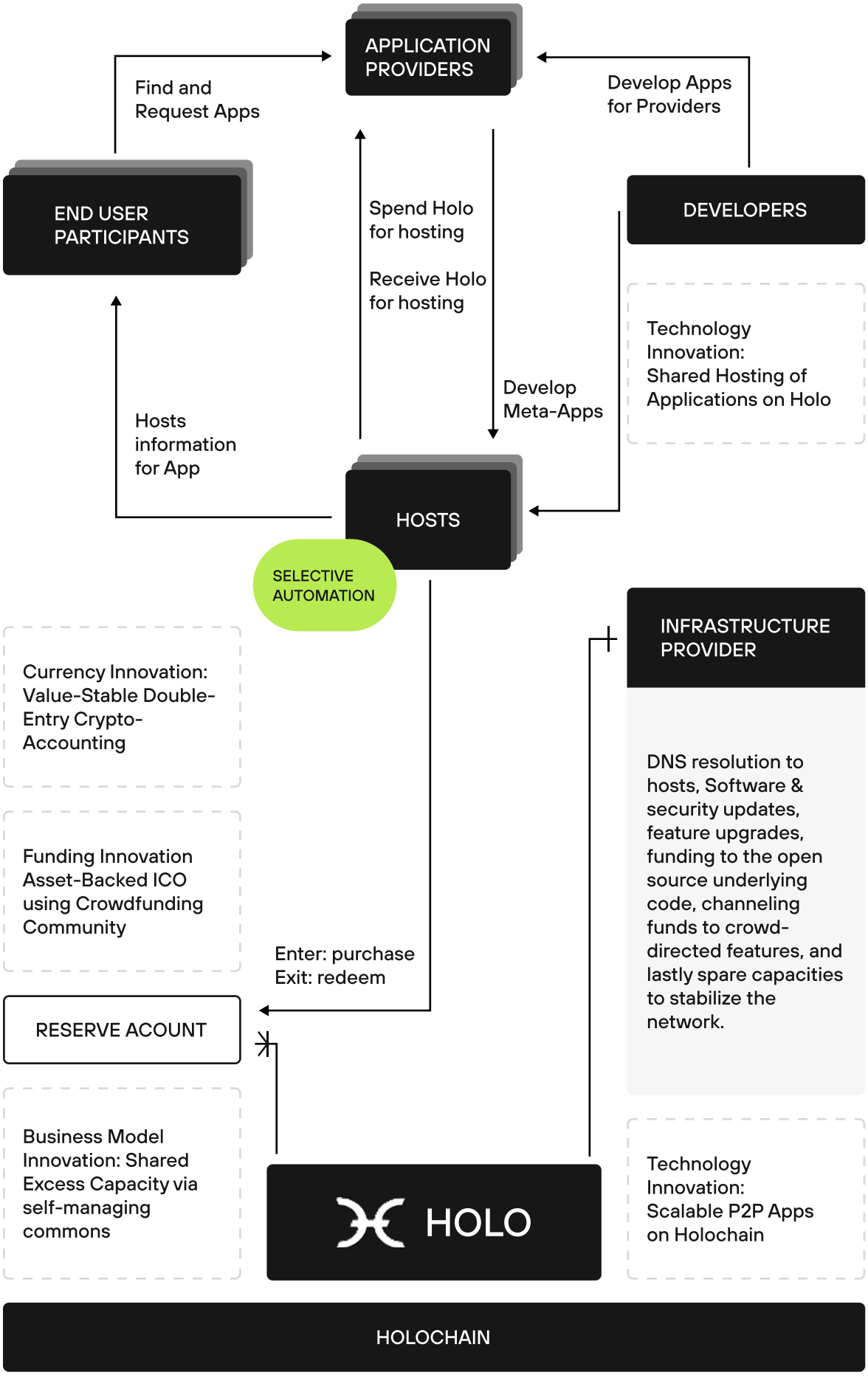
Holochain's architecture is critical to Holo's operation, ensuring data integrity and security by assigning each user their transaction chain. Hosts, using HoloPorts, provide the network's infrastructure by contributing computing and storage resources. HoloFuel facilitates transactions, rewarding hosts for their contributions.

The Holo network facilitates distributed hosting of Holochain applications (hApps) by leveraging computing resources provided by individual hosts. These hosts utilize devices such as HoloPorts to serve hApps to end-users via traditional web interfaces.

The network operates on a model where hosts are compensated for their services with HoloFuel, a digital currency designed for transactions within the Holo ecosystem. The process involves hosts connecting to the Holochain Distributed Hash Table (DHT) to fetch and serve application data to users, who access these services through conventional web browsers without requiring specialized software or direct interaction with the Holochain network.

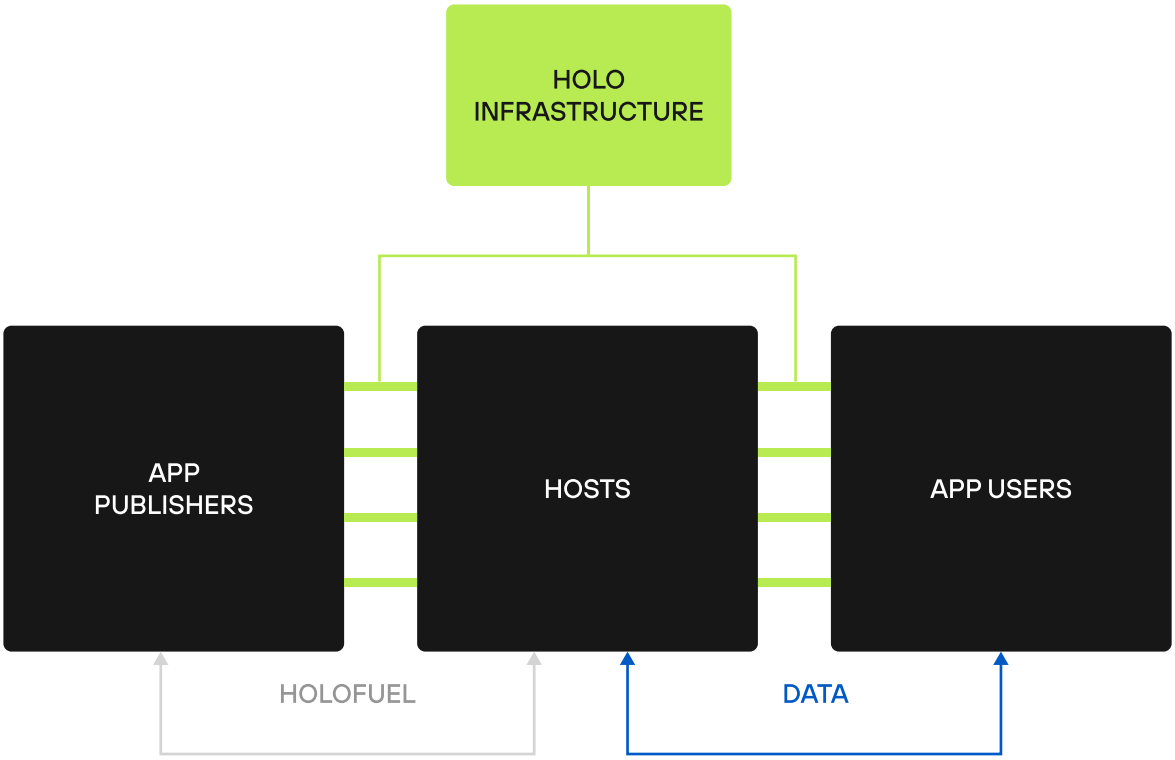
Holo serves as a bridge between the traditional internet and Holochain's decentralized world, allowing dApps to be accessed via standard web protocols. Holochain's dApp architecture is modular, enabling easy composition and code sharing.

Holo Architecture



Each app (DNA) has its own logic, peer network, and database, with users operating as independent agents. The architecture includes client-level interactions with the Holochain conductor via WebSocket, with the conductor hosting multiple hApps. Each hApp comprises cells - live instances of DNAs - running with unique cryptographic keys. DNAs contain zones for core logic and data integrity, ensuring each user's sovereignty within the network.

Holo Platform



Product updates

Holochain Beta Release: Early 2023 saw the release of Holochain Beta 0.1.0, followed by continual updates and an early release of version 0.2.x.

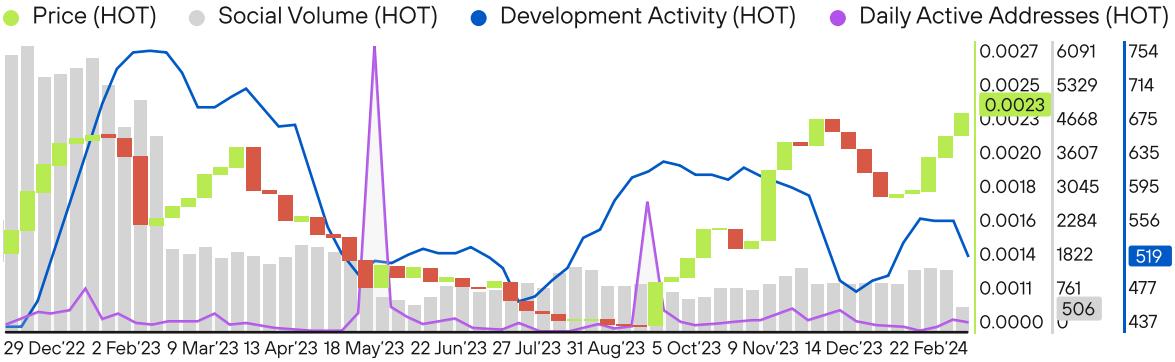
Developer Engagement: Holochain conducted online developer training and participated in various events like EthDenver, focusing on enhancing developer skills and understanding of the Holochain framework.

In December, Holo announced the Network Release Candidate. This release, which is not the final launch, focused on completing critical features and preparing for a third-party security audit, particularly of HoloFuel.

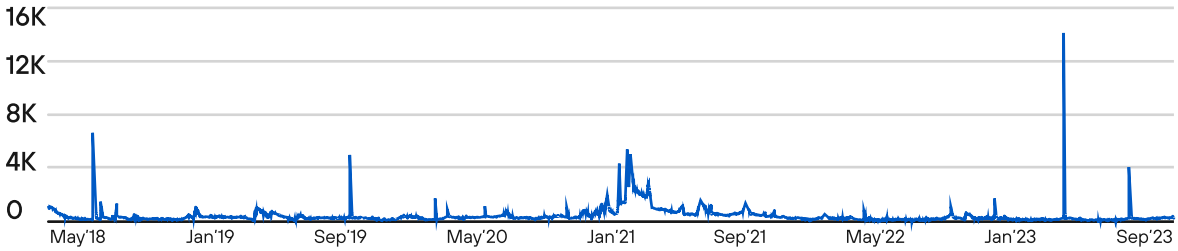
The Network-RC phase involved hosting different applications on the alpha network and was followed by a period of enhancing security measures and preparing the code base for operational readiness. The release was initially deployed to the Alpha Test network, with plans for public deployment and further development based on user feedback and ongoing enhancements. The official network launch is anticipated in Q2 2024.

Metrics

Holo (HOT) Santiment



Holo: Number of Active Addresses



Ecosystem

DWeb Camp Participation: Holochain's active involvement in DWeb Camp included developing a custom app for the event and having a workshop about how to "Build Businesses with Holochain". And much more productive discussions, AMAs and workshops were handled during this event.

Web3 and Blockchain Integration: Fall 2023 marked Holochain's increased application in Web3 and blockchain contexts, showcased through various collaborative projects and event participations. Nor and Fractal Tribute were developped and showcased at different events through the end of the year.

There are 4 apps that are on the front of the hApps development in the Holochain network. Fractal Tribute, Nor, IOEN and Neighbourhoods. Which are:

- ***Fractal Tribute*** — a collaborative art game built on Holochain and inspired by r/place. In this real time game, players make "moves" by placing pixels on a shared canvas, building upon all previous moves, and thus coordinating to draw new patterns and art.
- ***Nor*** — the foundation for games or as they call it "Game of games".
- ***IOEN*** (Internet of Energy Network) — A software protocol to coordinate devices that produce, consume, or store electricity.
- ***Neighbourhood*** — Giving groups the capacity to intentionally design cultural values into their groupware tools.

Livepeer

Key Concepts

Livepeer is a decentralized video streaming network built on blockchain technology. The primary actors include content creators and broadcasters (broadcaster nodes), transcoding nodes, and token holders. Content creators and broadcasters who generate video content send their streams to the network for processing.

Transcoding nodes, operated by individuals or entities holding Livepeer Tokens (LPT), provide the computational power necessary for video transcoding, converting streams into formats suitable for various devices and bandwidths.

The Livepeer Media Server (LPMS) enables the efficient transcoding and distribution of live video content. The network decentralizes video processing through this arrangement, offering a scalable and cost-effective alternative to traditional centralized video streaming services.

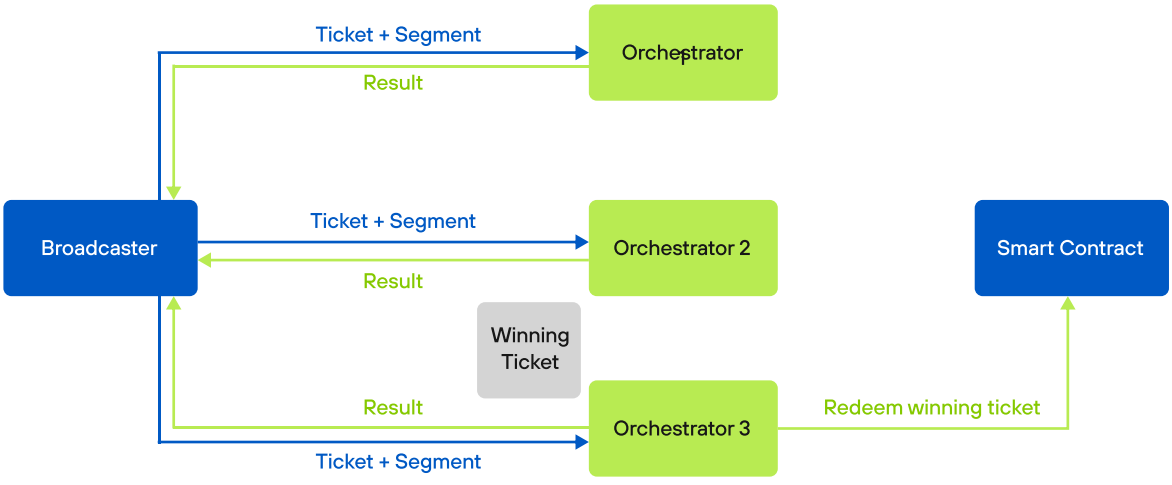
INFRASTRUCTURE LAYER: ARBITRUM.

In the Livepeer ecosystem, some Orchestrators and Delegators facilitate efficient video processing and distribution. Orchestrators are responsible for transcoding video streams, converting them into various formats and resolutions to ensure compatibility across different devices and bandwidth conditions.

They stake LPT to participate in the network, and their performance and reliability can influence their earnings from transcoding jobs. Delegators, on the other hand, are token holders who delegate their LPT to Orchestrators they trust to perform the work effectively instead of directly participating in transcoding.

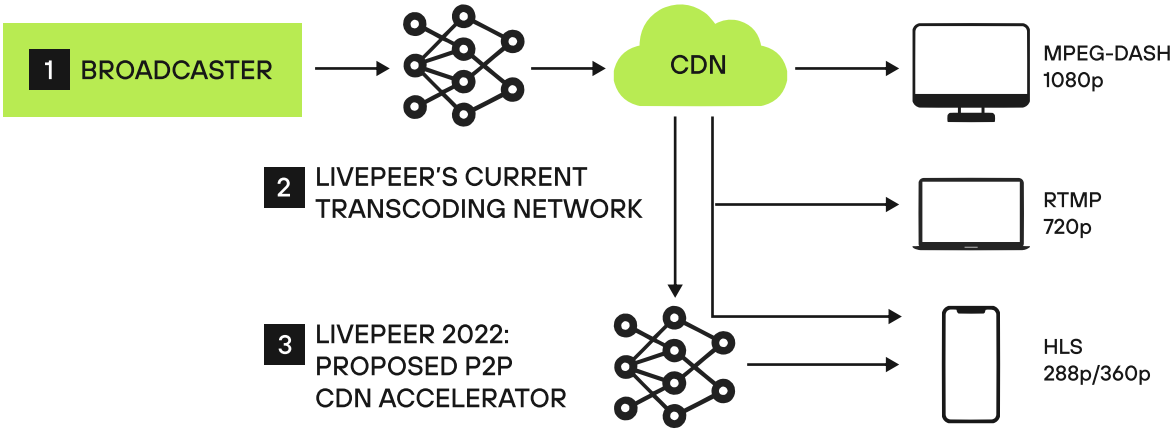
All these nodes receive compensation for their services in the form of LPT and transaction fees. LPT serves as both a medium of exchange for services and a tool for protocol governance through a Delegated Proof of Stake (DPoS) system.

Livepeer Payment Model



How Livepeer decentralizes video infrastructure

1 The broadcaster sends video through Livepeer using standard video API.	2 Nodes on Livepeer network transcode video.	3 Livepeer's proposed p2p CDN accelerator can take 75% of the load (and cost) off the CDN.



Livepeer's architecture is centered around "Assets," which are essentially static video files within its ecosystem. Each asset is given a unique ID and attached metadata for easy management and reference. These assets are stored with s3-compatible storage providers, making them accessible for playback through Livepeer or any compatible third-party video player via a unique 'playbackId.'

For security of these video assets, Livepeer employs 'AES-CBC' encryption. This involves a two-step encryption process where the video content and its encryption key are encrypted. Once encrypted, these assets and their keys are safely stored on Livepeer. Through this approach, Livepeer leverages blockchain technology to provide a secure and decentralized video streaming service, allowing users and service providers to manage and distribute video content securely.

Product updates

> In 2023, Livepeer introduced significant upgrades to its documentation and developer tools, incorporating AI technology. This included an AI-powered chatbot, Interactive API, multi-language SDKs, and a revamped command line interface.

> Additionally, Livepeer Studio received enhancements such as improved streaming latency, clipping capabilities, livestream thumb-nailing, multi-streaming, user engagement features, in-browser broadcasting, a transcoding API, and stream health monitoring.

> The technical roadmap for Livepeer identifies key areas for future development. These include enabling video developers to create custom workflows, integrating AI video compute jobs on Livepeer's GPU network, expanding media processing capabilities, and strengthening network resilience through increased decentralization.

> Go Livepeer, the Go implementation of the Livepeer protocol, released new versions to improve transcoding quality and introduce a new broadcaster selection algorithm.

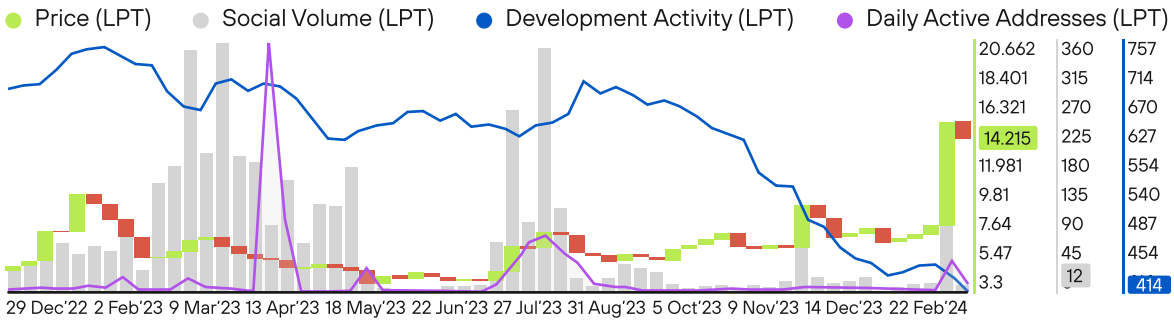
A survey of node operators on the Livepeer network revealed insights into their operational costs and hardware configurations, predominantly smaller GPUs, with an average of four GPUs per operator.

In governance developments, the Livepeer community launched the Delta Upgrade and an on-chain treasury in October 2023. This treasury, funded by a portion of mintable tokens, supports ecosystem projects and initiatives like the Grants Program and Livepeer Innovators DAO.

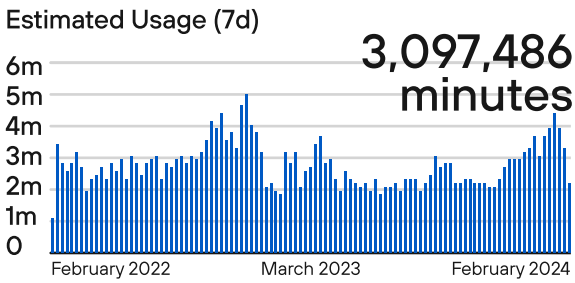
Discussions are underway to expand Livepeer's scope to include AI-based video compute jobs, leveraging the network's decentralized physical infrastructure. A proposal for node operators to run AI inference jobs on a mainnet sub-network is being considered.

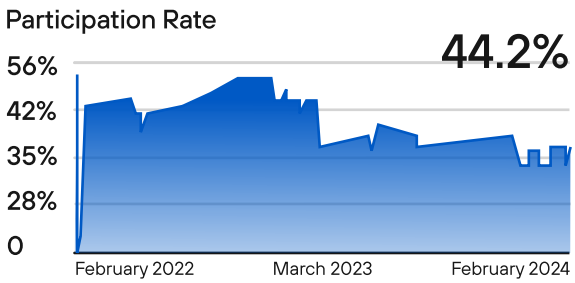
Metrics

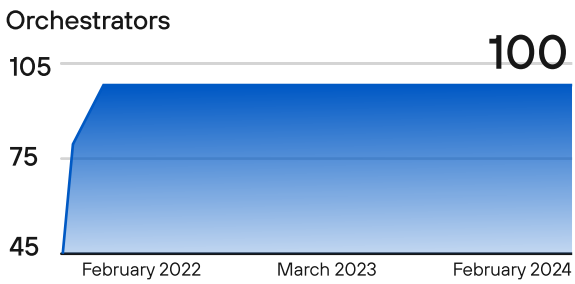
Livepeer (LPT) Santiment

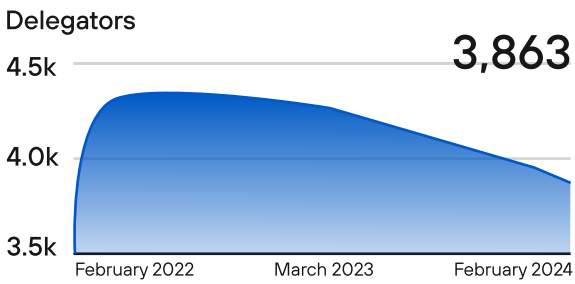


Livepeer Network Statistics

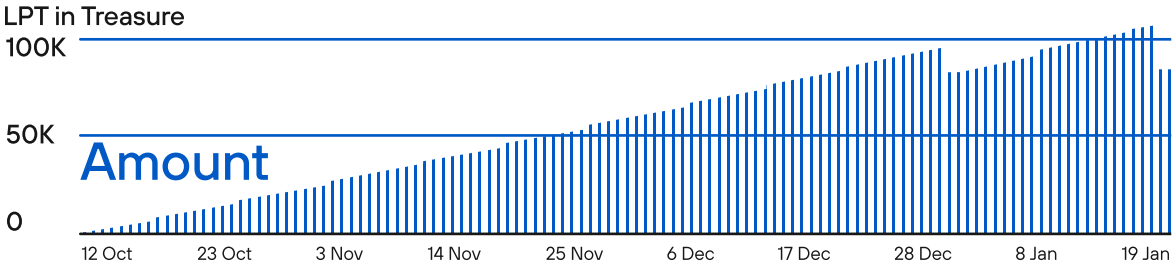




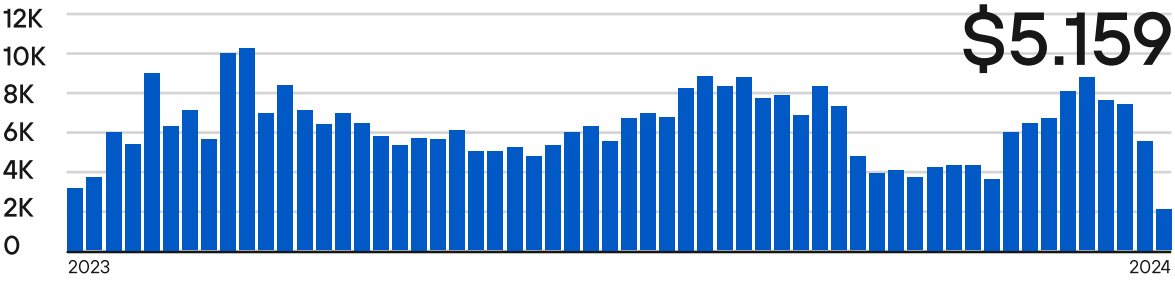




Livepeer Treasure Growth



Demand-side Protocol Fees (7d)

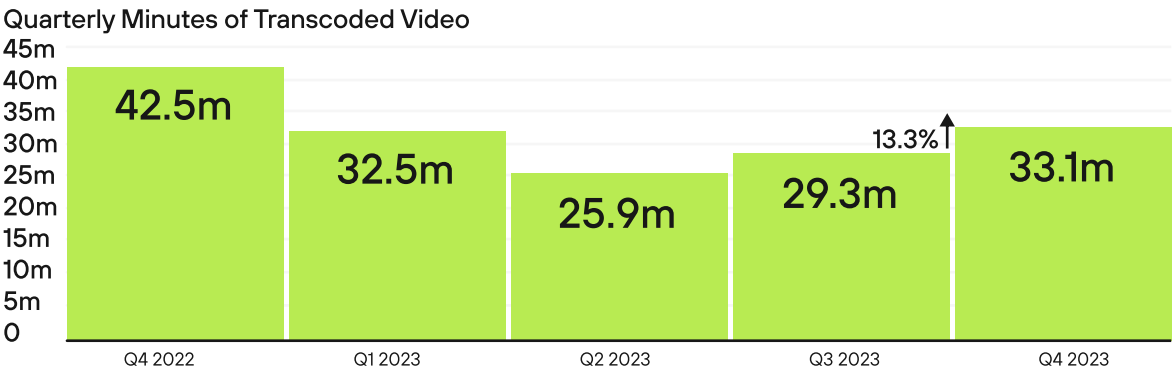


$29 582
30d Fees

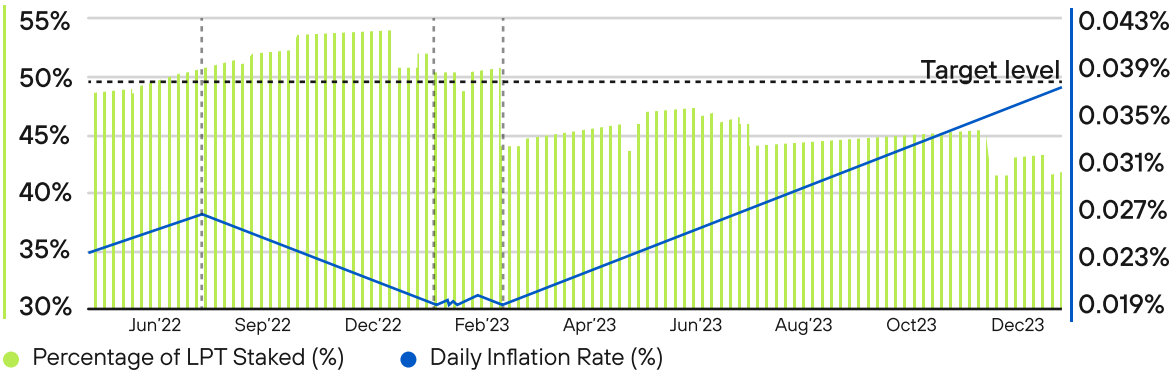
$76 102
90d Fees

$1 140 427
Total Fees

Livepeer network usage



LPT daily inflation rate



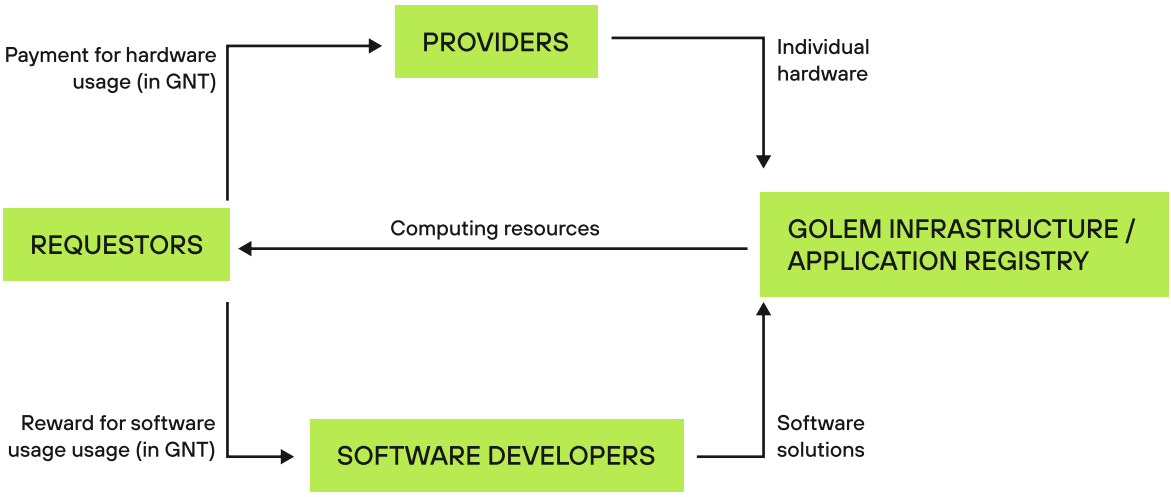
Golem

COMPUTING

The Golem Network is a peer-to-peer platform that facilitates the decentralized sharing and leasing of computing resources. It comprises many nodes, each being a system running a Yagna service. These nodes are categorized into two types: providers, who offer their computing resources, and requestors, who hire these resources for various computational tasks.

In the Golem Network, a task begins when a requestor needs to compute a task. They can select a task template from Golem's collection containing the necessary computational logic and source code. This template also outlines how to split the task into subtasks, verify results and assemble the final output. If existing templates do not cover a requestor's task, they can create their own using Golem's task definition framework.

Golem High-level Architecture



Once a task is defined, it's added to the task manager, which tracks all requested tasks from the node. The task details are then broadcast across the Golem network. Through their transaction system, providers receive these broadcasted offers and select the most suitable ones based on the reputation of each node.

The provider's system then connects with the requestor's node, submitting an offer with price and machine capabilities details. After the requestor's transaction system approves an offer, the provider downloads the required resources and begins computing the task. Depending on security and speed requirements, this computation can occur in various environments, such as Docker containers or virtual machines.

Once a computation is complete, the results and logs are sent back to the requestor via the IPFS network. The task manager then verifies these results, which can involve redundancy checks, rendering comparisons, or other methods specific to the task type.

The payment system plays a crucial role in the Golem Network. Upon successful task completion and verification, the payment system initiates a transfer of the agreed amount of Ethereum to the provider. The network's reputation system, vital for maintaining trust, tracks the interactions of nodes and adjusts their rankings based on performance, reliability, and successful transactions.

Furthermore, Golem supports the development of applications through its JavaScript SDK and Python with Ray on Golem. Developers can define tasks using these tools and execute them across the network. This includes sending and receiving data, orchestrating task execution, and processing results.

By the end of Jan 2024, the Golem network started to implement the steps for expansion and started Phase 1 of the GPU Beta Testing Program, with selected testers to evaluate the GPU Providers on the Golem platform.

Golem Factory, the company behind the Golem platform, was co-founded by Aleksandra Skrzypczak, Andrzej Regulski, Julian Zawistowski and Piotr Janiuk in 2016. That year, the Golem team sold 82% of the supply of GNT to the public, raising 820,000 ETH (roughly $8.6 million at the time and now could be $2,9B).

IO.NET 07

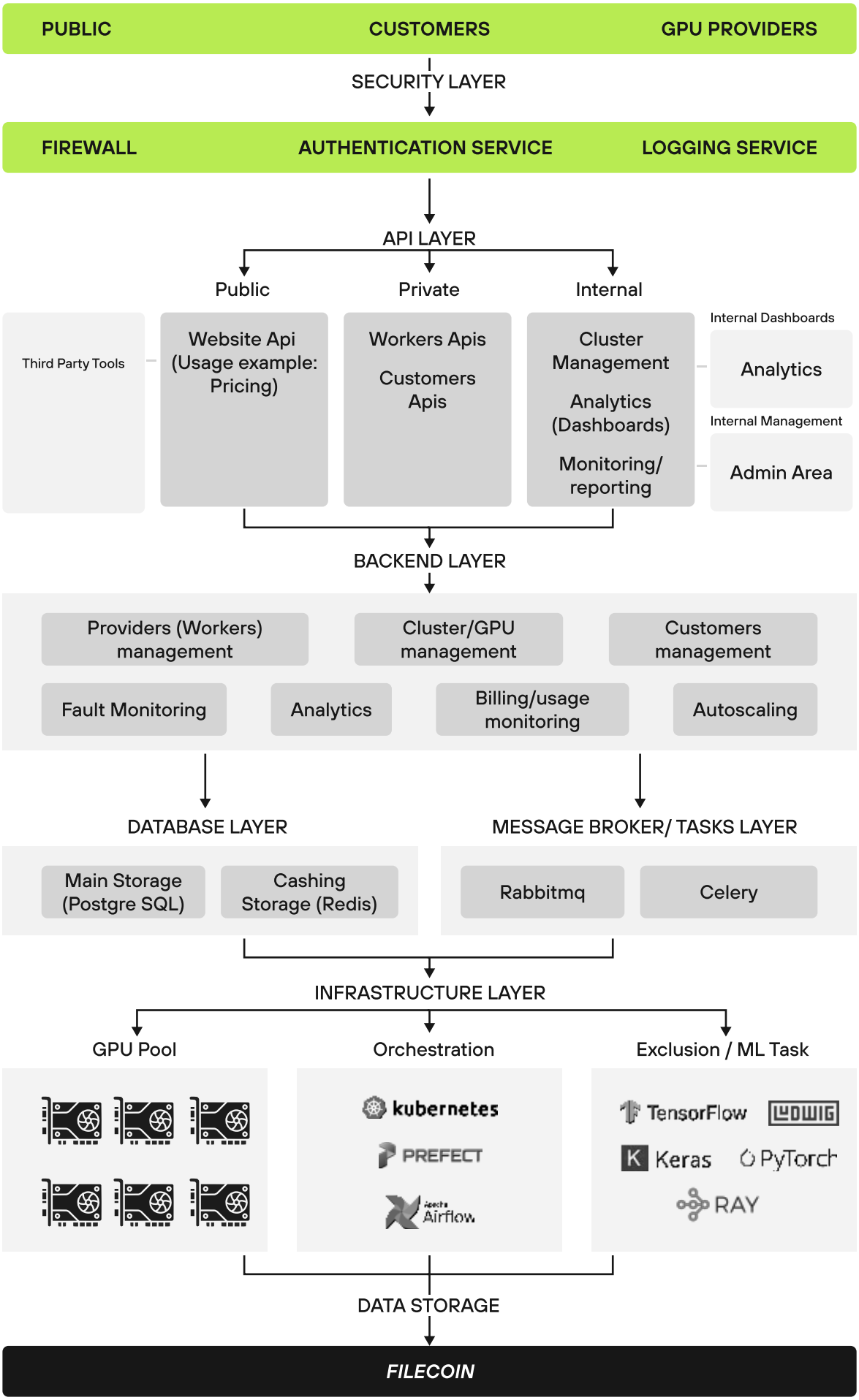
IO.NET, powered by Solana, is a decentralized computing network providing affordable access to distributed cloud clusters for machine learning engineers. It aggregates GPUs from various underutilized sources into a DePIN, offering solutions for batch inference, model serving, parallel training, hyperparameter tuning, and reinforcement learning.

The architecture of IO.NET integrates multiple layers to offer a decentralized GPU computing service. It features a user-friendly interface for public access and GPU providers, a security layer for system integrity, an API layer for communication, a backend for managing operations, a database for storage, and a message broker for task orchestration. Additionally, it includes an infrastructure layer that manages the GPU pool, task execution, and data storage, leveraging technologies like ReactJS, FastAPI, Python, Postgres, RabbitMQ, and Kubernetes to ensure efficient, scalable, and secure operations.

IO.NET's architecture connecting machine learning engineers to a vast network of distributed cloud clusters. It incorporates various roles, including GPU resource providers (including data centers and individual contributors), machine learning engineers as users, and a decentralized infrastructure to facilitate resource allocation and usage. These roles interact within a framework that facilitates resource aggregation from diverse sources.

IO.NET secured a $30 million Series A funding. The financing was led by Hack VC, with additional capital from entities like Multicoin Capital, Solana Ventures and other VCs.

IO.NET Architecture



Dynex

(A guy from DeSci)

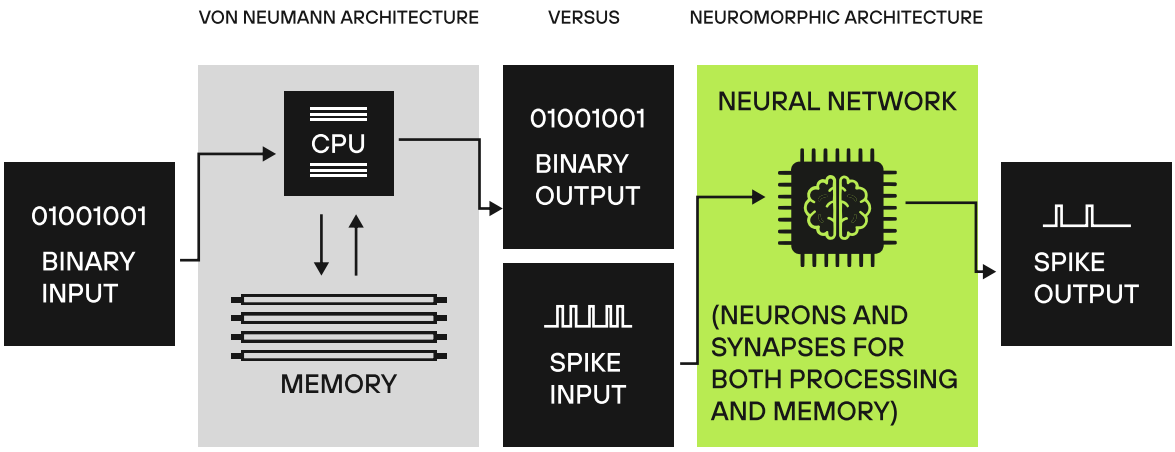
08

Dynex is a decentralized supercomputing network architecture based on neuromorphic computing, which mimics the human brain's neural structure, offering efficient parallel processing capabilities. This approach allows Dynex to handle complex computational tasks more efficiently than traditional computing systems.

The platform's Proof-of-Useful-Work (PoUW) model ensures that the computational power is utilized for solving real-world problems, making the process efficient and productive in terms of application. This is in contrast to the probabilistic nature of quantum computing, which, while powerful, faces challenges in stability and error rates.

Dynex's design integrates these advanced computational techniques with blockchain technology to provide a decentralized, scalable, and versatile computing platform. It's designed to cater to a range of applications including AI, healthcare, science, architecture, and smart city planning. Miners in the Dynex network contribute by converting their computers or unused GPU rigs into neuromorphic machines, aiding problem-solving and earning rewards simultaneously.

Comparison of the Von Neumann Architecture with the Neuromorphic Architecture



SEQUENTIAL PROCESSING	OPERATION	MASSIVELY PARALLEL PROCESSING
SEPARATED COMPUTATION AND MEMORY	ORGANIZATION	COLLOCATED PROCESSING AND MEMORY
CODE AS BINARY INSTRUCTIONS	PROGRAMMING	SPIKING NEURAL NETWORK
BINARY DATA	COMMUNICATION	SPIKES
SYNCHRONOUS (CLOCK-DRIVEN)	TIMING	ASYNCHRONOUS (EVENT-DRIVEN)

Gensyn

COMPUTING

Gensyn is a decentralized machine learning compute network aiming to reshape the landscape of AI development by uniting the world's computational resources into a global supercluster. This network is designed to be accessible to anyone at any time, addressing a significant bottleneck in AI development: the limited and costly access to computational power, particularly GPUs.

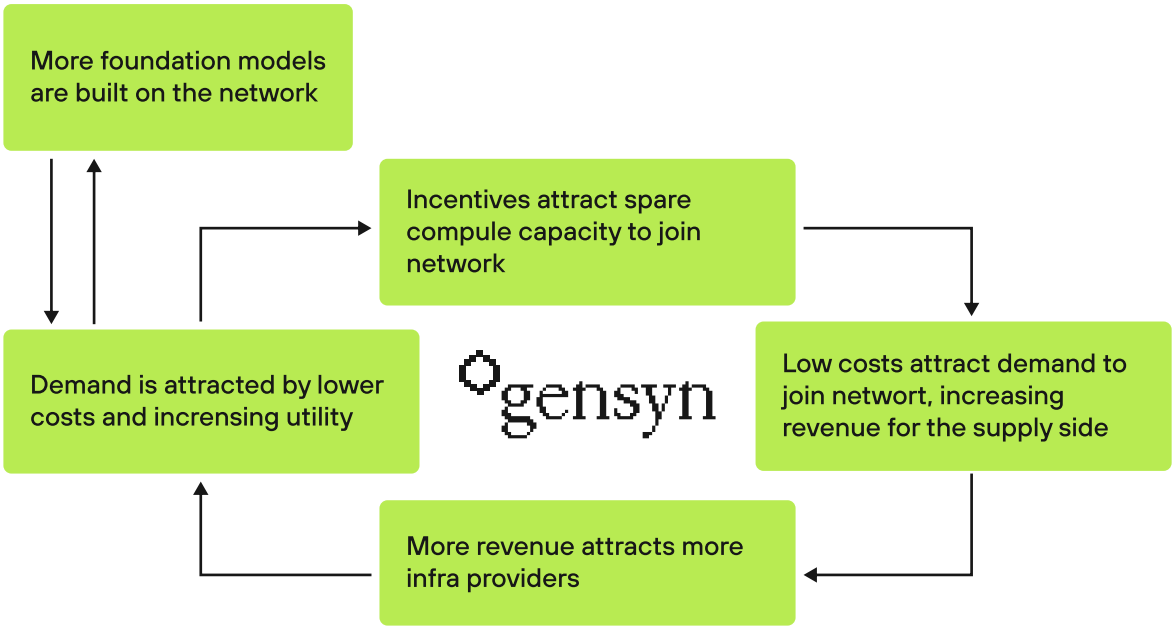
The core principle of Gensyn's network is to link a wide array of computing devices, from data centers with excess capacity to personal laptops with latent GPUs, into a single virtual cluster. By leveraging a peer-to-peer network, Gensyn eliminates traditional cloud margins, thus significantly reducing the cost of compute resources compared to mainstream cloud providers like AWS.

Gensyn is also developing mechanisms including cryptographic and game theoretic components to ensure the accuracy and reliability of computations performed within its network. This innovation aims to verify that computations are executed correctly, addressing one of the novel challenges posed by their approach of allowing any hardware to supply computing.

> Backed by significant investment, including a $43 million Series A funding round led by Andreessen Horowitz and other investors, Gensyn is well-positioned to play a transformative role in the AI and machine learning space. By cutting out intermediaries and leveraging underutilized hardware globally, Gensyn aims to enable the development of larger models at lower prices, potentially reshaping the AI landscape in the coming years.

> With its latest round, Gensyn has raised more than $50 million. Prominent investment firms CoinFund, Canonical Crypto, Protocol Labs, Eden Block and a variety of AI and crypto venture capitalists and angels joined a16z in the round.

Gensyn Flywheel



Web3mine

10

Web3mine is building the open access computing network to democratize the creation and capture of value on new or established decentralized networks. They propose the Sealing as a Service (SaaS) model in the Filecoin network, representing a structural shift from the traditional operational paradigm. Initially, miners were responsible for both data storage and the sealing process.

Web3mine is focused on democratizing decentralized network value creation and capture by providing an open-access compute network featuring a SaaS model that efficiently divides data storage and sealing processes between storage providers and specialized sealers.

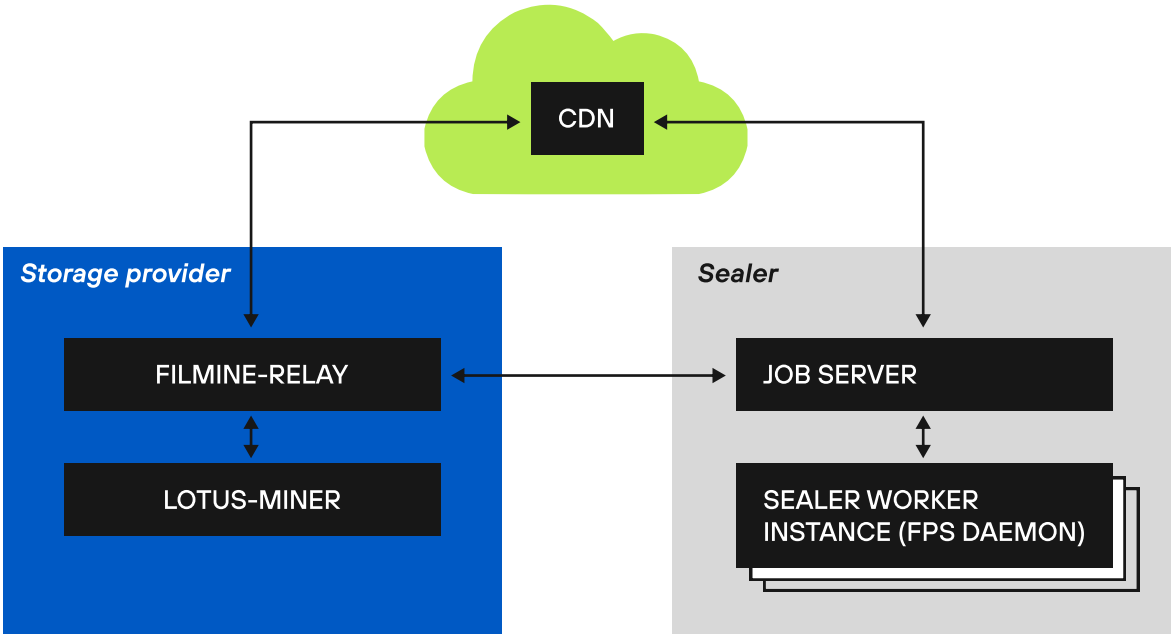
The advent of SaaS divides these roles into separate functionalities: storage providers and sealers. Storage providers focus on data storage, while sealers, equipped with specialized computational resources, undertake the sealing process. This architectural change enhances operational efficiency and scalability, driven by task-specific optimization and process modularization. The model's ongoing development involves collaboration with the community to refine its efficacy further.

In the SAAS architecture, Storage Providers and Sealers are decoupled. Compute providers (Sealers) will run only the necessary software to finish sealing jobs. Sealing as a service is implemented modularly and multiple deployment scenarios are possible. A simple setup can consist of:

- one storage provider
- one monolith sealing provider
- a job market

> Web3mine raised $6 million in seed funding in 2022. 1kx, PL Ventures, and a community of angel investors led the round.

Sealing-as-a-service setup



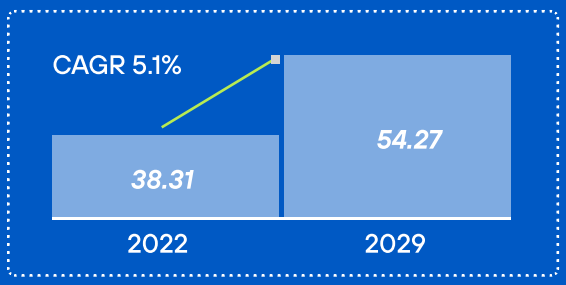
WIRELESS

The Market Statement

In 2024, the wireless industry is experiencing a transformative phase, marked by challenges and promising trends. The successful deployment of 5G-powered fixed wireless access by industry giants like Verizon and T-Mobile showcases the industry's commitment to push the boundaries of connectivity.

Telecom Tower Market

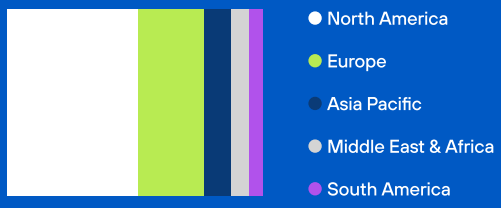
Market Size in US $ Billion



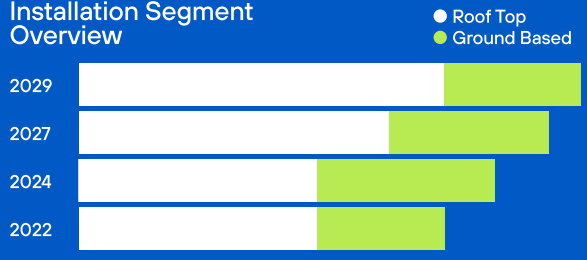
Key Players

Bharti Infratel Limited	Conduent, Inc.
Helios Towers Africa	Kapsch Group
American Tower Corporation	Mitsubishi Heavy Industries Machinery Systems, Ltd.
AT&T Inc.	Siemens Mobility GmbH
GTL Infrastructure Ltd.	Thales Group
T-Mobile Towers	Continuum
Phoenix Tower	Electroproducts LLP
China Tower Corporation	

Regional Analysis in 2022 (%)



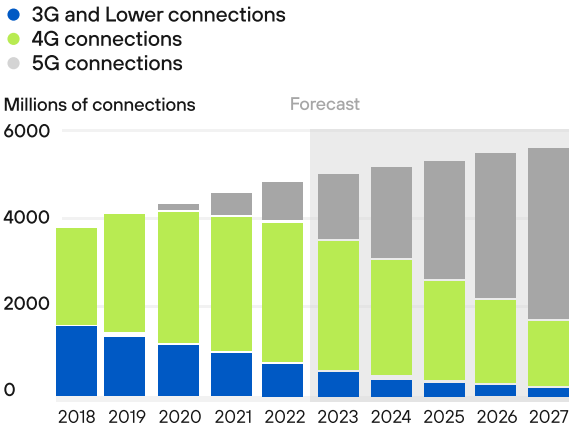
Installation Segment Overview



The Wireless segment is dynamic and rapidly evolving within the technology industry, encompassing a wide range of wireless communication technologies and services. From 5G networks driving unprecedented data speeds to the proliferation of IoT devices, the sector presents exciting opportunities for innovation and disruption. Key areas of focus include wireless infrastructure, connectivity solutions and the development of cutting-edge wireless-enabled applications.

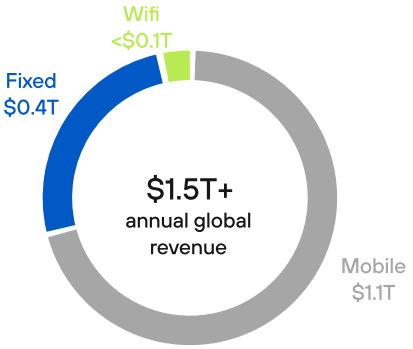
In the ever-evolving landscape of wireless communication, emergence of blockchain technology has ushered in a new era of security, privacy and innovation. The "Wireless" DePin segment represents Decentralized Privacy and Integrity, highlighting a paradigm shift in perceiving and securing wireless networks.

Device Connections



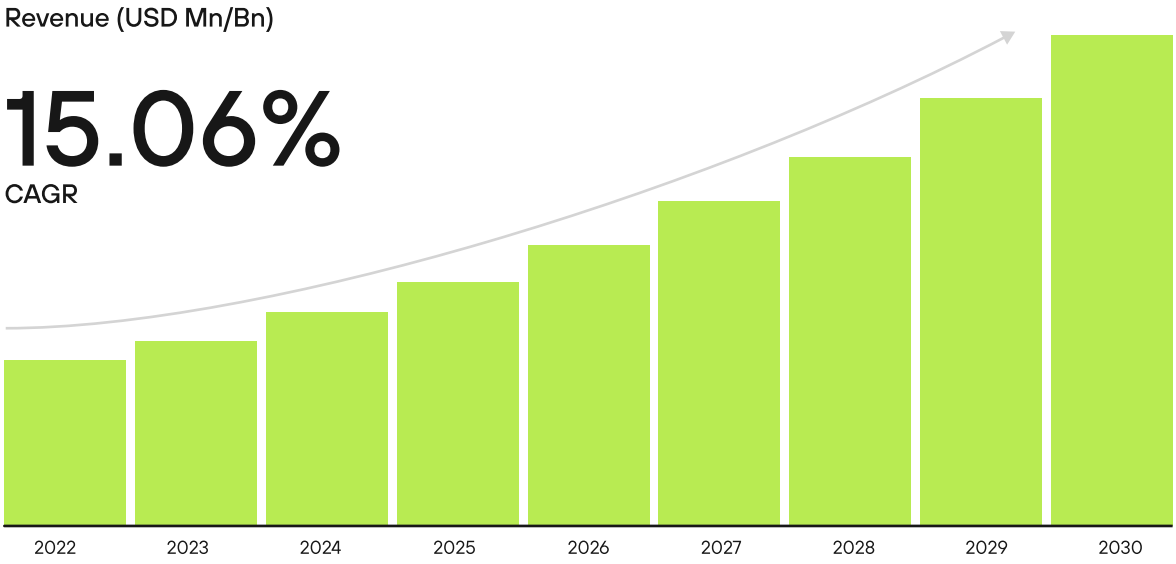
Global wireless device connections by type (m)

Market Size



Global annual wireless services revenue ($)

Global Wireless Connectivity Market 2030



Privacy Use-cases

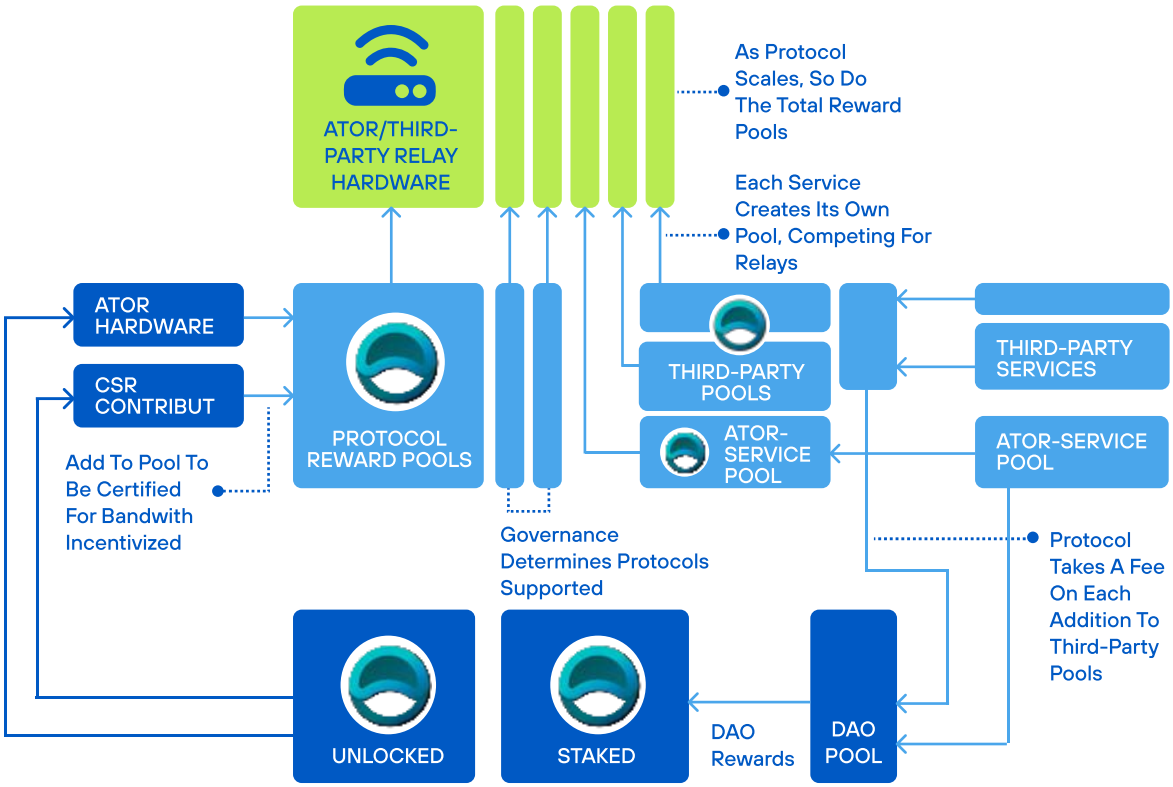
Privacy and security stand as crucial elements in wireless technology. The absence of encryption protocols, such as in certain radio frequency ranges or public WiFi access points without passwords, poses a risk of data leakage. It is prudent to exercise caution when utilizing such methods. While adding extra security measures like VPNs is advisable, alternatives should be considered where possible. One effective means of safeguarding data is through the Tor browser. Renowned for its decentralized private routing protocol, Tor has long been a cornerstone for users worldwide seeking enhanced privacy.

Tor utilizes onion routing to encapsulate messages in three layers of encryption, which ensures that routers can only see the addresses of nodes in the communication chain, thereby safeguarding the underlying message from prying eyes. With nearly 5 million global users relying on Tor for privacy, its crucial role in securing online communication is undeniable.

Looking forward, the ATOR Network is set to secure users' internet access by forking the Tor network in 2024. This initiative aims to establish a scalable, high-performance ecosystem that caters to privacy-centric developers. ATOR Network aims to tackle the performance issues of the Tor network by introducing hardware relays and offering token rewards to node operators. This initiative seeks to counteract the stagnation in relay growth, enhancing wireless privacy for users.

The ATOR Relay Device, a specialized, low-power, autonomous computing device, embodies the dedication to global anonymity. As ATOR network expands with more nodes, it promises improved privacy and fosters an environment for developers to create efficient privacy-focused applications, marking a new era for wireless security.

ATOR Architecture



Key Trends for 2024

> Open RAN Deployment: The adoption of Open RAN architecture is on the rise, promising increased flexibility and efficiency in wireless networks.

> AI in Network Deployment: The integration of Artificial Intelligence (AI) is becoming pivotal in optimizing network operations and ensuring efficient management.

> Network Densification: To meet the demand for low-latency networks, further densification of 5G is anticipated in both urban and rural markets.

Global 5G Services Market

Drivers

Rise in investments by governments and network operators

Increase in adoption of Internet of Things (IoT)

Opportunities

Integration of blockchain technology with 5G

Emergence of autonomous vehicles and smart cities

US$ 82.7 Bn

In 2022 (A)

Market Revenue

CAGR (2023-2031) 30.8%

By Communication Type

mMTC

Relatively high CAGR of XX% from 2023 to 2031

Key Players

AT&T, Inc.
China Mobile
BT Group plc
China Telecom
Vodafone Group

By Region

Asia Pacific

Largest market share in 2022 and relatively high CAGR of XX% from 2023 to 2031

The revolutionary impact of blockchain in wireless communication lies in its inherent strengths:

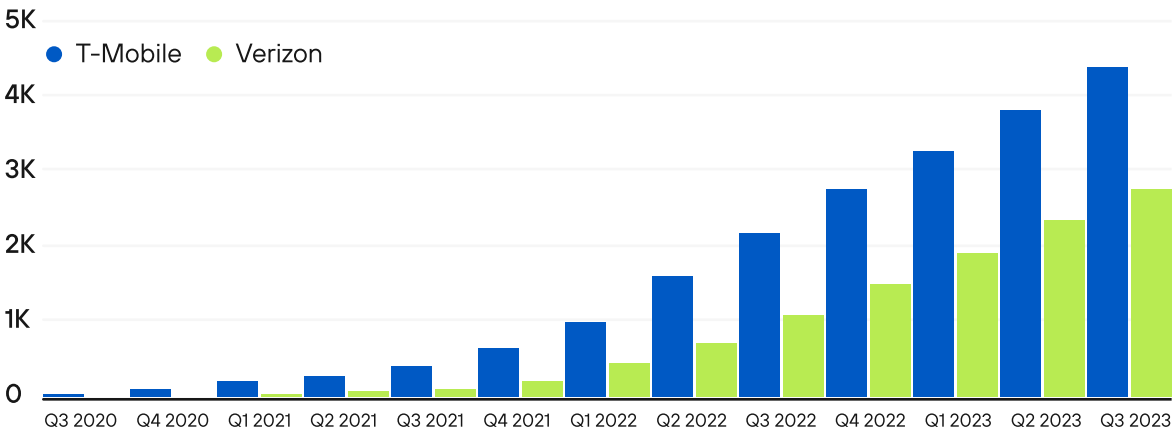
> ***Data Integrity:*** The decentralized nature of blockchain ensures data immutability, safeguarding wireless communication from manipulation and unauthorized alterations.

> ***Enhanced Privacy:*** By eliminating intermediaries, blockchain reduces the risk of unauthorized access to sensitive information, preserving the confidentiality of data in the wireless realm.

> ***Improved Transparency:*** Every transaction recorded on the blockchain creates a transparent and accountable environment, facilitating the identification of fraudulent activities and building trust in wireless communication.

> ***Increased Scalability:*** Blockchain's decentralized approach to data distribution across nodes enhances the scalability of wireless networks, fortifying them against potential attacks or failures.

Fixed Wireless Access (FWA) Customers



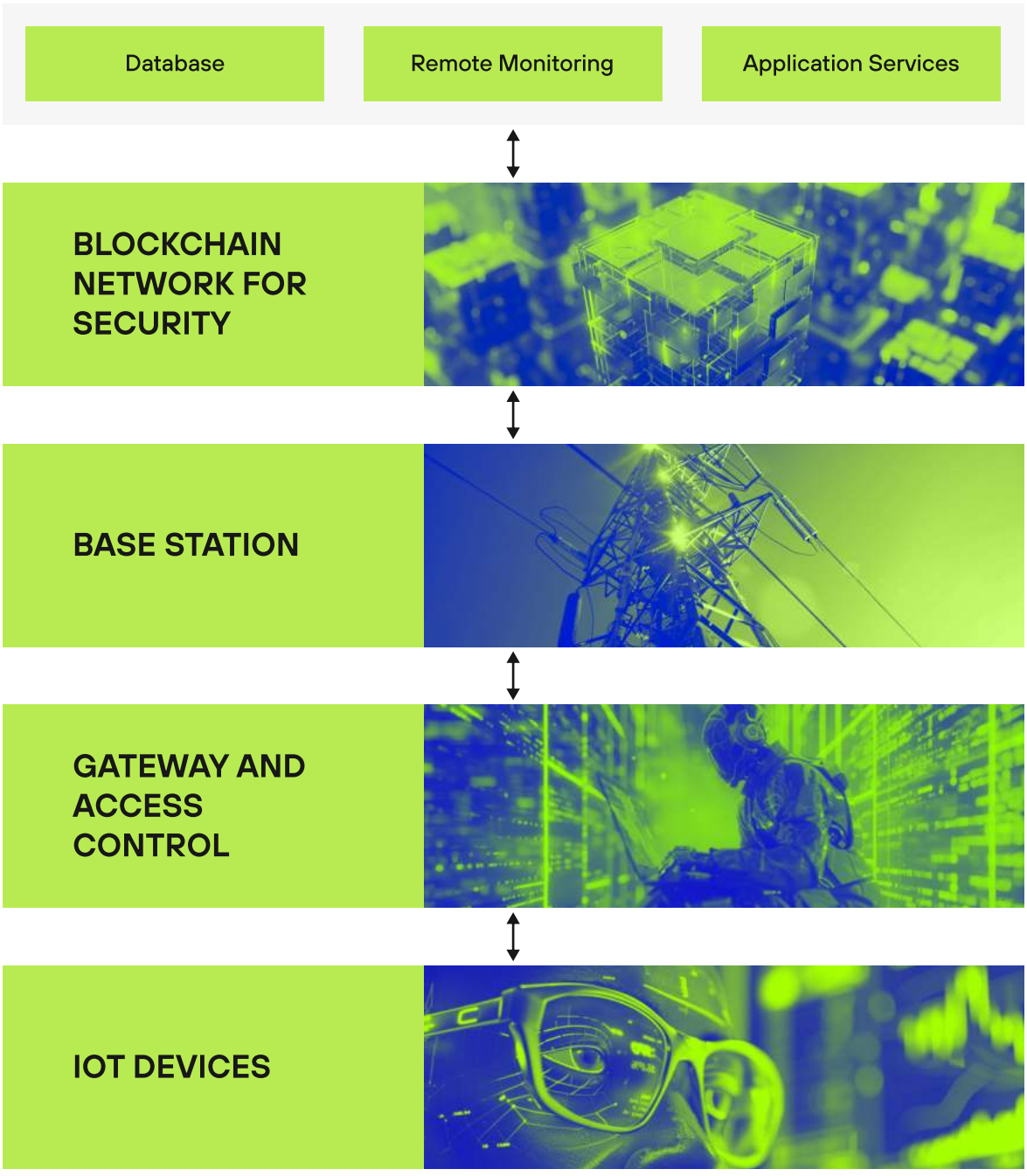
The ongoing development of blockchain-based solutions in the wireless communication sector includes:

> ***Secure Identity and Access Management:*** Blockchain ensures secure and tamper-proof identity verification, enhancing access management in wireless networks.

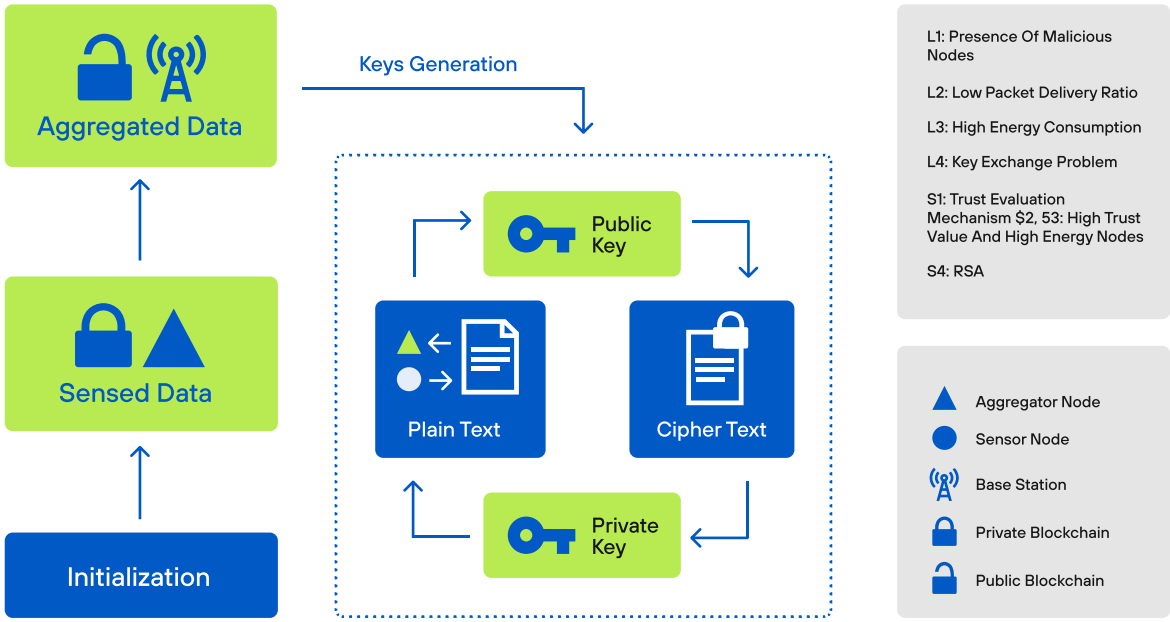
> ***Secure Data Sharing and Communication:*** The decentralized nature of blockchain guarantees secure data sharing and communication, mitigating the risk of unauthorized access.

> ***Secure IoT Connectivity:*** Blockchain facilitates secure connections in the Internet of Things (IoT) realm, ensuring the integrity and privacy of wireless communication.

Fixed Wireless Access (FWA) Customers



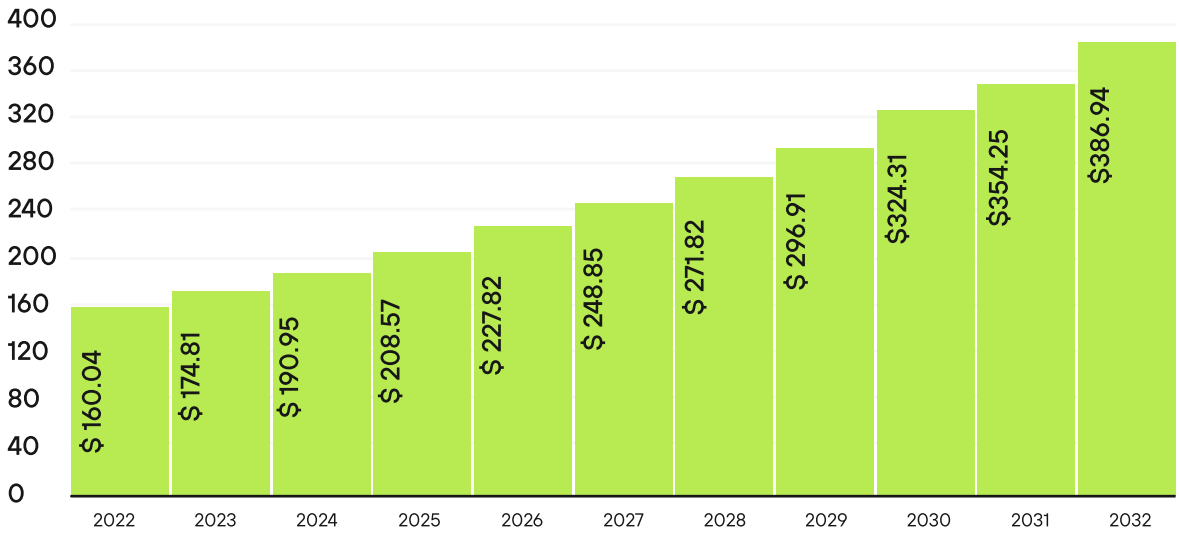
Blockchain Based Secure Routing and Trust Management



Challenges and Opportunities in the Wireless Landscape

While 2023 witnessed a slowdown in the wireless industry attributed to cooldown in 5G rollout, 2024 brings new avenues for growth. The industry is strategically focusing on revenue diversification, sustainability initiatives and cybersecurity measures.

Wireless Infrastructure Market Size 2022 to 2032 (USD Billion)



AI's Impact: The significant demand for AI in 2023 is expected to persist in 2024, influencing digital infrastructure ecosystems and enhancing network capabilities.

Converged In-Building Networks: The growth of converged in-building wireless networks signifies a trend towards AI-enabled technologies, reducing operational costs and accelerating project delivery.

Micropayments and Blockchain: Blockchain's potential in facilitating micropayments, from IoT transactions to content monetization, positions it as a key enabler in reshaping revenue models in wireless communication.

MPOST Cryptomeria Capital.

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Hack Seasons is a series of community events featuring renowned speakers from the cutting-edge fields like Zero-Knowledge, L2, DePIN, Modular Blockchains, and more.

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04
DEPIN ECOSYSTEM PROJECTS:
WIRELESS

	HELIUM	ALTHEA	WAYRU	FOAM	WIFI MAP
TYPE	5G, LoRaWAN	5G, LoRaWAN	WiFi	Location, LoRaWAN	WiFi
TOKEN MODEL	Buy a Helium 5G Hotspot or Miner to earn IOT and MOBILE tokens by supporting LoRaWAN and 5G, sharing data on popular phone usage areas.	Connect your device to Althea L1 and share your bandwidth to earn token rewards for data routing.	Connect your router with WayruOS to the Hotspot Pool and earn WRU rewards for the Internet sharing.	Buy a FOAM Zone Anchor device and set it for "signaling" where location services are needed to earn FOAM tokens.	Download the WiFi Map app and add new WiFi hotspots on the map to earn WIFI token rewards. Purchase eSIM for WIFI tokens and get a cashback.
INFRA LAYER	Native L1 (Proof-of-coverage or PoC) Solana (PoS)	Native L1 based on Tendermint (PoS)	Algorand (Pure Proof of Stake or PPoS) IoTeX (Roll-Delegated Proof of Stake or Roll-DPoS) Peaq (Multichain cross-consensus)	Ethereum L1 (PoS) Native L2 Optimistic Rollup based on OP Stack (Proof of Location)	No blockchain
DEVICES AMOUNT	IOT — 395,663 MOBILE — 13,111	N/A	500+	75+	No devices
USERS	MOBILE — 69,300	N/A	250,000	N/A	170,000,000
COVERAGE (COUNTRIES)	190+	4 Countries and 12 US States	Latin America	North America, Europe, New Zealand	200+ and 80+ with eSIM support
HARDWARE	22+ Hotspot models from Third-party Manufacturers and Vendors	N/A	Wayru Genesis and 12 models from Third-party Manufacturers and Vendors	Zone Anchor, Mobile LoRa Node	No hardware
SOFTWARE	Maker Starter App and Helium Wallet	Althea Wallet	Wayru WiFi	Hostel App	WiFi Map
FUNDRAISING	$364,80M+	N/A	$1,96M	$16,75M+	$1,60M

WIRELESS

	ANDRENA	DROP WIRELESS	CHIRP	GRASS	MESON NETWORK
TYPE	WiFi	5G, LoRaWAN	LoRaWAN	CDN	CDN
TOKEN MODEL	Connect your device to the Andrena network as a last-mile internet infrastructure, and share your bandwidth to earn revenue for data routing.	Build your own Wireless IoT network and monetize it.	Connect your device to Chirp Network as a gateway to earn CHIRP tokens by supporting the IoT network.	Install the "Grass Extension" in your browser and share your internet bandwidth to earn Grass Points that'll be converted into GRASS tokens.	Connect your server resources to the Meson Network, and share your internet bandwidth and free storage capacity to earn token rewards.
INFRA LAYER	Helium (Proof-of-coverage or PoC) Solana (PoS)	IoTeX (Roll-Delegated Proof of Stake or Roll-DPoS) 5 IoT clusters and their types based on PoP, PoC, PoD, PoV, and PoE consensuses.	Sui Blockchain (PoS)	Solana (PoS Native L2 Layer 2 Data ZK-Rollup (PoS)	Ethereum (PoS) IPFS — PoSC based on TEE Arweave — SPoRA
DEVICES AMOUNT	N/A	1,500	719	20,000 - 100,000	69,938
USERS	N/A	N/A	9,689	1,000,000	100,000
COVERAGE (COUNTRIES)	USA	17+	30+	N/A	150+
HARDWARE	N/A	G2 Node and 4 specific devices	Blackbird, Cardinal Miner, and models from Third-party Manufacturers and Vendors	Any device that supports an Internet connection	Any device that supports an Internet connection
SOFTWARE	N/A	DROP app	N/A	Grass Extension	CDN & GatewayX, GaGaNode, IPCola
FUNDRAISING	$25M	N/A	N/A	$4,50M	$12,25M+

Helium 01

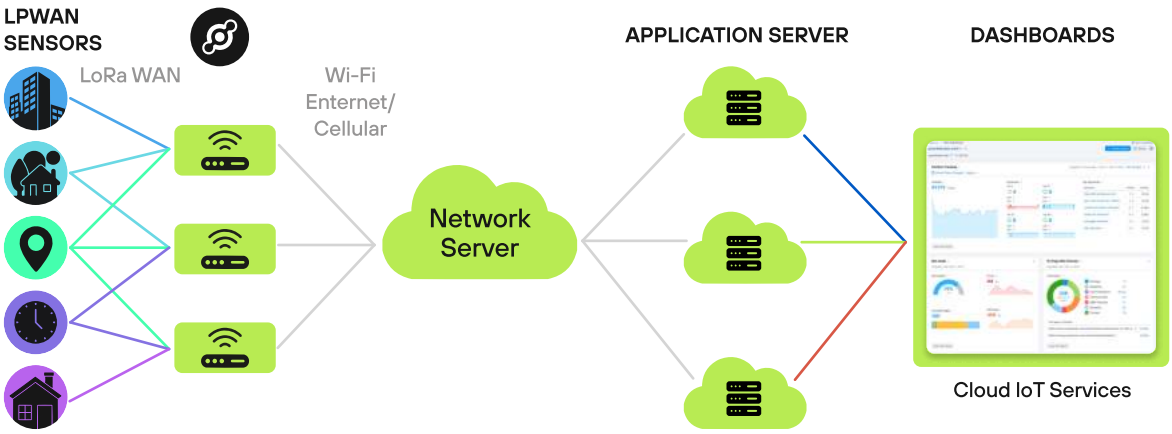
Key Concepts

Helium is a network created by Nova Labs, initially built on its own blockchain and later migrated to the Solana network, connecting IoT devices. The Helium network aims to facilitate communication and connectivity for IoT devices, offering internet access to various smart devices. The project provides a cheaper and more stable alternative to traditional wireless networks, satellite equipment, and mobile internet.

- **INFRASTRUCTURE LAYER: SOLANA**

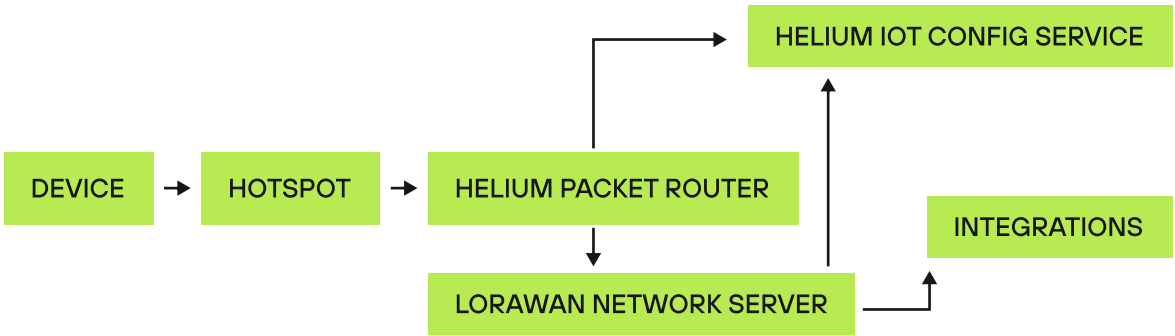
The wireless network uses specialized modems employing Helium LongFi technology, connecting the LoRaWAN (Long Range wide-area network) wireless communication protocol with the blockchain.

End-to-end Secure Payload



At its core, the Helium Packet Router (HPR) manages the connection between LoRaWAN Network Servers and Hotspots (gateways). The IoT Config Service organizes how devices communicate between HPR and the LNS. In this setup, the Hotspot doesn't directly connect with the LoRaWAN Network Server.

Helium High-Level Architecture



Within the Helium Network, each LoRaWAN Network Server (LNS) gets a special ID - Organizationally Unique Identifier (OUI) and registers with the blockchain. Two important aspects are then managed by OUI Operator:

1. It reserves space for the OUI's devices on the Helium Network using one or more sets of Device addresses.
2. A LoRaWAN device can be linked to any of these device addresses. Multiple devices can even share the same address at the same time, thanks to the Message Integrity Check (MIC) that helps tell them apart.

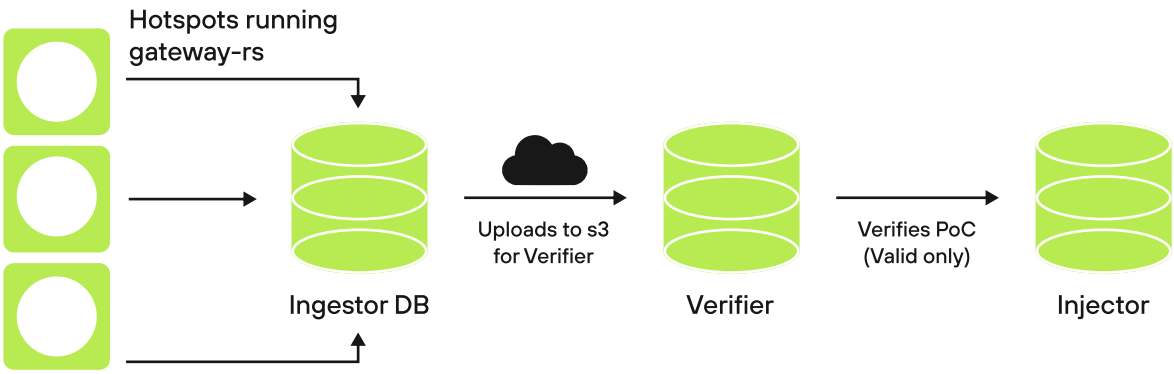
One of Helium's key distinctions from other blockchains is its proprietary consensus algorithm called Proof of Coverage. Its primary objective is to accurately represent Hotspots' location, configuration, and the wireless coverage they generate.

It decides how to share rewards between HNT holders and node operators. Users must buy a mining device on the Helium website and set up access points to get started. Miners use radio frequencies to connect to the network and the Coverage Proof system checks where the access points are located.

During the IoT Proof of Coverage process, a Hotspot initiates by broadcasting a Beacon, which is witnessed by nearby Hotspots. Subsequently, the Witness Hotspots submit receipts to an Ingestor Oracle, and the Packet Verifier gathers data from the Packet Router. The Ingestor Oracle then uploads the receipts to a cloud store.

A Verifier Oracle utilizes input from the Ingestor Oracle and the Packet Verifier to filter out invalid receipts, generating a Reward output. This Reward output is forwarded to the Reward Oracle, determining the number of reward shares a Hotspot should earn for the epoch. Finally, the Injector Oracle distributes the earned rewards to the respective Hotspots in the IoT network.

IoT Proof-of-Coverage Architecture



In the Helium ecosystem, different subnetworks operate independently, offering various services and setting their rates. For example:

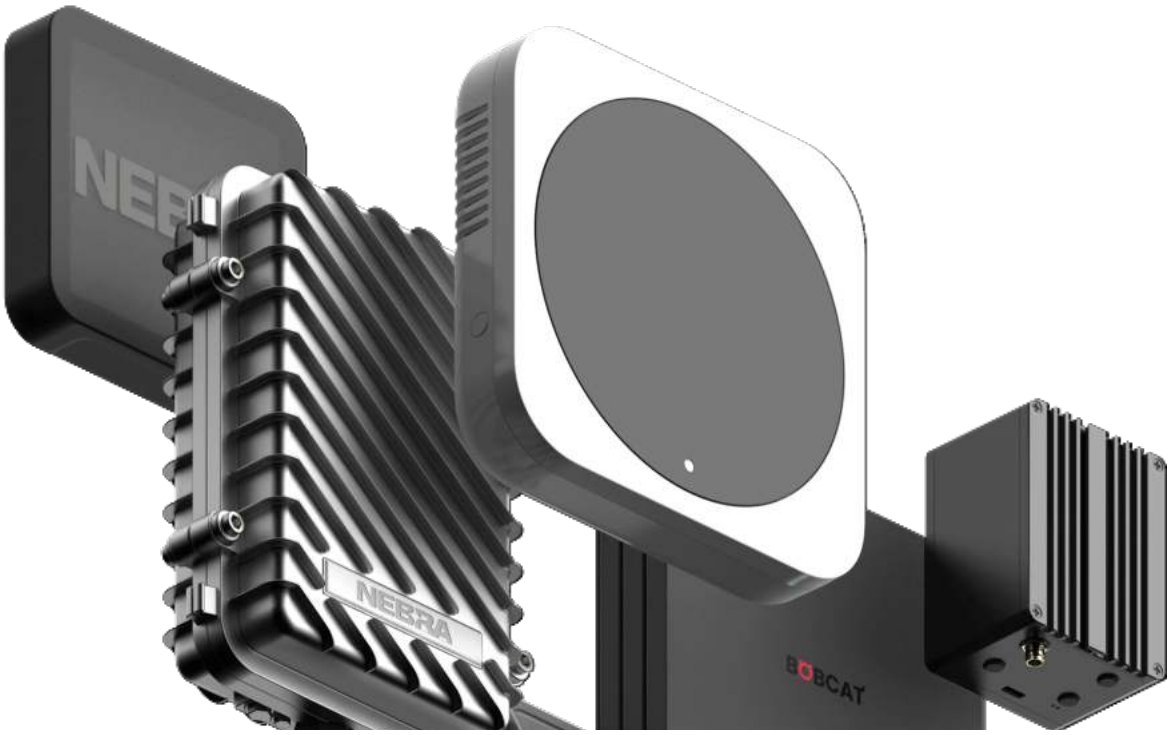
> Helium has three tokens: HNT, MOBILE and IOT. HNT is the native currency of Helium, incentivizing hotspot operators to expand the decentralized wireless network. IoT tokens facilitate connectivity for low-powered IoT devices on the network, rewarding hotspot operators for enabling data transmission from sensors and trackers. MOBILE tokens are introduced with 5G-enabled gateways, expanding Helium's services to mobile devices and allowing users to provide 5G wireless coverage and earn tokens in return.

> HNT is the primary token that helps transfer important data using Data Credits. It is the native cryptocurrency for the Helium network and can be burned to get Data Credits, which are needed for device data transmission and always have a fixed value in US dollars. Data Credits (DC) are the exclusive method of payment for sending data on The People's Network, priced at $0.00001 USD per credit. Similar to prepaid cell phone minutes, Data Credits cannot be transferred and can only be used by the person who owns them.

> IOT is the token of the Helium IoT network protocol. The first IOT tokens were minted after the migration to Solana on April 18, 2023. The IOT token is mined by LoRaWAN Hotspots through data transmission and coverage confirmation. The IoT network charges 1 Data Credit (DC) for each 24-byte data packet sent or received.

> MOBILE is the token of the Helium mobile network protocol. The MOBILE token is mined using 5G-CBRS and Wi-Fi access points through data transmission and coverage confirmation. The MOBILE network charges users $0.50 per gigabyte (GB) of data used. The more data transferred on a subnetwork, and thus, the more DC consumed, the more Helium Tokens (HNT) the treasury of that subnetwork earns.

Helium Network Hotspots



Product updates

In April 2023, Helium migrated to the Solana network. The project also transitioned data transfer and confirmation of the Proof-of-Coverage (PoC) consensus algorithm to oracles. According to the Helium Foundation's review, the Solana network offers improved speed, scalability, wallet compatibility, and a viable ecosystem, aiding its growth.

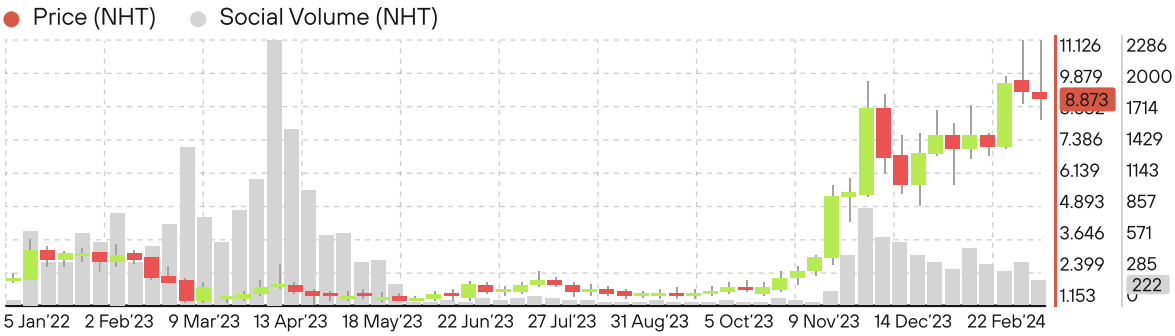
In December 2023, SenseCore was launched. Initiated by experienced plumbers in Canada, the company ingeniously merged its plumbing expertise and water data with the Helium Network to introduce groundbreaking water monitoring and leak detection solutions. To accomplish this, SenseCore utilizes its proprietary device, The Kraken - Water Monitoring device.

On December 6, 2023, the Helium network announced that users across the United States can now enjoy unlimited data, voice, and text for $20 per month through a newly launched mobile service.

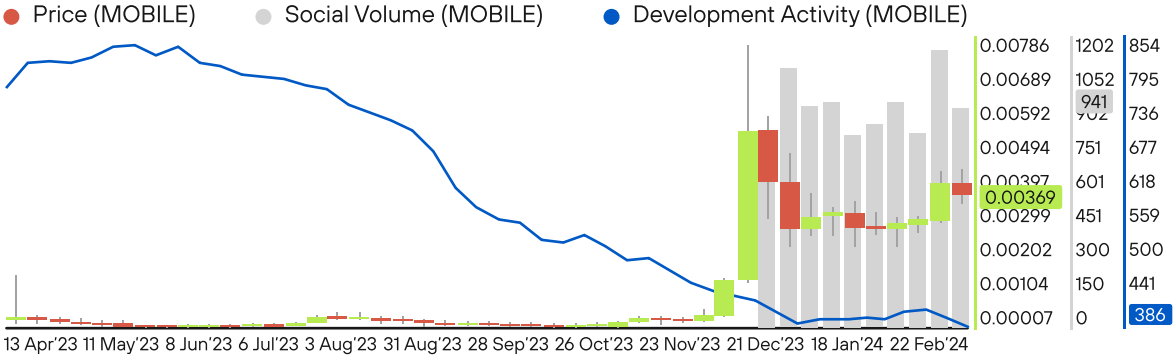
In January 2024, Nova Labs announced a partnership agreement with Telefónica, a multinational telecommunications company, to launch mobile access points for Helium in Mexico.

Metrics

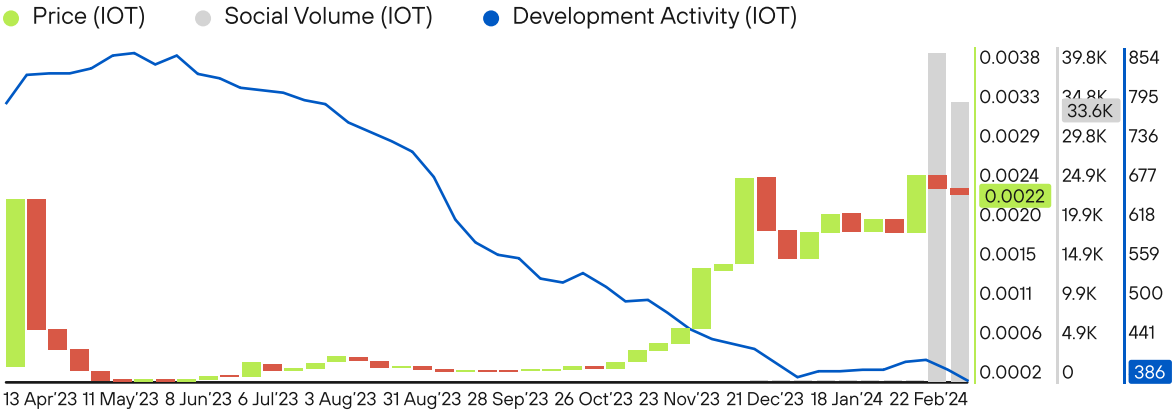
Helium (HNT) Santiment



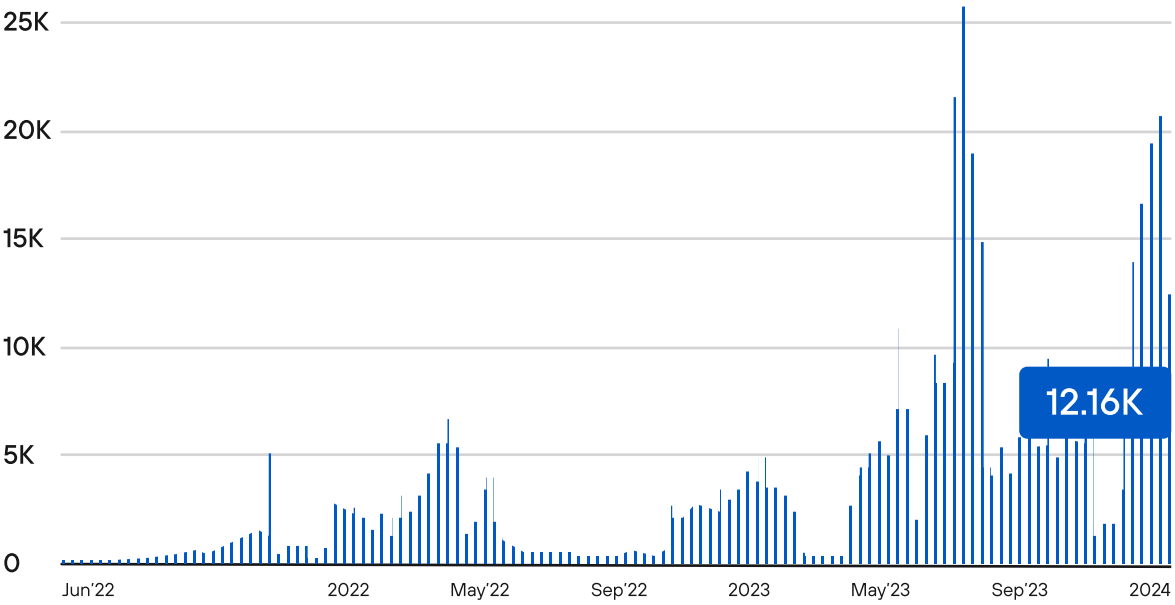
Helium (MOBILE) Santiment



Helium (IOT) Santiment



Helium Demand-side Fees



$18 376
Demand-side Protocol Fees (7d)

$75 543
30d Fees

$117 219
90d Fees

$495 694
Total Fees

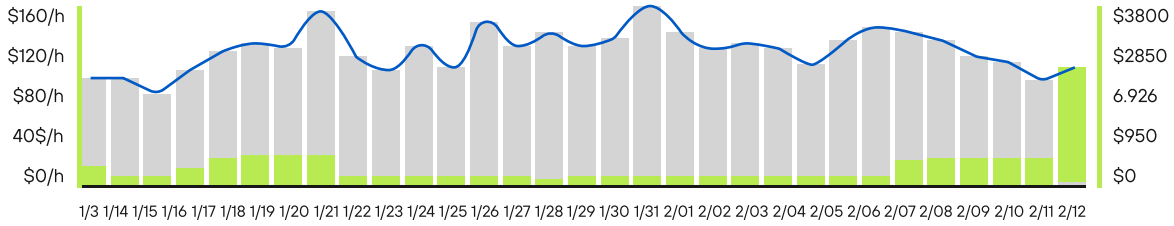
> The Helium ecosystem comprises of more than 380,000 of LoReWan devices worldwide and more than 3,600 5G in the USA, serving as wireless access points and forming The People's Network.

Network Stats

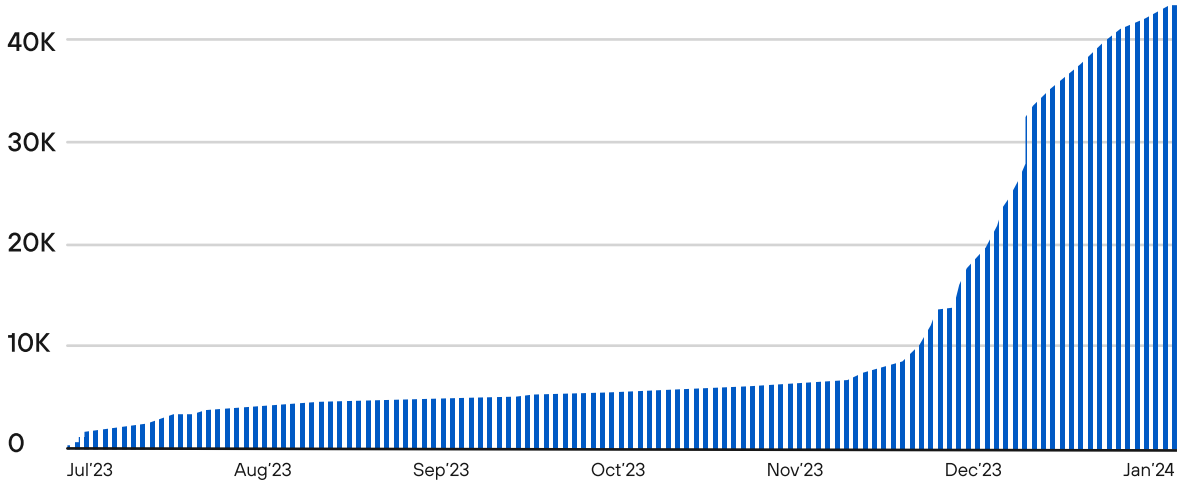
Network	Delegated to IOT	Delegated to MOBILE
Positions	Positions	Positions
TOTAL 11,661	TOTAL 5,769	TOTAL 4,085

IOT	IOT	MOBILE	MOBILE
Active Hotspots	Onboarding Fees	Active Hotspots	Onboarding Fees
393,387	$16,123,690	10,470	$280,210

Network Usage in USD (30 days)



Total Helium Mobile Subscriber NFTs



Ecosystem

In the Helium Network ecosystem, product presence consists of the following categories:

Integrations — including various IoT platforms and Toolkits (such as Microsoft Azure IoT Central and IoT Hub, Datacake, Tagoio, ubidots, ThingsLog, akenza, and others);

Roaming — related to mobile communication services (Actility, Dish, Skynet, Senet, netmore, X-TELIA);

Community Tools — products to enhance existing Hotspot services within the Helium ecosystem (Helium Geek, HotspotRF, Hotspotty);

Hotspots — services and products directly related to Hotspots, including manufacturers and distributors of physical devices and providers (Bobcat, CalChip Connect, Merryiot, Linxdot, Sensecap, and others);

Users — other products related to both IoT and Wireless, as well as other solutions built on Helium. This category includes applications that are devices for monitoring air composition and quality (Awair, Airly, oxygen at work), tracking devices and applications (Trackpack, Abeeway, invoxia, COTX, Digital Matter, and others), devices for loading and logistics in commercial transport (Bolero Wireless), sensors for plumbing systems (Enica), pest control devices (Victor), and many others.

Althea

02

Key Concepts

Althea L1 is a specialized settlement layer designed for infrastructure and connectivity, offering high availability and reliability. Althea is a solution designed to tackle the "last mile" challenge in providing broadband internet, which refers to the final and often expensive leg of connecting a user to an internet exchange, typically within 16 kilometers.

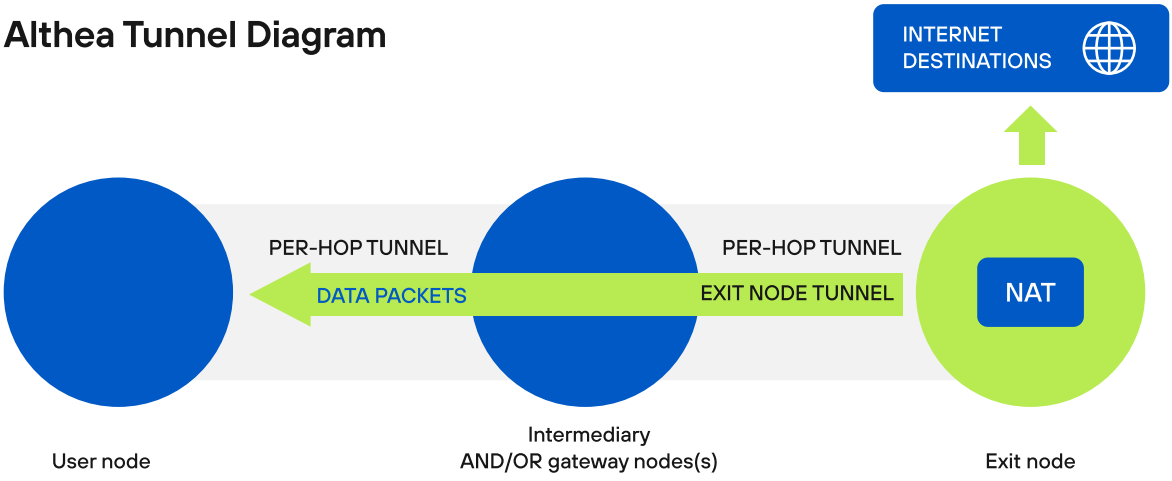
Deployment Components

Althea addresses this issue with its innovative technology, allowing users to set up and manage their own internet service provider (ISP) or enhance existing ones. The goal is to replace centralized ISPs with a decentralized network where individuals and businesses participate, creating a competitive market with automated revenue sharing.

- **INFRASTRUCTURE LAYER: TENDERMINT (COSMOS SDK).**

Upon its launch, Althea L1 will include Tendermint consensus, safeguarded by Althea L1 validator nodes, and an EVM execution layer constructed using the Cosmos SDK. Althea L1 autonomously utilizes Cosmos' robust technological base, striving for expansion and broad acceptance without depending on the Cosmos ecosystem.

Althea Tunnel Diagram



The Althea network supports both traditional hub-and-spoke and modern mesh network topologies. It consists of four main types of routers:

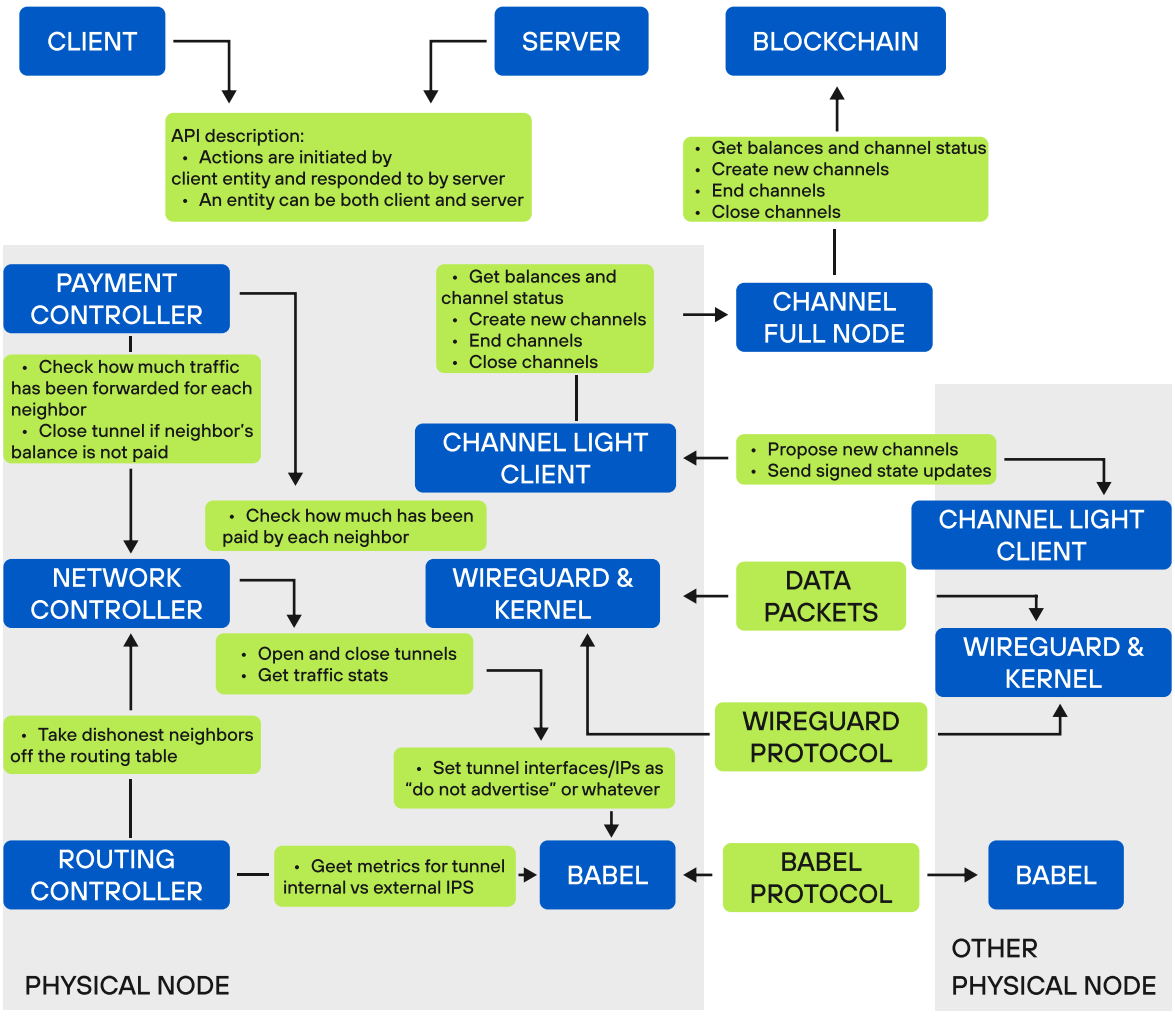
> ***Endpoint Routers:*** These are used by individual end users in a traditional ISP. However, in Althea, they pay for services from their neighbours instead of being tied to one ISP. This ensures quality and cost-effective service for the end user. Endpoint routers may also earn small income by forwarding traffic.

> ***Relay Routers:*** Installed by individuals who want to earn money by forwarding internet traffic, these routers are typically more powerful and strategically placed to ensure a good line of sight to other routers.

> ***Gateway Routers:*** Similar to relay routers, gateway routers connect to a source of affordable internet bandwidth, such as an internet exchange, fiber connection, or a business-grade connection from a conventional ISP. They serve as the link from Althea's physical layer to the external internet.

> ***Exit Routers:*** Exit routers play a crucial role in ensuring the smooth operation of the Althea network. They serve as endpoints to verify quality metrics, fuelling the Althea routing protocol. Exit routers also take on the legal responsibilities of an ISP, allowing gateway routers to function purely as providers of bandwidth.

Althea Architecture



On Althea L1 developers can function as validators to ensure the chain's security. They can also create connectivity services like mesh and IoT networks, generate token representations for physical infrastructure and utilities, and kickstart new infrastructure-focused L2 networks, such as decentralized energy grids or registries, using the Althea L1 EVM and agile routing. Developers receive a percentage of network fees when their contracts are utilized through Contract-Secure Revenue.

Althea's routing protocol builds on established ISP routing protocols. To address potential issues with malicious routers in the decentralized network, Althea introduces an accuracy score, periodically testing routers to confirm their advertised quality of service. Additionally, a price metric is incorporated to find the most cost-effective route. Users can customize their preferences through the Althea Dashboard.

In terms of payments, the decentralized network relies on individual routers compensating their neighbors using blockchain. Each router has its wallet and Network Organizer Payment Address. Once the optimal service route is determined, channels are created between routers, transferring Althea tokens as payment, later distributed after a holding period.

Product updates

> Since 2022, Althea has partnered with Compudopt, a non-profit organization empowering youth through technology, to provide Internet to low-income CBRS families across Dallas.

> In 2023, Ulukhatok, a remote settlement in Canada, was connected with 4G coverage.

> The latest significant development in the Althea blockchain launch is Testnet 2. The project is poised for a significant milestone with its Mainnet set to launch in Q1 2024. This pivotal event will transition Althea into a new phase focused on scaling operations and enhancing its Liquid Infrastructure.

> Althea is launching regional chapters, inviting builders, innovators, and supporters to pioneer change. The initiative seeks three pilot locations, offering chapter leaders exclusive benefits and opportunities like the Liquid Infrastructure Launch Party in March 2024 with a chance for one leader to receive tickets and lodging.

> Althea has also developed its KeyLTE technology, which contributes to LTE network deployment with a flexible toolkit for design and deployment, avoiding expensive legacy topologies. It enables affordable, agile and scalable networks, embedding the EPC in the Althea smart router. KeyLTE offers accessible plug-and-play, cost-effective building, and flexible, dynamic deployments. The solution scales seamlessly with traditional or hybrid cloud deployments, ensuring resilient networks in challenging scenarios.

> Another development by the team is iFi (Infrastructure Finance) - a platform for real estate owners to unlock liquidity by tokenizing infrastructure as fungible or non-fungible tokens. Utility companies can leverage Althea's technical innovations to earn recurring revenue from tokenized assets, while developers can build composable interfaces and decentralized applications for managing open, interconnected markets, offering new ways to fund, build, and coordinate infrastructure for all.

> In September 2023, Althea L1 also hosted the world's first iFi Hackathon with a $30,000 prize pool, where the top positions were secured by startups Electra, Chandra Station, AltheaAds, and NetSpan.

Liquid Infrastructure

Tokenized telecom infrastructure using AltheaL1 enables the funding and coordination of networked utilities

Tokenized telecom or utility real world assets (RWAs) can be funded by unconnected pools of investors and communities.

The Gravity Bridge and Althea enable the use of user friendly stable coins. Users don't need to understand crypto - they simply pay in digital "dollars".

Tokenized assets can be traded easily and securely on Althea L1 marketplaces providing liquidity to historically illiquid RWAs.

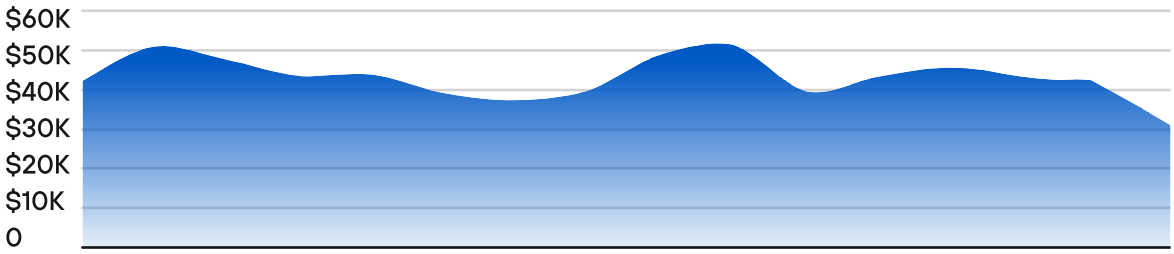
Existing RWAs can also benefit as tokenization provides liquidity and adds back the 20-30% discount applied to illiquid assets.

Liquid Infrastructure makes funding, ownership and financial rewards related to RWAs available to the masses and removes the historic barriers to entry

Metrics

> In 2023, Althea demonstrated impressive progress, achieving an 85% Compound Annual Growth Rate (CAGR) in revenue while expanding its network across 14 U.S. states.

Althea Onchain Revenue



Ecosystem

Ecosystem's key players: Tribal Resource Center, AgFiber, Wave7ISP, UW and Takoma Cooperative Network, Pacific Northwest Rural Broadband Alliance, Hub Advanced Networks (Puerto Rico), Revabit (Ghana), Local network pilot in Nigeria, red_medellin (Columbia).

Partners: Rural Urban, mahuman, Mintscan by Cosmostation, KR1, Interchain Foundation, Hub Advanced Networks, Gravity Bridge, Figment, Connect Humanity, Chandra Station, C14, Assembly Capital Partners.

Wayru Network 03

Key Concepts

Wayru.io is a decentralized internet network aimed at bridging the digital divide. This solution brings together medium-sized internet service providers, entrepreneurs, and communities to create, operate, and own internet networks.

Wayru is a network of networks that introduces a new collaborative economy model, focusing on minimizing the significant operational constraints current internet service providers face.

The responsibility for operating and maintaining the network is shared with entrepreneurs, communities, and local businesses, substantially reducing operational expenses for internet network operations.

INFRASTRUCTURE LAYER: ALGORAND, PEAQ NETWORK.

At the core of the Wayru network is WayruOS™, which taps into the untapped potential of everyday Wi-Fi devices, enabling the creation of a global network interweaving connections between cities, towns, and countries, ultimately aiming to span continents and become more than just Wi-Fi.

Node operators (owners of access points that provide internet and Non-Fungible Nodes, 25 USDC for Wayru Devices and 50 USDC for others) can share their WiFi connection and receive tokens as rewards. These tokens can then be used within the network to purchase WiFi credits. Users needing internet access can also acquire WiFi credits using $WRU tokens, gaining access to the global network of shared WiFi access points, running by WIFI Validators.

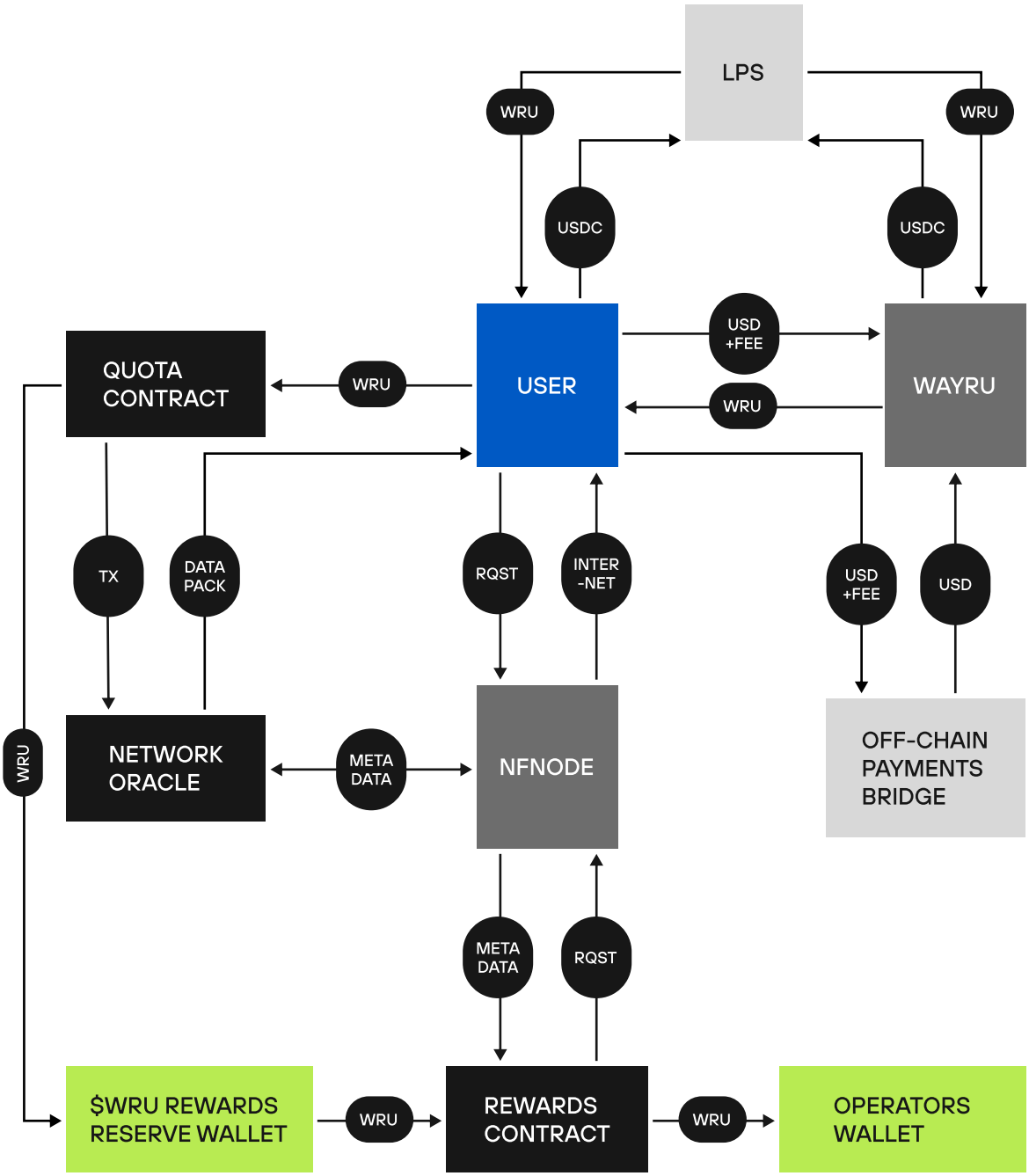
Wayru Genesis

Wayru focuses on commercial devices such as specific Wi-Fi routers from TP-Link and their in-house development, the Genesis router.

The router utilizes plug-and-play technology, allowing any user from anywhere on Earth to set up their own access point and earn various rewards for it. A power source and an internet cable are required for the device to function correctly. After connection and setup, any user can access the Wi-Fi network.

Every user connecting to such a network will reward the router owner with Wayru company tokens. If the network has a certain level of security, voted by the community, the rewards will be significantly more substantial.

Wayru Basic Token Flow Example



Wayru currently has 3 active key services and two in active developments:

> ***WayruOS:*** A system based on OpenWRT compatible with a wide range of access points from various manufacturers. WayruOS enables the transformation of any Wi-Fi device into a cryptocurrency-generating machine, creating open Wi-Fi access points for users. Using WayruOS, users earn cryptocurrency whenever others connect to their shared Wi-Fi networks. The architecture of WayruOS ensures that traffic from guest users, private users, and access point management passes through separate encrypted tunnels. Each device under WayruOS control has a unique identifier in the blockchain, called Non-Fungible Nodes (NFNs), which secure every transaction in the network.

Wayru WiFi App: Users can find and connect to nearby networks effortlessly. It consists of the following components:
— WiFi Explorer: A map displaying available Wi-Fi access points for connection.
— Wayru WiFi Community: A community acting as validators of the network. The community can provide reviews and validate the security of access points, internet connection speed, and the actual radius of the Wi-Fi signal. The community also receives rewards for such actions.
— The Wayru WiFi Leaderboard: An internal mini-social network displaying rankings for both router owners and validators.

Wayru for Non-Profits & Government: Provides non-profit organizations the ability to create self-sustaining networks in underserved communities, thereby offering internet access to people in areas where internet connectivity is scarce. Owning a personal access point and service package is a luxury for low-income families. Wayru handles technical aspects and selects the necessary equipment, while non-profit organizations bring the funds and the vision. Wayru guarantees that the deployed networks will become self-sustainable over time.

Product updates

In February 2024, Wayru announced that it would join the Peaq ecosystem and further develop its product within the ecosystem. A version of hotspot firmware with peaq ID support will be released soon, allowing users to migrate and officially run on peaq.

Wayru has already deployed over 300 Genesis access points in Ecuador.

There are plans to create the $HPT token - Hotspot-Pegged Tokens are digital assets within the Wayru ecosystem that enable individuals to support a specific hotspot by depositing $WRU tokens, earning a share of the extra rewards generated by the hotspot.

Wayru introduced a Captive Portal to enhance the user experience for those connecting through Genesis devices. This portal offers a seamless process, allowing users to create accounts and view advertisements for free internet access.

Partnership with UN — UNHCR: Wayru has established a self-sustaining network through a strategic partnership with UNHCR in Ecuador. As a result, 42 access points were installed in the challenging area of Guayaquil, providing vital internet access to over 2500 refugees daily.

Launch and release of WayruOS: A system based on OpenWRT, allowing any WiFi device to become a tool capable of generating cryptocurrency for providing internet access.

Wayru WiFi 3.0: Release of the Android and iOS application that enables people worldwide to discover, use, and assess WiFi networks.

Private round, CEXes and DEXes listings with Token Generation Event of $WRU are scheduled for Q2 2024.

2 MORE SERVICES WILL BE RELEASED SOON:

Wayru for Business (Coming Q2-Q3 2024) — a solution for managing WiFi networks and enhancing customer experiences. Includes: WiFi Management, Remote Monitoring, OTA Provisioning, Splash Page Editor, OpenRoaming, and Mobile SDK.

Wayru for Advertisers & Ad Agencies (Coming Q3-Q4 2024) — a platform that allows the creation of campaigns displayed to users during free WiFi connection, making the connection free for end-users. The $WRU token is tied to all of this, allowing advertisers to offer discounts, promotional campaigns, or rewards using $WRU tokens, strengthening the connection between the brand and users.

Metrics

+500
Total Active Hotspots

+5M
Total Shared Networks

+250K
Total WiFi Users

Over
250K
Network users

More than
300M
MB of data has been utilized

Over
9K
users downloaded The Wayru application

Wayru released
1000
hotspot units at $200 each. These were quickly sold out, and the company continues to develop this direction for even greater scalability.

Over
5M
Wi-Fi networks the Wayru Wi-Fi App has mapped over

Ecosystem

Support for Wayru hotspot models from manufacturers such as Mikrotik, YunCore, Linksys, TOTOLINK, and others is also planned soon. In the future, the team will add compatibility with devices using IoT and 4G/5G technologies and introduce over 100 new compatibility features.

With the support of UNHCR, Wayru has already connected thousands of residents of Juan Montalvo (Ecuador) to a high-quality fiber-optic network using WiFi routers, with a radius of 100 meters on each block. Additionally, in collaboration with Father Simón's KAIROS Foundation, 10 free WiFi points have been installed for the benefit of 2,500 inhabitants of Monte Sinaí (Guayaquil, Ecuador).

Among Wayru's partners and investors: Algorand, Peaq, UNHCR, World Council, Open Wisp, Big Brain Holdings, Ferrum Network, Cogitent Ventures, Snackclub, 816 Cap, OpenWrt, HNT Fund, Borderless, LVT Capital, Pulsar Trading, Meld Ventures, 7 O'Clock Capital and others.

FOAM 04

Key Concepts

There is a lack of standardized location encoding in the realm of smart contracts and blockchain-based projects. Current location standards are unsolved, with 70% of the world remaining unaddressed. FOAM addresses three fundamental problems: 1) location encoding standards; 2) user experience for spatial applications; 3) secure verification of location data authenticity.

FOAM is a protocol that helps create reliable maps for various uses by using decentralized geospatial data markets. Using a utility token ensures security and accuracy through computational work and network verification. Tokens and crypto-economics support FOAM, allowing users to work together in a decentralized form.

- **INFRASTRUCTURE LAYER: ETHEREUM, OPTIMISM.**

FOAM's CSC simplifies location tracking on Ethereum. It allows smart contracts to claim blockchain addresses and real-world map locations using the geohash standard. This means any smart contract can now refer to a specific spot in the physical world, adding a spatial dimension to Ethereum transactions. The hierarchical nature of geohashes ensures that contracts automatically understand their spatial relationships.

FOAM Radio

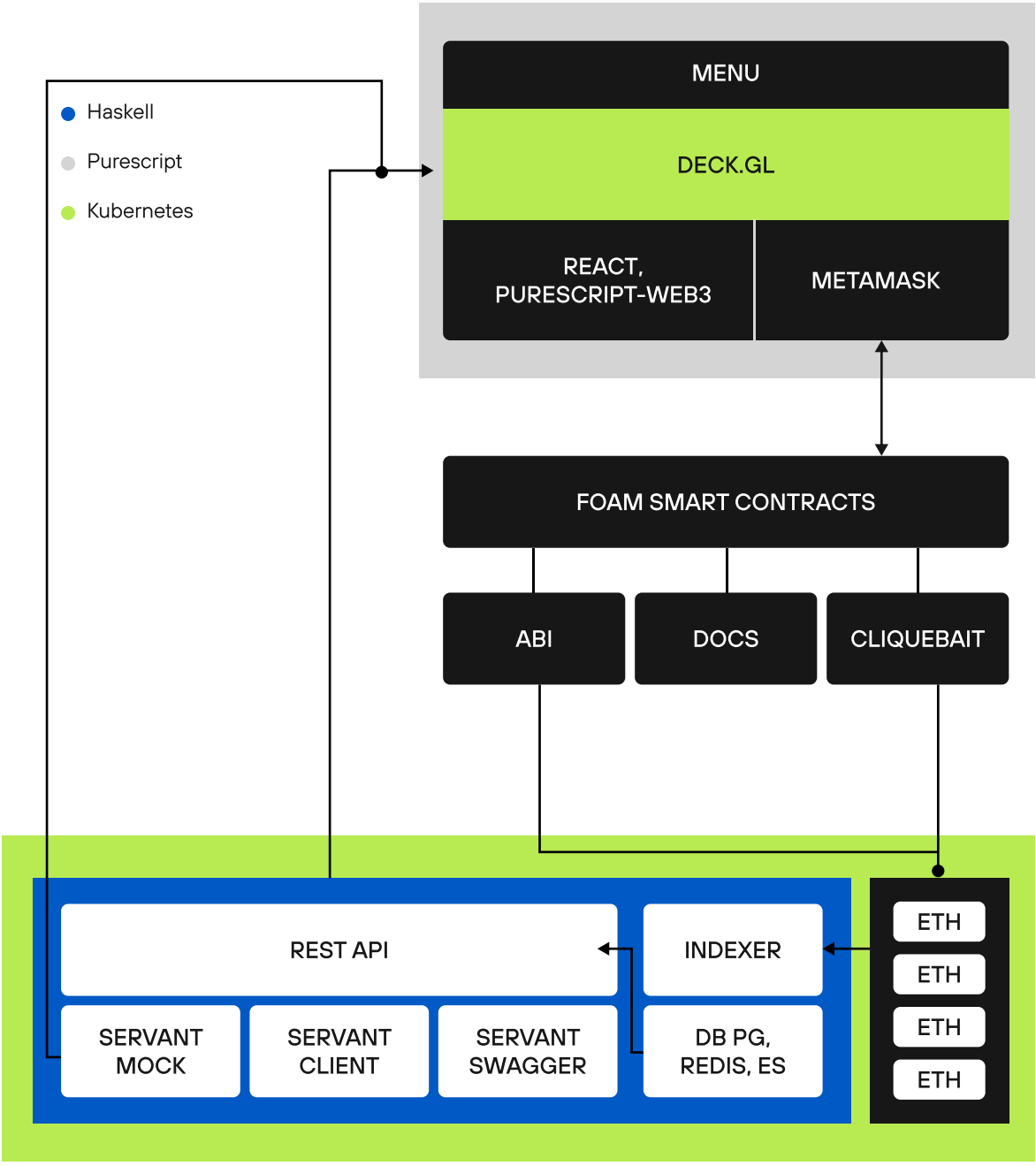
To overcome these challenges, FOAM introduces solutions such as Crypto-Spatial Coordinates, the Spatial Index and Visualizer, and Proof of Location. Existing dominant mapping players, like Google, pose issues as whoever controls the map influences global navigation. FOAM aims to provide an open and standardized solution, differentiating itself from proprietary systems like

What3Words and offering a decentralized approach to address the persistent problems in location standards.

Key features of the CSC include both on- and off-chain verification, allowing contracts to claim locations and users to check this information physically and on the blockchain. The CSC uses a geohash and an Ethereum address for its functionality, providing a user-friendly representation. Shorter CSCs represent larger areas, similar to ZIP codes. Essentially, the CSC is a combined representation of a geohash and an Ethereum address, permanently recorded on the blockchain, offering a mapping tool for smart contracts.

As a result, FOAM will enable obtaining location data without satellites, verified by the community, while keeping the code open and providing access to a decentralized alternative to centralized maps and location services.

SIV Architecture



FOAM's Token Curated Registry (TCR) involves three key actors: Consumers, Candidates, and Cartographers (FOAM Token holders). The goal is to create a reliable and useful list of Points of Interest (POIs). Candidates deposit FOAM Tokens to propose a POI, facing a challenge period. If uncontested, the POI is added to the list, and tokens are staked. Challenges can be initiated by Cartographers, with in-person verification possible. Voting occurs, and successful challenges are rewarded from the Candidate's deposit. Unsuccessful challenges result in forfeited deposits and rewards for the winning voters. Cartographers can adjust TCR parameters, fostering flexibility and potential development of multiple TCRs for various purposes. The FOAM TCR is accessed through the Spatial Index Visualizer (SIV).

In addition, FOAM has the FOAM Location direction - a network of terrestrial radios and time-of-flight algorithms that work independently and freely, providing secure location services and preventing fake location data by syncing time without relying on centralized sources like GPS.

FOAM Location consists of several vital elements that are interconnected:

FOAM Location is a comprehensive system comprised of interconnected elements. First, Zone Anchors, radio beacons forming a network, employ signals to connect with nearby anchors. Zone Anchors utilize a Byzantine Fault Tolerant clock synchronization protocol to ensure accurate location verification, achieving time consensus by exchanging messages and calculating time differences.

> All these forms work with a special consensus called “Proof of Location.”

Once synchronized, Zone Anchors can collectively form a Zone, committing to offering location services with smart contract safety deposits to ensure accountability. This Zone maintains agreement on both time and space. Triangulation occurs as Zones collect time-stamped customer messages in a competitive market, with Validators providing fraud proofs and calculating triangulations for precise location data. Verifiers, acting as computing power agents, scrutinize Zone time logs for potential fraud. Finally, Verifiers submit Fraud Proofs to the Ethereum Blockchain, creating Proof of Location certificates in the process.

Use-cases

INTERNET OF THINGS

Secure location verification and localization for networks of IoT devices sensor data.

LOCATION INTELLIGENCE

Adding spatial attribution to the toolkit of blockchain-enabled analytics.

SUPPLY CHAIN

Adding verifiable and accurate product tracking in decentralized ecosystems from supplier to customer and all the steps in-between.

GEOSPATIAL DATA

Verifiable spatial data provenance and attribution through Proof of Location supports the development of decentralized data-markets.

MOBILITY

Supporting the growth of mobility services and autonomous vehicles through location tracking and fraud prevention.

INSURANCE

Automated conflict resolution and contract enforcement through trusted reporting of spatial variables.

Product updates

September 2023 — FOAM Testnet was released on the migrated OP Stack. FOAM has been quietly running its own OP Devnet, a fork of the OP Stack, for testing and development. FOAM is building its Proof of Location contracts on the Optimism Collective's OP Stack to complement its Physical Testnet. FOAM aligns with Ethereum's vision of scaling through rollups and layer 2 solutions, choosing Optimism as its home for scalability. FOAM plans to migrate its contracts to a public Optimism testnet like OP Goerli in the near future.

October 2023 — FOAM announces the FOAM MVP, a full-stack demonstration of an open Proof of Location network. FOAM MVP's first stage, MVP 1.0, focuses on minting a Presence Claim NFT as a digital certificate verifying the existence of someone or something at a particular place and moment and viewing it in a web3 wallet. MVP 2.0 will demonstrate Presence Claims in web3 applications, including an onchain geospatial game to be done by FOAM themselves.

Metrics

Zones in North America, Europe & New Zealand

1950+
hours of experiments

15+
vetted teams

75+
radios built

WiFi Map

05

Key Concepts

WiFi Map — is a platform of services aimed at increasing the availability of WiFi networks, improving internet connection accessibility and security, and informing people about accessible WiFi access points. The main elements include both publicly available access points and initially closed ones, but access to which has been opened for and by WiFi Map users.

INFRASTRUCTURE LAYER: POLYGON.

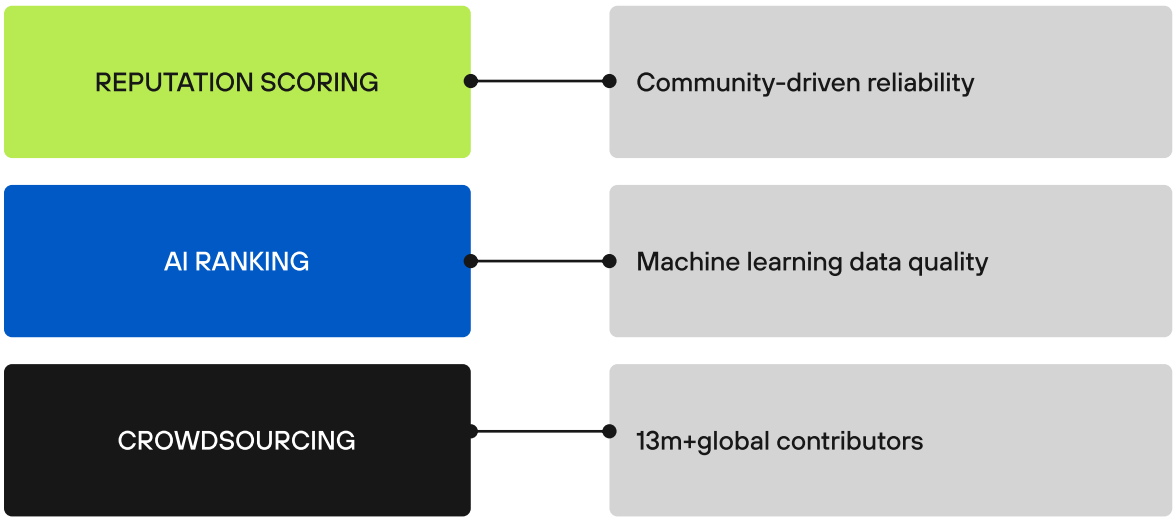
The architecture of WiFi Map revolves around a user-driven model that displays a global map of WiFi access points contributed by millions of users. These access points include essential information such as network name, password, and reliability rating.

Among the key services of WiFi Map are:

- The "WiFi Finder" map, directly showcases free WiFi hotspots;
- eSIM for over 80 countries;
- Offline Maps with millions of marked free WiFi hotspots for quick location of places offering free internet access;
- VPN for secure internet usage;
- Data Saver, reducing the amount of data used when loading web pages;
- $WiFi Wallet, where users can store $WiFi tokens, receive rewards, and unlock access to premium service features.

The application's search feature allows users to locate WiFi access points in specific areas. Users can download region maps for offline use, ensuring access without an internet connection.

Innovating Principles for Maintaining Data Quality



Reputation scoring ensures accuracy and reliability of user-contributed data.

AI ranking system selects top WI-FI hotspots based on reliability, speed, and location.

Security is prioritized by providing a VPN for users connecting to public WiFi networks, ensuring the protection of user data and privacy.

Additionally, WiFi Map incorporates a blockchain system, rewarding users with $WIFI tokens for adding new access points. $WIFI tokens can be exchanged for eSIM data packages. Also, users can receive 15% cashback in tokens for using eSIM data services. Some token rewards are given for contributing to and enhancing the WiFi Map ecosystem. Last but not least, users can send tips to those who add WiFi hotspots.

Despite being categorized as a DePin service, the blockchain's role in the product is not pivotal, and the main information is stored on centralized solutions. Through blockchain, WiFi Map adds support for microtransactions within its services.

Product updates

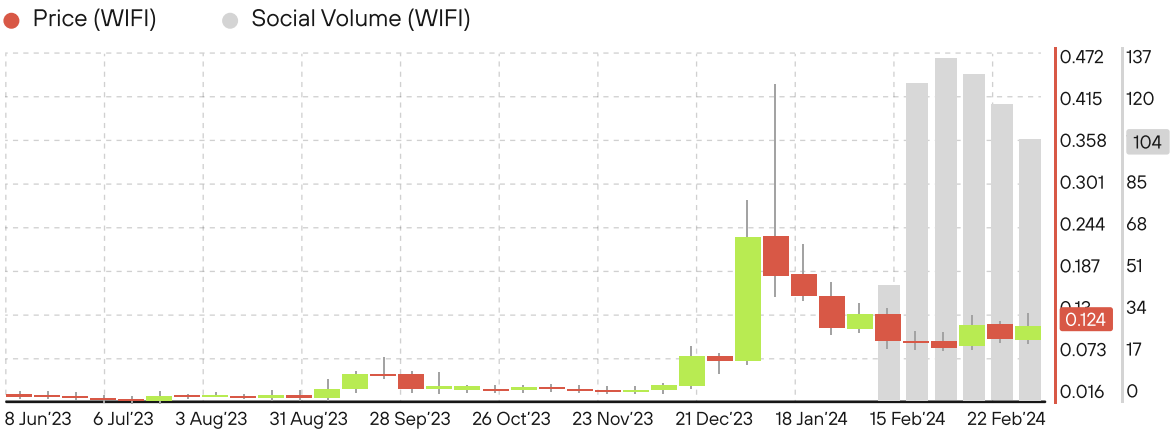
> In April 2023, the team released its utility token based on Polygon into the product, bringing WiFi Map and the DePin concept into the blockchain industry.

> Currently, the team comprises over 40 full-time employees, and the platform has become one of the leading WiFi scanner services for mobile devices.

> In 2024, the team will release new updates, such as WiFi auto-connect, expected to be introduced along with new eSIM plans, a verified premium hotspot feature, business stake initiatives, and further expansion of eSIM support to additional countries.

Metrics

WiFi Map (WIFI) Santiment



This platform is also notable for having one of the largest user bases in the blockchain industry, with over 170 million users. Thus, WiFi Map contributes to the mainstream adoption of blockchain technology.

WiFi Map Network Stats

200+
Countries with WiFi hotspots supported

150M+
Hotspots available worldwide

2B+
Connections

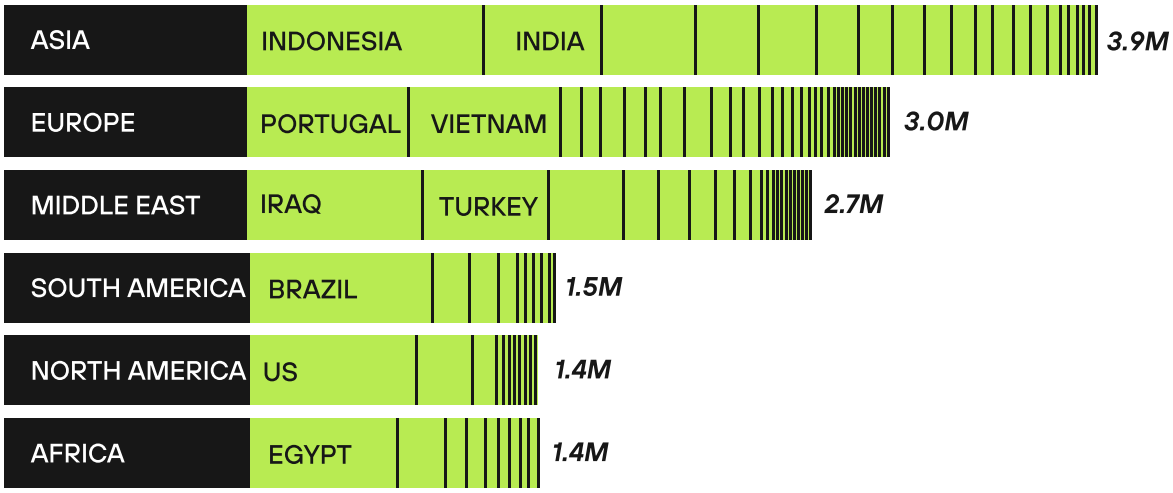
170M+
Users

15M+
Contributors adding and healing WiFi hotspots

2M+
Reviews

eSIM for
80+
Countries

Active WiFi Hotspots by GEO (m)



1 WiFi Map connects >14 million hotspots across >160 countries	1 >150 million app downloads and >4 million monthly active users
2 WiFi Map's network is truly global and decentralized	2 ~4.6 star app rating across >2 million reviews
3 $WIFI token will be central to the WiFi Map ecosystem	3 Highly-engaged community of contributors

WIRELESS

Andrena

06

Established in 2017, Andrena is a US-focused wireless internet company dedicated to transforming web accessibility. Using wireless technology transmitted from rooftops and Helium Stack, the company delivers high-speed internet to multi-tenant buildings and businesses at a significantly reduced cost compared to traditional providers. Andrena operates a decentralized wireless network, emphasizing fixed-wireless transport over fixed-wireless access.

Andrena's services involve a revenue-sharing arrangement and covering installation expenses in collaboration with real estate owners, offering affordable plans starting at $25 per month. The company's dedication to accessibility and affordability is reflected in its participation in the Affordable Connectivity Program, seeking partnerships with public housing authorities to provide low-income residents with affordable or free broadband. What sets Andrena apart from competitors is its reliance on software for service delivery, enabling remote issue resolution and scalable unit economics.

> In Q1 2023, the company secured $15 million in Series A funding, with investors like Dragonfly Capital recognizing potential in its innovative approach, particularly its substantial use of Helium 5G, part of Helium's MOBILE ecosystem.

Andrena Compatible Devices

AFFORDABLE
Plans start at just $25/ month

HIGH-SPEED
Plans up to 2 Gbps

SAFE & SECURE
Your data is yours alone

NO INSTALL
Get online in less than 3 minutes

Grass (Wynd Network) 07

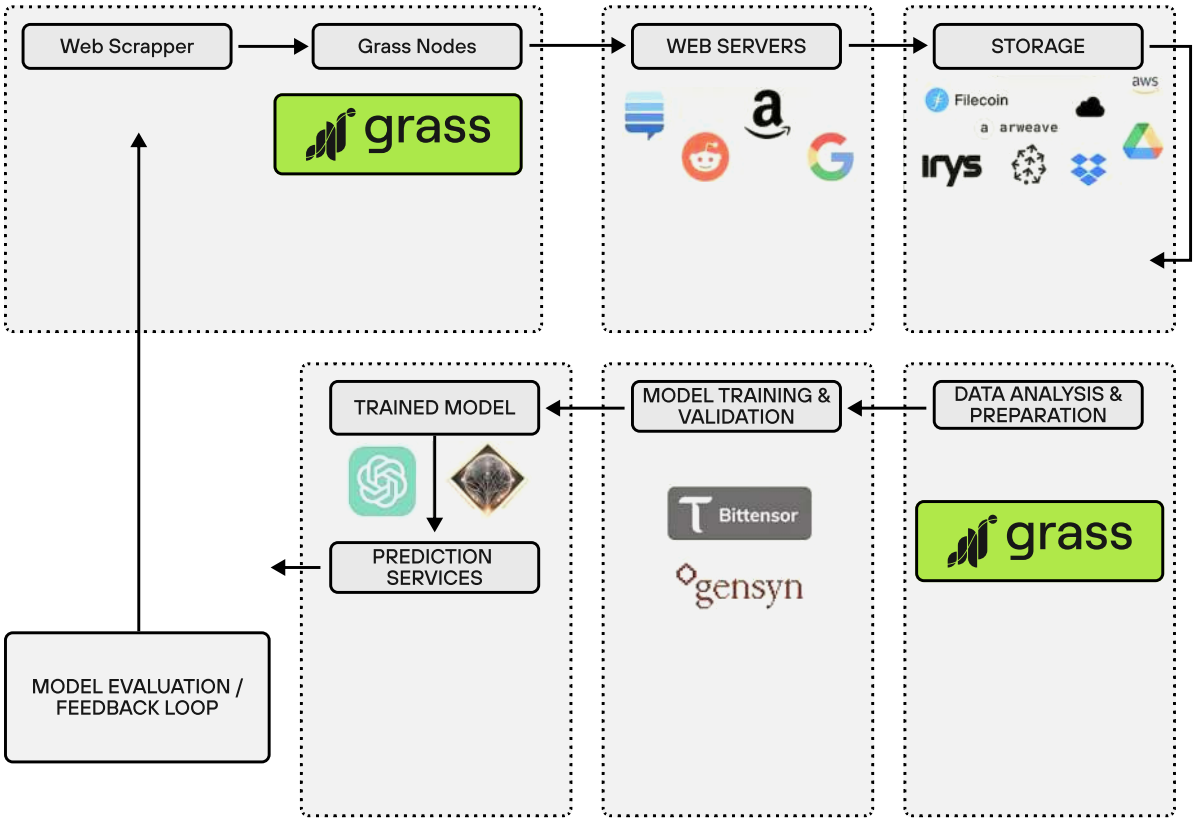
Grass is a network created by Wynd Network that allows users to monetize their unused internet bandwidth by selling it to corporations and institutions. The platform, accessible through a downloadable application on the Google Play Store or Chrome Extension Store, operates in the background of users' devices, generating passive income without any impact on personal data privacy.

Grass particularly caters to the needs of AI labs, enabling them to scrape the internet for data or obtain curated datasets through its decentralized web scraping protocol. With a commitment to user security, Grass ensures that personal data remains untouched and protected. Early adopters earn rewards for selling bandwidth and gain a stake in a future network that aspires to be a decentralized AI source of truth.

> In just four weeks of its beta phase on Solana, Grass has seen remarkable success, boasting over 190,000 unique IPs, 30,000 downloads, and 25,000 referrals, particularly emphasizing American IP addresses. Grass points earned during the Beta phase will be retroactively converted into network ownership.

> In December 2023, Grass successfully raised $3.5 million in a seed round led by Polychain Capital & Tribe Capital. The funds were secured from investors including Bitscale, Big Brain, Advisors Anonymous, Typhon V, Mozaik and others.

Grass Role in the AI Ecosystem



WIRELESS

Meson Network

08

Meson Network is an infrastructure layer and future marketplace for DePIN based on the native blockchain. Meson Network aims to make computing resources accessible to everyone and break the dominance of big computing providers. Using blockchain technology offers a decentralized approach to accessing computing power, reducing network costs. In this decentralized marketplace, small and mid-sized nodes are rewarded for contributing. Users pay fees in $MSN tokens for using computing power, which are then returned to the providers. The $MSN token is used for platform fees, rewarding nodes, and participating in community voting through DAO.

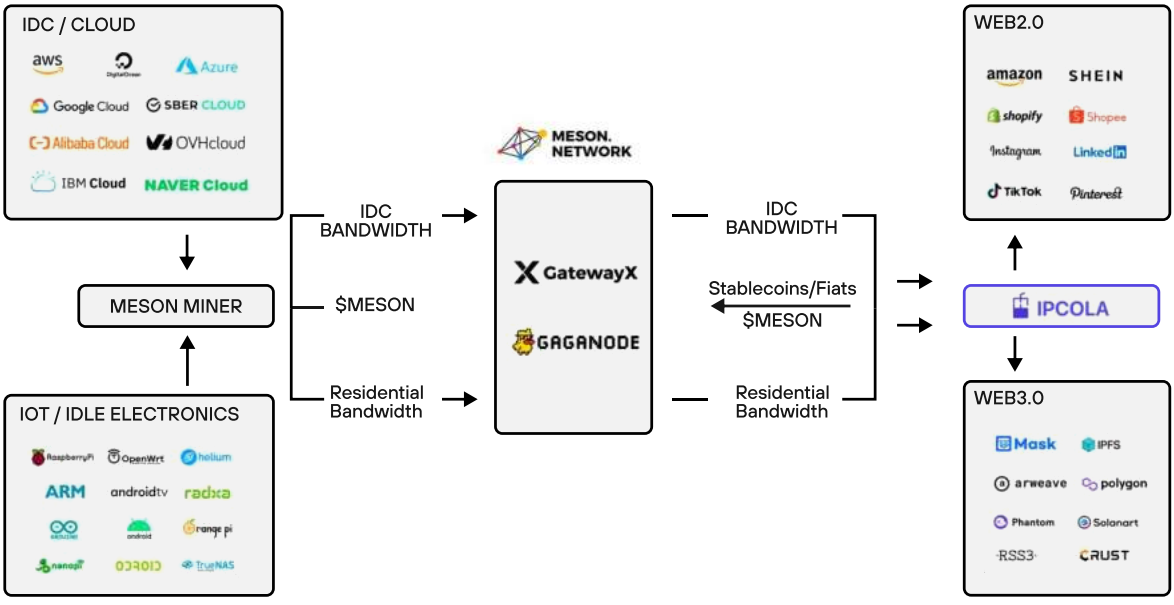
The main technologies employed by Meson Network encompass Gateway X, which addresses a fundamental challenge restricting the potential of IPFS, Filecoin, Arweave, and Greenfield applications. It facilitates users in deploying their own IPFS gateways, leveraging personal storage facilities for more efficient and cost-effective file uploading, storage, and sharing. Complementing this is Gaganode, designed to provide a privacy-preserving and anti-censorship experience by tapping into a vast reservoir of bandwidth and IPs from idle smart devices, with economic incentives tailored for network contributors. Building on the capabilities of Gaganode, IPCola emerges as a customizable big data solution actively utilized across various industries such as AI, social media, adTech, e-commerce, and more.

> The company raised $3.5 million in a Seed round, with investors including Arweave, Mask Network, Digital Currency Group, HashKey Capital, and others.

> With support of a robust community of 340,000 miners, Meson's decentralized network spans 150 countries, featuring over 100,000 active nodes and achieving an impressive bandwidth capacity of 20 Tb/s.

> Meson Network has recently finished its token sale on CoinList at a price of $1.75 per token, allocating 2,500,000 MSN Tokens and raising $4.375 million. The Token Generation Event and token listing are tentatively scheduled for March 15, 2024.

Meson Network Architecture



Drop Wireless 09

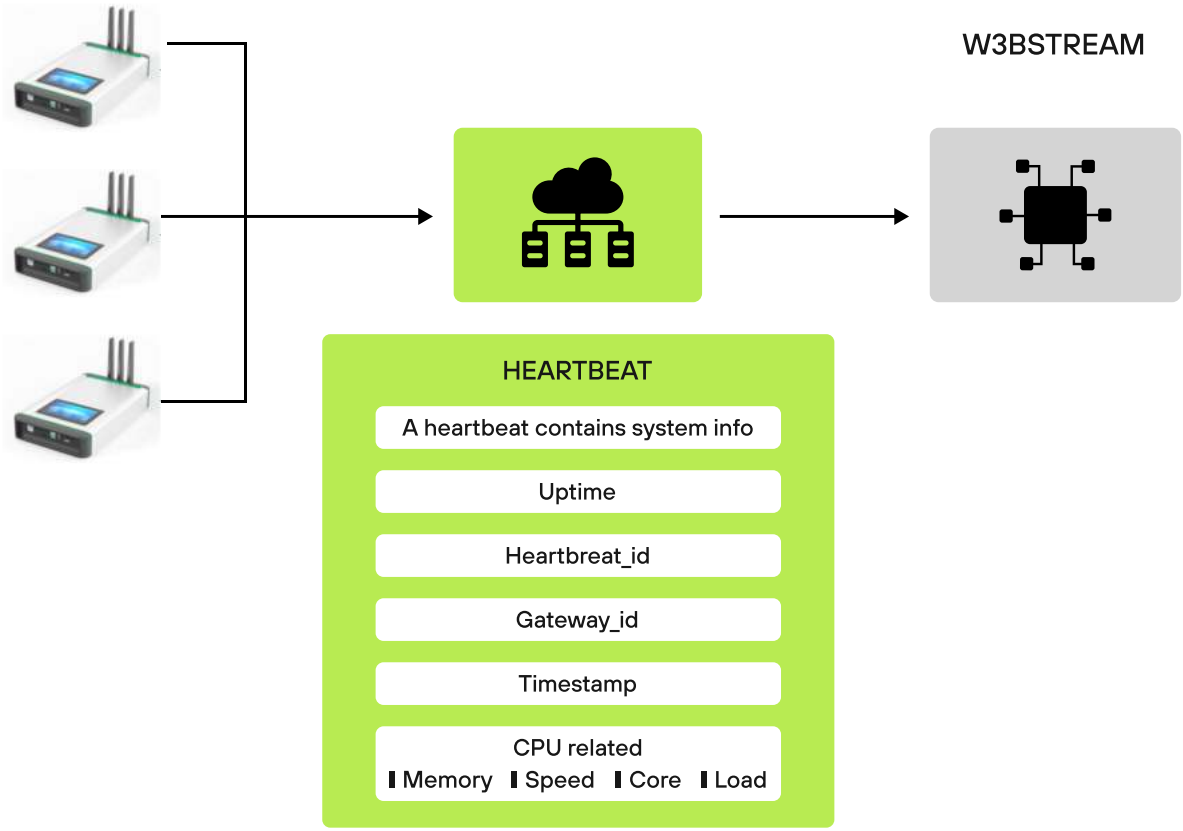
Drop Wireless is a project positioned to upgrade the telecommunications industry in the era of 5G and the Internet of Things. The mission of Drop Wireless is to implement Web3 technology and an ecosystem in real-world scenarios, establishing a community-driven infrastructure that empowers individuals to verify and validate activities independently. Additionally, the goal is to provide individuals with greater control over their data by employing encryption and distribution across multiple nodes, fostering the creation of applications built on decentralized protocols.

System overview of Drop wireless node, G1

The re-launch of Drop Wireless on IoTeX's DePIN infrastructure is a significant development, underscoring a global focus and a dedication to addressing critical issues for vulnerable populations. Notably, the company's decentralized display advertising solution is designed to tackle equity concerns in the global ad market, leveraging existing physical ads for a more inclusive approach. What sets Drop Wireless apart is the integration of W3bstream into its stack, which is pivotal in securing data and enabling sophisticated decentralized logic. W3bstream ensures the integrity and validation of data through mechanisms such as timestamped "heartbeats" from Drop Wireless's G2 unit, which are stored on the blockchain. This guarantees fair token rewards for node operators and minimizes the risk of data spoofing.

The broader industry shift towards a decentralized ad marketplace indicates progress, with IoTeX as a foundational platform empowering DePIN founders to focus on practical problem-solving rather than grappling with intricate protocols. The move by Drop Wireless is not just a one-off event; it hints at a potential trend where more organizations may follow suit, migrating to IoTeX's stack. This trend is expected to contribute significantly to transformative changes in the global economy, emphasizing the growing importance of decentralized solutions like IoTeX's DePIN infrastructure.

W3bstream integration



Formerly known as Nesten, Drop Wireless utilizes IoTeX and boasts a global LoRaWAN network comprising over 1,500 nodes spread across seventeen countries. Nowadays, Drop Wireless has scaled and focused on the general IoT and DePIN sectors. Also, it concentrates on scenarios that significantly impact the welfare of susceptible individuals by providing tele-healthcare services in India with plans to expand to Africa.

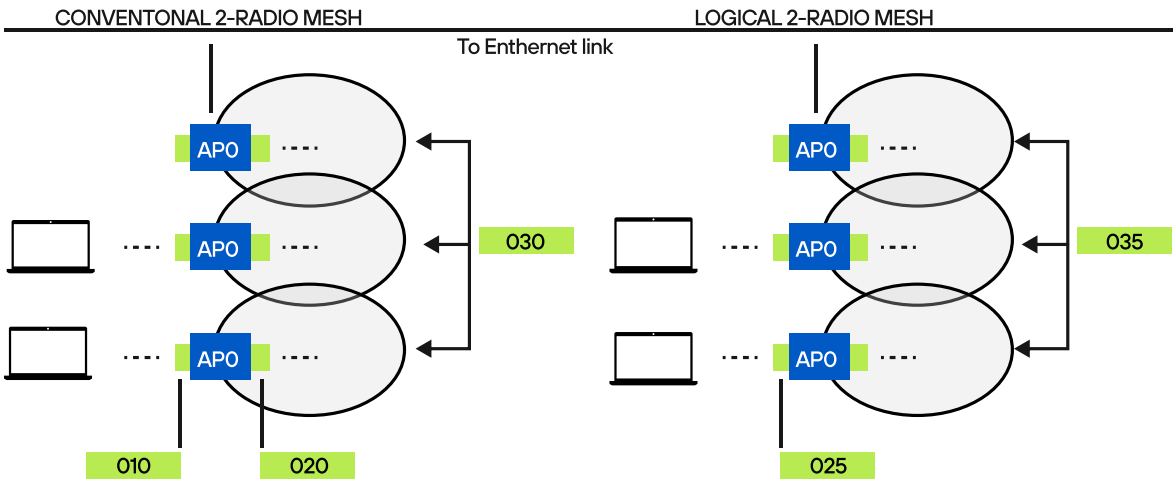
Chirp

10

Chirp is creating the robust and seamless DePIN blockchain by leveraging decentralization, connecting a vast number of devices through a radio-agnostic approach, and addressing the complexities in IoT, mobile and broadband internet connectivity. Focused initially on IoT, Chirp confronts the fragmentation challenge by providing a unified network that supports 14 connectivity protocols.

The Blackbirds and a Cardinal miner power Chirp's IoT network, offering seamless integration through a no-code platform. The platform eliminates the need for users to navigate various protocols and gateways, making IoT accessible for both residential and commercial setups. For mobile connectivity, Chirp introduced Cardinals, community-owned antennas forming an actual, scalable cellular network, promising affordability and enhanced performance. Cardinal is a unique 5G community-owned miner that operates independently of keepers' internet.

Chirp High-level Architecture



The Black Bird

The Blackbird, a long-range multi-protocol gateway, serves as an IoT hub. It utilizes LoRaWAN, LoRa 2.4 GHz, BLE, and thread/ matter protocols, offering precise indoor and outdoor connectivity that can even penetrate concrete and track movement accurately by the meter. Participants in community-owned miners and Blackbird keepers can earn $CHIRP for hosting the network.

> First Chirp gateways have not only sold out within hours but are now being deployed in 33 countries.

SENSORS

Sensor networks trend can be directly connected with IoT, which is all about connecting everyday devices to the internet, allowing them to send and receive data. Sensor networks are a big part of this because they help these devices understand what's happening around them. Whether it's a smart thermostat in your home or a plugin to your car, these networks help things work smarter and make our lives more convenient.

IoT

IoT technology is being integrated across different sectors: health monitoring devices that keep track of patients' vitals, smart city technologies that manage resources and services efficiently, smart homes where appliances and systems are interconnected, self-driving cars that use sensors and online data for navigation, and fitness trackers that monitor physical activity. Retail IoT empowers inventory management and customer service with real-time tracking.

Hospitality and tourism sectors also leverage IoT to personalize guest experiences. Central to these applications is cloud computing, providing the necessary infrastructure for massive data storage and computation, which shows the need for interconnectedness between all DePINs.

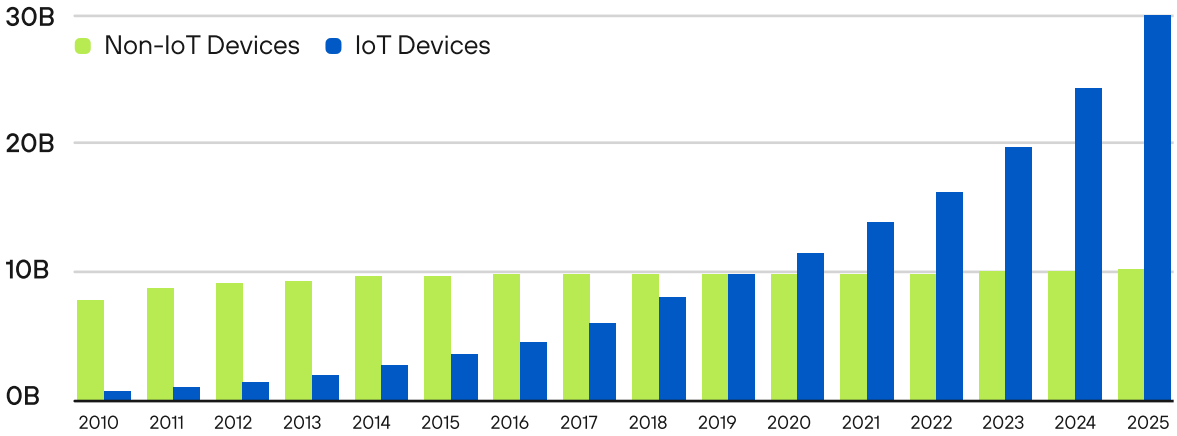
Self-driving Car | Smart Home | Smart Farming | Fitness Tracker | Smart Factories

IoT Applications

Retail IoT | Hospitality & Tourism | Health Monitoring | Smart Grid | Smart City

There has been a notable shift from non-IoT devices to IoT devices over the last decade. This change is vast, considering that in 2020, there were more IoT gadgets than traditional ones. The revolution highlights that our world is getting more intelligent and connected. Today, more devices around us can talk to each other, while the internet is making life easier and more efficient, from fridges to cars to street lights.

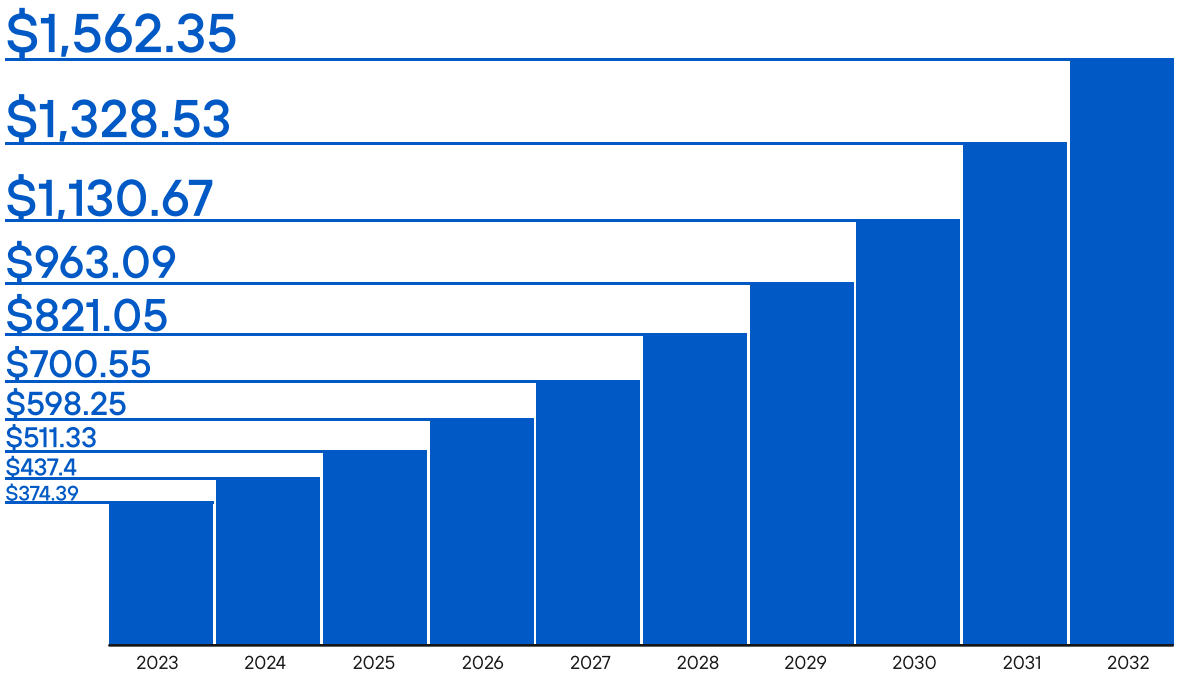
Non-IoT and IoT active devices from 2010 to 2025



The market segment for IoT devices is experiencing significant growth, with the market size expected to reach $374.39 billion by 2023, representing nearly a 4.5x increase. This growth is driven by the availability of cheaper sensors, improved networks, and increasing demand for data-driven devices across various industries. Such trends indicate a substantial economic impact and signal a future where IoT integration becomes widespread.

Industrial internet of things

2023 to 2032 market size forecast (in Billion USD)



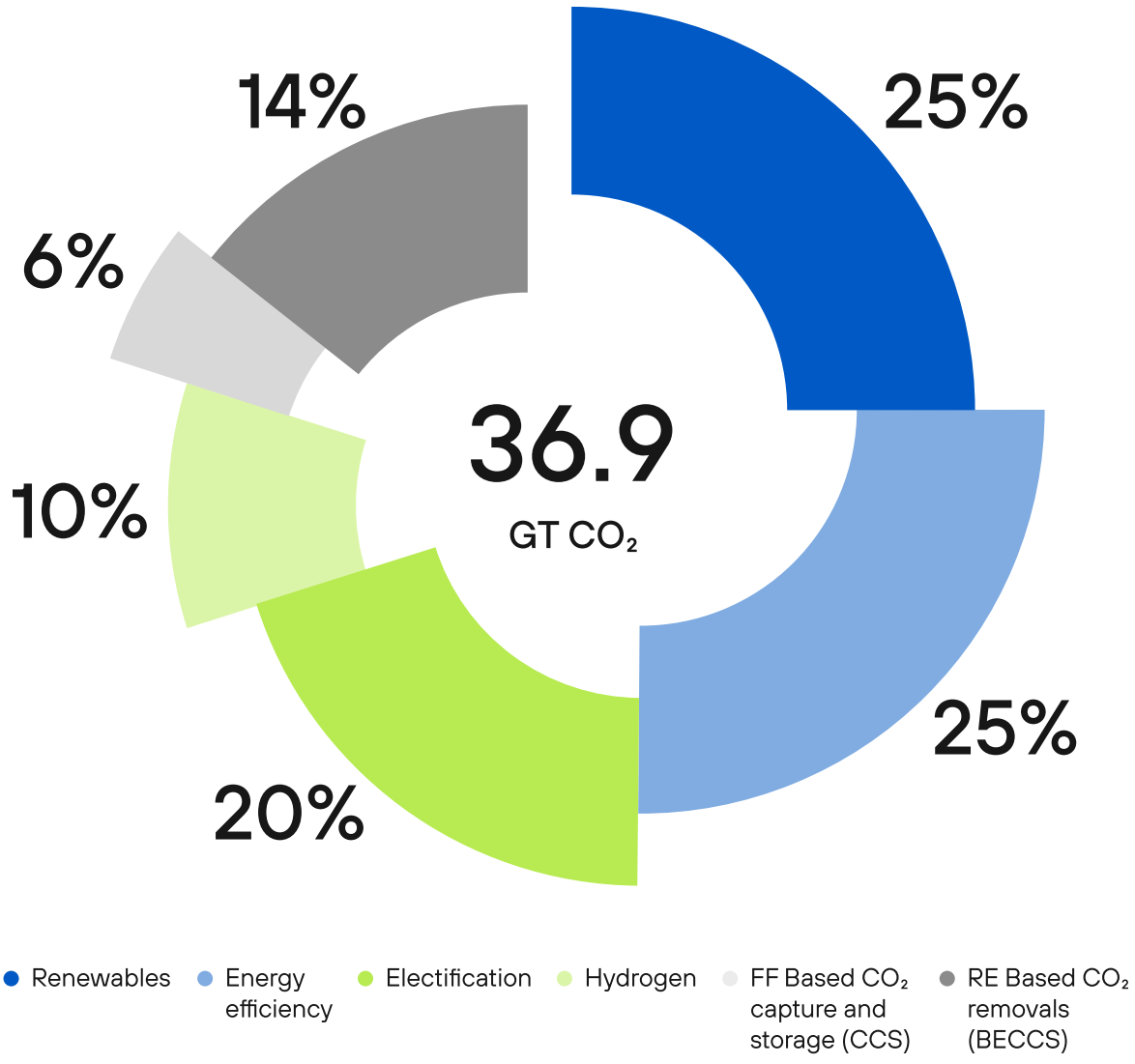
Energy Networks

In addition to the IoT market, several closely connected markets offer substantial potential for growth. Energy networks are pivotal in optimizing IoT functionality by ensuring uninterrupted power supply to connected devices. These networks efficiently monitor and regulate electricity consumption by employing innovative technology, promoting energy conservation and operational efficiency.

This integration enhances the intelligence of our power consumption, fostering eco-friendly practices while reducing carbon emissions. Energy networks are pivotal in devising strategies to mitigate CO2 emissions, contributing to environmental sustainability.

Renewable energy and energy efficiency account for 25% each in emission reductions, leveraging IoT capabilities to optimize utilization. Electrification (20%) and hydrogen (10%) signify a shift towards cleaner energy sources managed effectively through IoT systems. Additionally, IoT facilitates the monitoring and efficiency of carbon capture from fossil fuels (6%) and CO2 removal via renewables (14%).

CO2 Reduction Chart

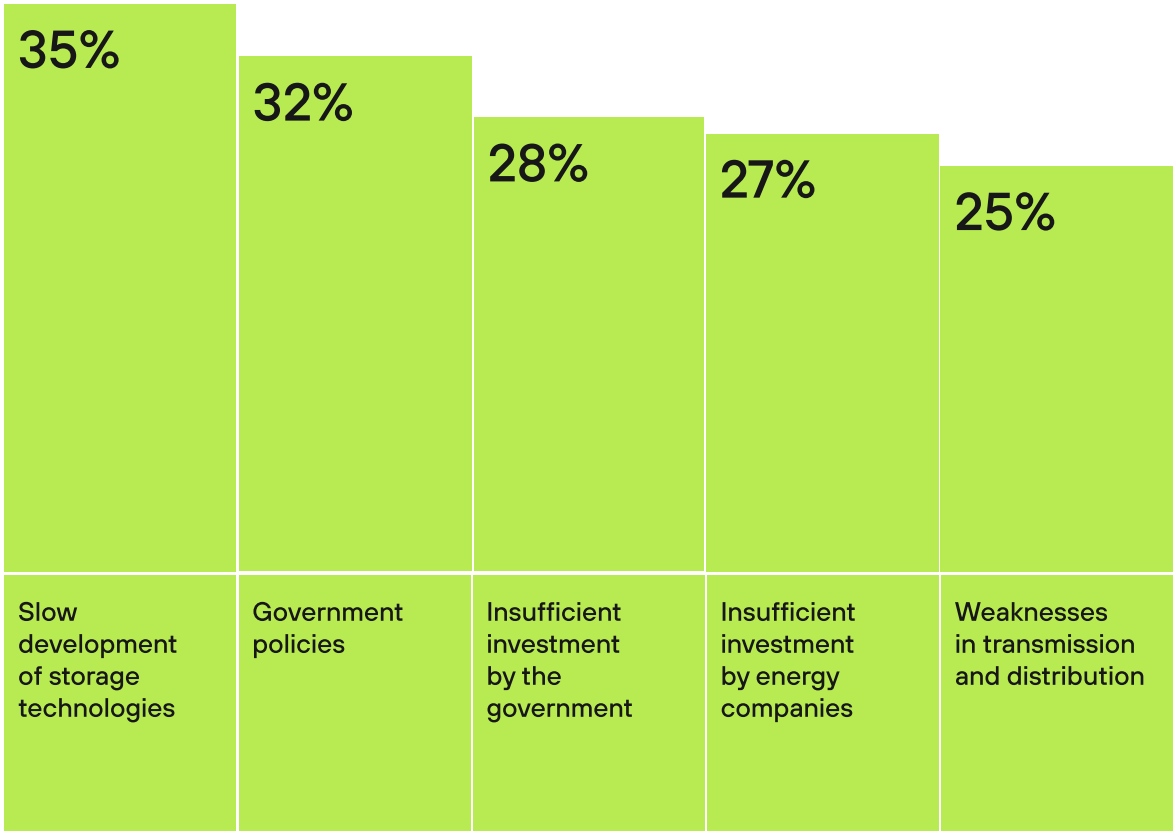


Despite numerous use cases, energy networks still lack support. It faces limitations due to outdated battery technology that cannot adequately store power from sources like the sun and wind. Government regulations and funding fall short of providing sufficient assistance.

Energy companies are also failing to invest adequately to improve the situation. Additionally, most power lines and systems need to be updated and equipped to handle new forms of energy effectively. Addressing these issues is crucial to fully realizing the benefits of utilizing renewable energy with new smart devices. The IoT market is poised for significant growth, requiring more power while simultaneously aiding in reducing CO2 emissions through clean energy. IoT is rapidly expanding, connecting devices ranging from refrigerators to cars for enhanced living experiences.

Factors inhibiting renewables growth in the energy mix

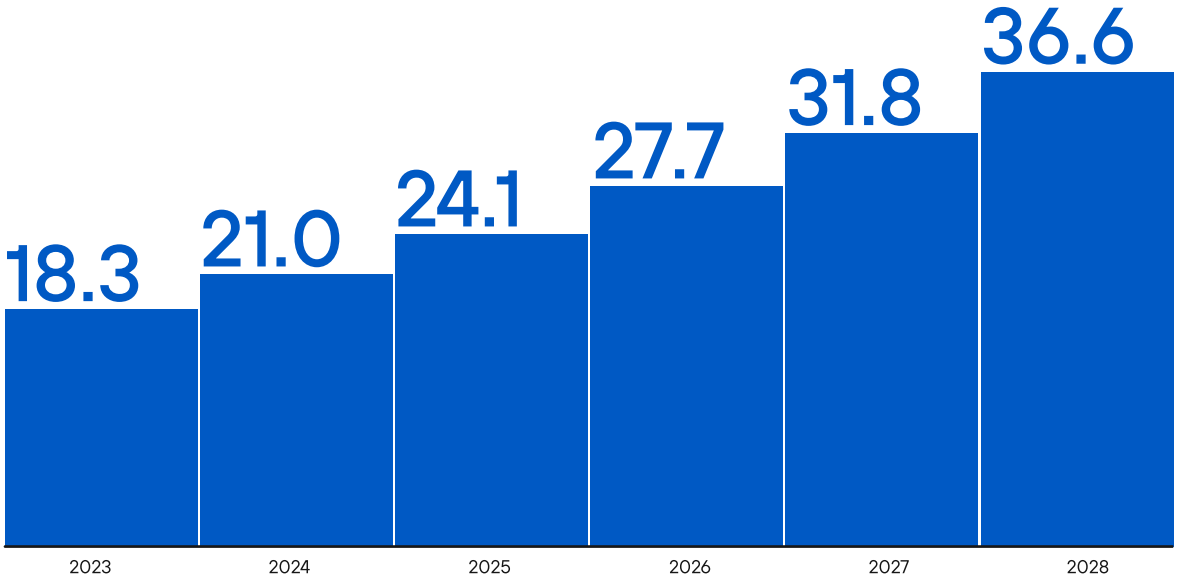
Global survey of energy executives



Mapping

Amidst challenges within the classic market, navigation emerges as a prominent issue. Despite retaining its top map position, Google Maps often lacks real-time updates for various situations. Nonetheless, revenue for general navigation apps continues to climb and is projected to reach $36.6 billion by 2028. The navigation and mapping industry faces significant hurdles yet holds immense growth potential.

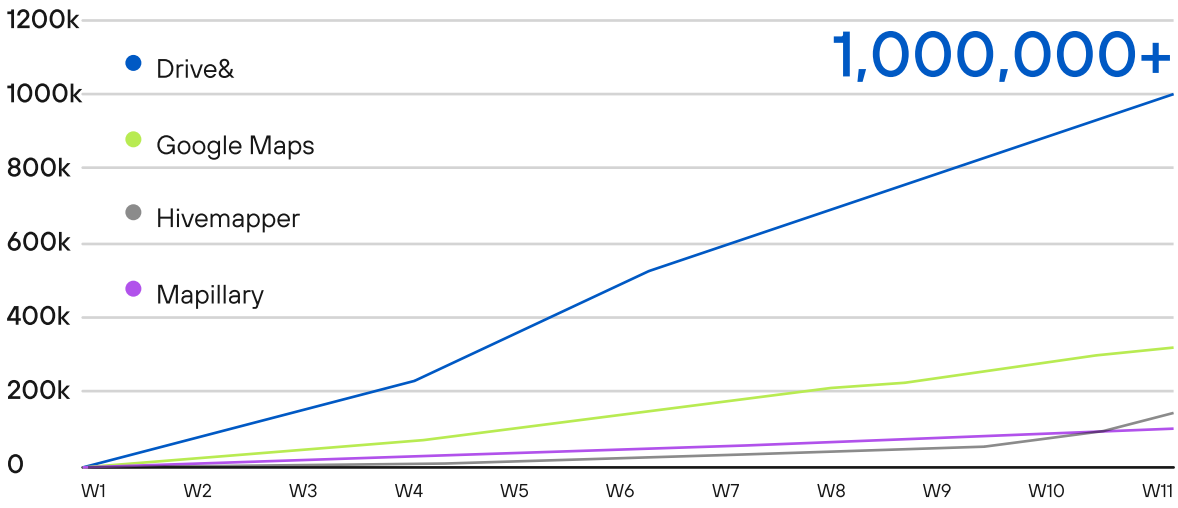
Navigation app sector forecast annual revenue 2023 to 2033 ($bn)



New mapping applications are surpassing Google Maps in speed, moving at a rate 2.5 times faster. Drive&App from Natix is not the sole example; Hivemapper experienced exponential growth a couple of years ago and is progressing at a similar pace, albeit with a larger area mapped. These navigation apps offer updated maps and gather extensive data from phones or dashcams used by average drivers, making them more efficient in comparison.

The combined sector of IoT, Energy Networks, and Mapping holds immense market potential, albeit encountering significant challenges. Despite these hurdles, there remains a pressing need for a solution to store, update, and utilize this data effectively. This is where DePIN steps in, bridging IoT, Energy Networks, and Mapping with Storage, Computation, and Blockchains. By addressing scalability and security challenges, DePIN provides a comprehensive solution.

NATIX and Hivemapper results in first 11 weeks after launch



This report is a collaborative effort between Cryptomeria Capital, known for its comprehensive analytical research, and Mpost media, distinguished for its:

Design and Visuals Quality

Market positioning and Expertise

Promo to millions of eyeballs

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Cryptomeria Capital.

MPOST

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Quality businesses interested in collaboration opportunities are encouraged to contact us for more information.

04
DEPIN ECOSYSTEM PROJECTS:
SENSORS

	HIVEMAPPER	DIMO	WEATHERXM	NATIX	GEODNET
TYPE	Mapping	Automotive	Weather	Mapping	Real-Time Kinematics Network
TOKEN MODEL	HONEY is distributed among network contributors for providing data with Dashcam.	Drivers are awarded $DIMO for connecting their cars and streaming data.	Station owners are awarded $WXM for providing high-quality weather data to the Network.	Throughout the month users earn GEMs for providing data, and at the end of each Cycle, users get rewarded with in-app $NATIX.	The $GEOD token is earned via mining and staking.
INFRA LAYER	Solana (PoS)	Peaq (Multichain cross-consensus)	Arbitum (PoS)	Peaq (Multichain cross-consensus)	Polygon (PoS)
DEVICES AMOUNT	N/A	56,893 vehicle ids (connected devices)	7,795 Weather stations	N/A	4,391 Miners
USERS	63,723 Contributors	20,966 Vehicle id holders (users)	8,000+ Users	50,000 Users	N/A
COVERAGE (COUNTRIES)	90+ Countries, 2,886 regions	38 Countries supported	Europe + USA	N/A	123 Countries
HARDWARE	DashcamsOS 2.0 and Hivemapper Bee	DIMO Macaron or AutoPi	WSM WX2000, Weather Pyramid	—	RTK Rovers
SOFTWARE	Hivemapper Companion	DIMO Mobile	WeatherXM App	Drive& App	—
USE CASES	Mapping and navigation	Vehicles connectivity, Automotive data aggregator	Collection, analysis, and sharing of Weather Data	Real-time collection, sharing, and utilization of data that can be gathered by vehicle	Collection, analysis, and sharing of earth observation data,
FUNDRAISING	$21.00M	$20.5M	$5M	$3.5M	$5M

SENSORS

	SILENCIO	SOARCHAIN	SPEXIGON	DRIFE	ARKREEN
TYPE	Noise pollution	Automotive | L1	Drones | Mapping	Automotive	Energy
TOKEN MODEL	Token model is in the process of creation.	Users are rewarded with $MOTUS for consistently providing data to the network, through connection between vehicles, and to network through MOTUS device.	Token model is in the process of creation.	Complete rides, provide feedback and participate in promotions to earn $DRF.	The $AKRE can be distributed as a reward to contributors who help build and maintain the Arkreen Network and pay the Arkreen Network transaction fees and external entity payments for using the green energy data service provided by the Arkreen Network.
INFRA LAYER	Peaq (Multichain cross-consensus)	Native L1 (PoS)	N/A	BSC (DPoS)	Polygon (PoS)
DEVICES AMOUNT	N/A	600+ devices	Launch is planned	N/A	28,644 Miners
USERS	155,000+ Users	2,000+ cars in network	Launch is planned	30,000+ drivers, 350,000+ users (riders)	N/A
COVERAGE (COUNTRIES)	175+ Countries	N/A	Launch is planned	N/A	N/A
HARDWARE	—	MOTUS	—	—	In the prototyping process
SOFTWARE	Silencio App	Motus Connect & Drive	Spexi App	Drife - Taxi 3.0 App	—
USE CASES	Real-time noise pollution monitoring	Real-time road data, vehicle connectivity, AI Models training	Fly-to-earn, Geospatial data and aerial imagery	Decentralized taxi	Renewable Energy monetization
FUNDRAISING	$1M	$2.3M in Seed	$5.5M	$200K	N/A

Hivemapper 01

Key Concepts

Hivemapper is a mapping and navigation platform that utilizes crowdsourced data to create detailed, up-to-date maps. Its architecture integrates user-generated content, primarily from dashcams, to continuously update and refine its mapping database. This approach leverages decentralized data collection, enabling real-time updates and comprehensive coverage. Hivemapper's system is designed to process and integrate vast amounts of data efficiently, offering a dynamic and evolving mapping solution.

The Hivemapper ecosystem operates through the contributions of three distinct roles: contributors, builders, and developers. Contributors are responsible for acquiring and uploading geospatial data via dashcams or equivalent devices, providing the raw material for the map. Builders play a role in the network's infrastructure by managing nodes that process and validate this data, ensuring its reliability and accuracy. On the other hand, developers leverage the Hivemapper API to create applications that use the map data, adding functionality and utility. This interaction facilitates a continuous data collection, validation and application development cycle, enabling the Hivemapper network to maintain an up-to-date and accurate mapping service.

Product Updates

In 2023, Hivemapper announced several updates including:

> ***Created and Implemented MIP-29***
> The Map Improvement Proposal 2 by the Hivemapper Foundation, introduced in March 2023, aims to enhance the incentives for map contributors within the Hivemapper network. This initiative was introduced to address issues related to the influence of region boundaries and weights on the incentive structure, which resulted in the HONEY tokens being minted at a slower rate than desired. MIP-2 implements changes in certain regions, with the final plan involving the distribution of HONEY tokens across multiple regions within targeted areas. This strategy is designed to promote broader coverage across entire countries or metropolitan areas rather than concentrating rewards in only one part of these regions. For instance, in the EU, these changes affect regions like The Netherlands, Portugal, Paris, and Madrid. Implementing MIP-2 will increase from 1x to 2x on base Map Coverage rewards in these regions, ensuring that map contributors receive up to three times as much Map Coverage reward as they would without a bounty. For countries within the EU, MIP-2 utilizes the Nomenclature of Territorial Units for Statistics (NUTS) system to define new regional boundaries. Specifically, the NUTS3 level is a starting point for determining regions due to its standardized approach based on population size, a crucial proxy for economic activity and map data value.

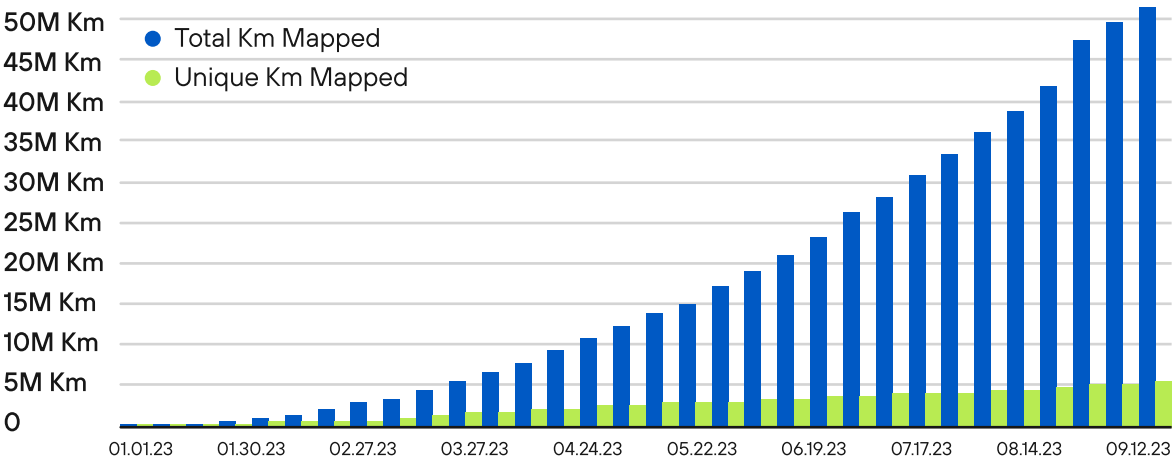
> ***DashcamOS 2.0***
> The DashcamOS 2.0 and Hivemapper Bee update for Hivemapper dashcams introduce key improvements to enhance the mapping experience. Notable changes include the capability for extended mapping operations without the need for phone pairing, simplifying the process for users. Additionally, the update brings advancements in GPS fix speed, improving the accuracy and reliability of location tracking.

Hivemapper Dashcam

Mapped over 5m unique road km

Hivemapper has mapped over 5 million kilometers since early 2023, a task that took Google 5 years from its 2007 Street View launch. The platform has cumulatively mapped 50 million kilometers and collected 3 billion street-level images, surpassing Meta's Mapillary. Hivemapper's rapid scaling has increased competition in the mapping market, offering cost-effective solutions and expanded geographic coverage. Its frequent data collection improves map accuracy, which is essential for industries like autonomous vehicles. Hivemapper also integrates advanced machine-learning features, enhancing data utility for clients.

8% of Global Roads Mapped in 8 Months



Hivemapper Scout

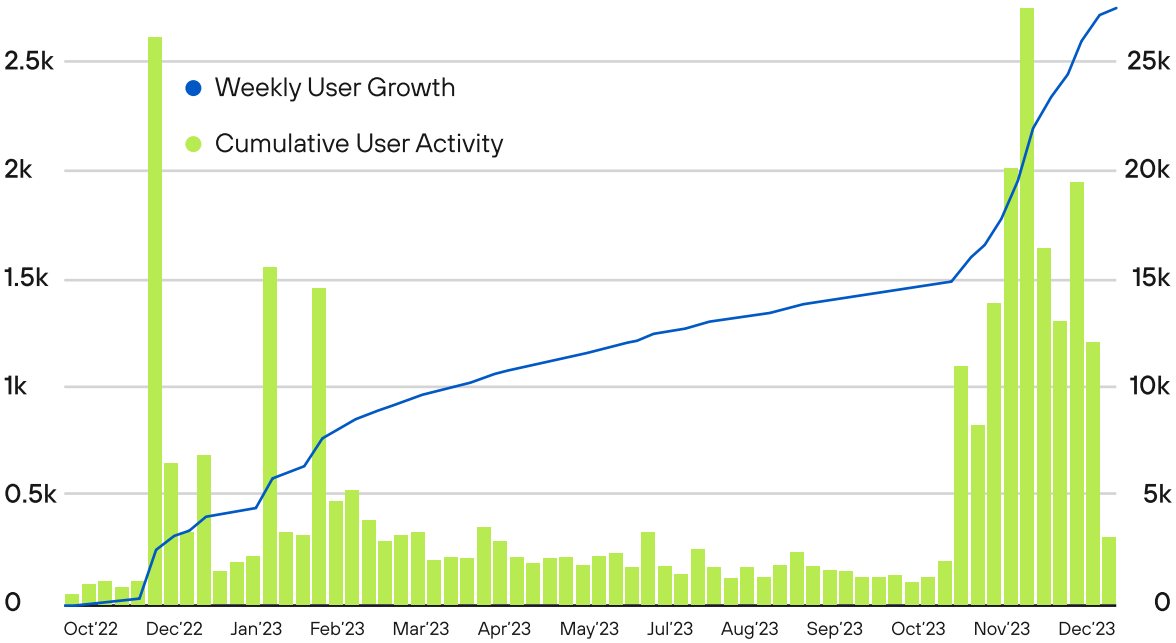
Hivemapper Scout is a location monitoring tool providing real-time street-level data. It allows users to mark locations of interest and receive updates without relying on outdated images or physical site visits. The tool offers a cost-effective solution through the Bursts feature, where users can place bounties on specific locations for data collection by Hivemapper Network drivers. Integrated with the Hivemapper Network via the Map Image API, Scout offers extensive coverage and fresh data, enhanced by its open-source Scout UI Library. It is valuable for monitoring critical infrastructure, tracking changes in environments, and providing insights for various industries like autonomous vehicles, logistics and advertising.

Honey Bursts
The Honey Bursts in Hivemapper rewards users with Honey. These bursts are allocated for capturing and sharing crucial updates like new road conditions or construction sites. Unlike regular rewards, Honey Bursts are designed to recognize and compensate for exceptional contributions directly impacting the platform's accuracy and comprehensiveness, emphasising quality and relevance in user submissions.

Honey Bursts for Targeted Mapping helped achieve 90%+ for cities

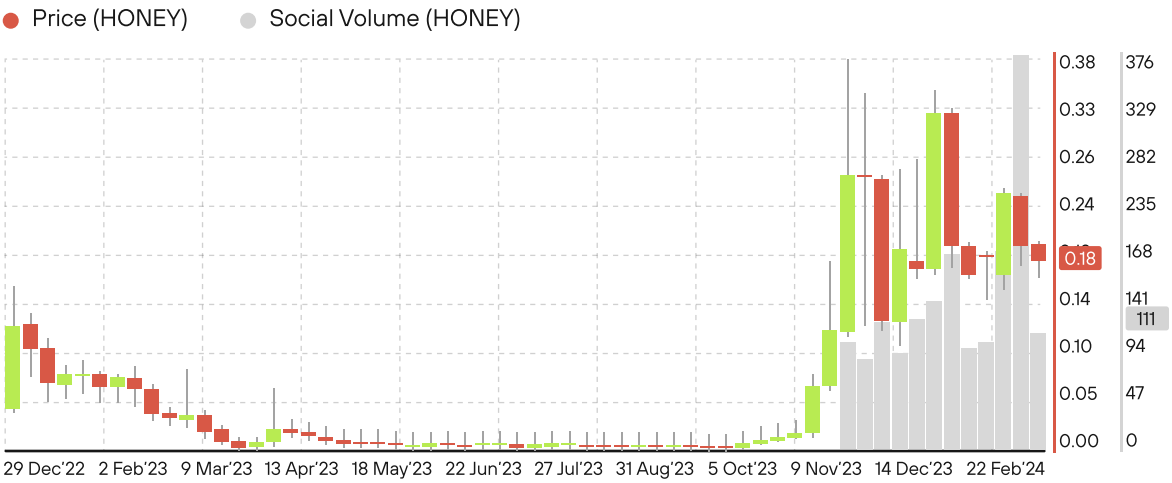
Metrics

Contributor Growth Weekly



26,295
Total Number of Contributors

Hivemapper (HONEY) Santiment



Hivemapper general statistics

90M
Total road KM of street-level imagery submitted

5.7M+
Total Unique road kilometers mapped

8K+
Dashcam delivered

90+
Countries with active mapping

800KM
Weekly average from contributors

9%
Of the world's roads mapped

50K
Community members X, Discord, LinkedIn and YouTube

6.1M
Total unique road KM of street-level imagery submitted

24-100x
we see a location more frequently than Google Maps

80M+
Total road kilometers mapped

75M+
Reviews by AI Trainers to train Map AI

Map AI
Is fully operational

Key Concepts

DIMO is a decentralized network that connects vehicles and aggregates automotive data. Its architecture focuses on gathering and processing this data, offering insights for improved vehicle management and maintenance. By utilizing a distributed ledger system, DIMO ensures data integrity and transparency in exchanges. The platform's approach is tailored towards optimizing the use of vehicle data, catering to both vehicle owners and businesses.

DIMO operates with a participatory model encompassing vehicle owners, data consumers, and developers. Vehicle owners contribute by sharing vehicular data through a connected device, thereby earning rewards through DIMO tokens for their data contributions. Data consumers, which include insurers, automotive manufacturers, and service providers, utilize this aggregated data to improve their offerings, making decisions based on real-time, comprehensive vehicular insights. Developers engaging with the DIMO platform create applications that leverage this data, enhancing vehicle utility and owner experience. This ecosystem is structured to incentivize continuous data sharing and utilization, with rewards distributed to vehicle owners for their contributions, thereby ensuring a constant flow of valuable data to consumers and developers.

DIMO creates a common language

Product Updates

DIMO and NATIX are partnering to enhance vehicle-related decentralized physical infrastructure networks (DePINs), focusing on user participation in infrastructure building. This collaboration enables drivers to earn through data contributions with NATIX and access vehicle insights with DIMO, promoting data-driven services like maintenance and insurance.

In response to Helium's rollout of their nationwide 5G network, DIMO has also announced plans to partner with the network and ultimately release devices that support both networks at once. By acting as validators and mappers, it's possible that users will earn both $DIMO and $HNT at the same time.

DIMO Macaron

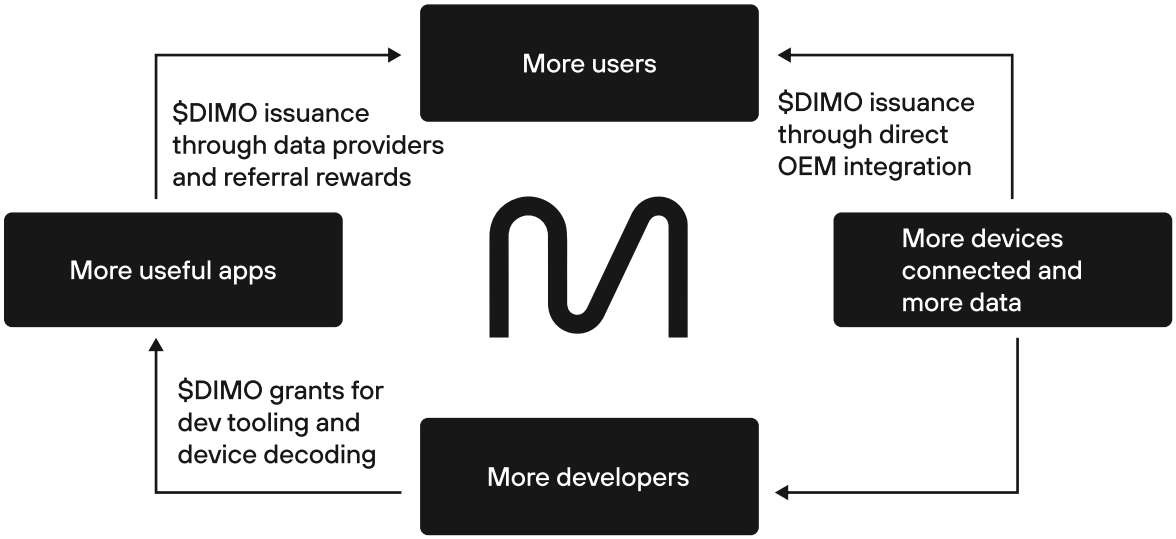
A bite-sized device that connects via the cost effective Helium IoT Network

DIMO AutoPi

A powerful device that connects via cellular for real-time data every second

A new referral program was launched, where both the referrer and the referred friend earn 50 $DIMO each upon connecting a car to DIMO. It includes a competition to encourage more referrals. Users can share a unique referral code or QR code, and rewards are distributed weekly. The program supports all connection methods, including free connections and hardware purchases, promoting increased participation through hardware connections for higher rewards.

DIMO Flywheel

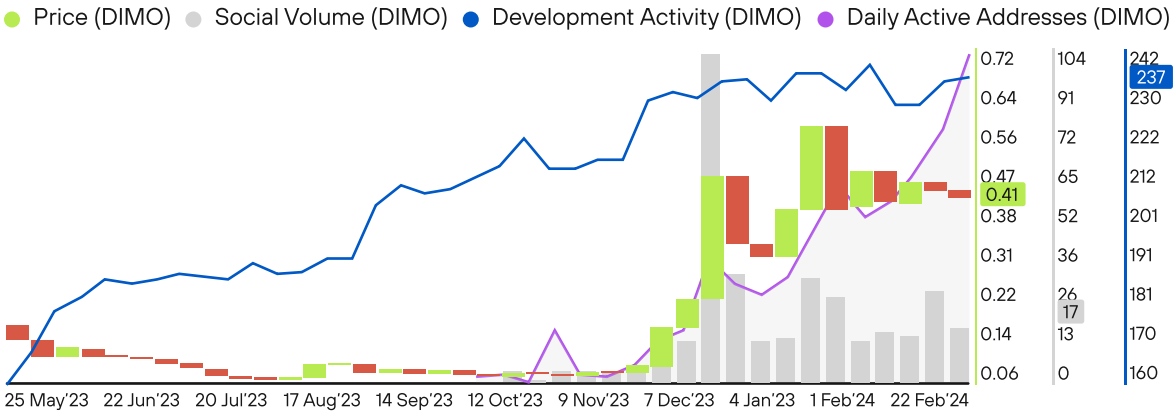


> The DIMO Macaron is a connected vehicle device designed to upgrade any car into a smart, connected vehicle, enhancing it with digital capabilities and real-world value. JDI manufactures it. The Macaron, coupled with the DIMO Mobile app and DIMO Marketplace, offers real-time diagnostics to decode error codes, monitor battery health, track fuel levels, GPS tracking, and a rewards system for sharing data. It is positioned as the most cost-effective solution for connecting cars, leveraging the Helium IoT network to minimize connectivity costs.

> Moreover, DIMO Ignite program funds developers to support the DIMO Protocol infrastructure, with $2M available. Matt English is developing a smart contract to convert $DIMO tokens into stable DIMO Credits for data access payments. Phil Hutchins is working on tools to facilitate DIMO Nodes deployment, including automation tools and GDPR-compliant deployment strategies.

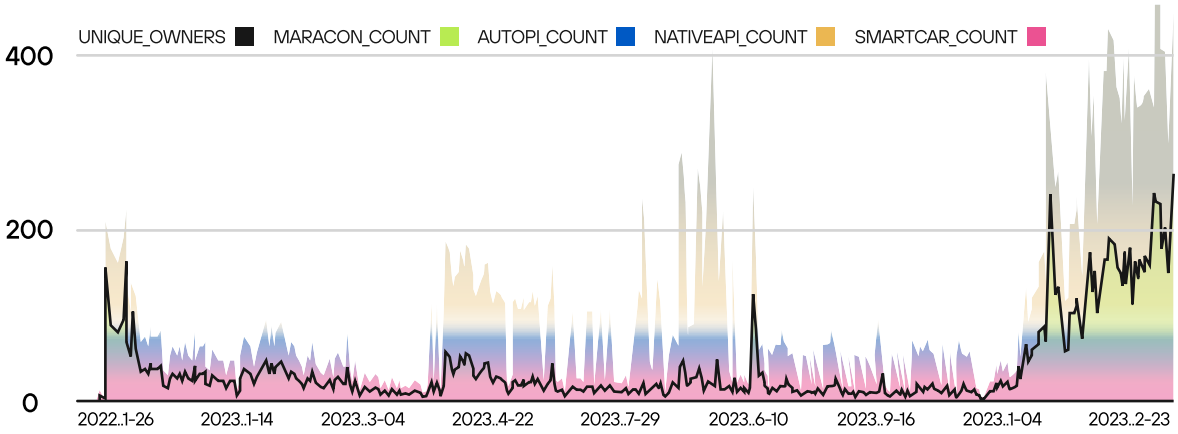
Metrics

DIMO (DIMO) Santiment

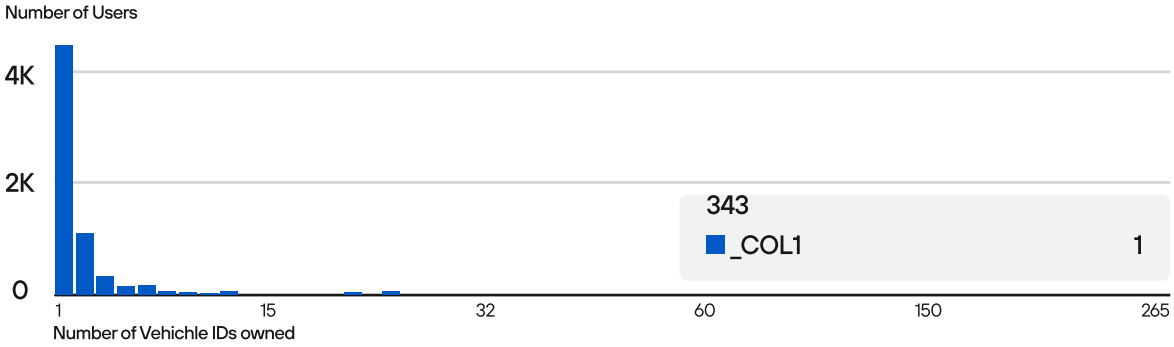


Paired Devices per manufacturer

Counts unique vehicles on their first connection date with their last connection type. Updated 1/16 to include mintVehicleSign and mintVehicleAndSdSign mints

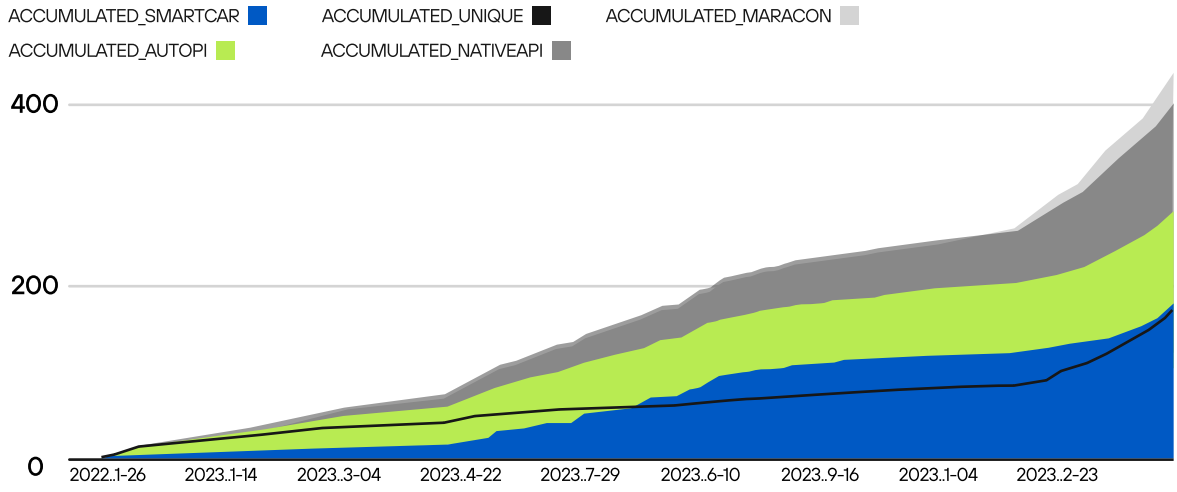


Vehicles per User



Accumulated Paired Devices per last manufacturer

Counts unique vehicles on their first connection date with their last connection type. Updated 1/16 to include mintVehicleSign and mintVehicleAndSdSign mints



WeatherXM

03

Key Concepts

WeatherXM is pioneering a new weather data economy by incentivizing the deployment and maintenance of weather stations through WXM token rewards. The network leverages community contributions and EVM compatibility. Key roles involve weather station owners who install and manage stations, contributing data that enhances network accuracy and coverage.

It ensures EVM compatibility. The network's transparent development can be monitored through its explorer, inviting widespread participation and contribution towards a shared goal of accurate and accessible weather data.

INFRASTRUCTURE LAYER: ARBITRUM ONE.

The Current Reward Mechanism v2.0 enhances the system's transparency by implementing a Merkle Tree structure for reward distribution. Additionally, WeatherXM strongly emphasizes the Quality of Data (QoD), employing an algorithm to assess the accuracy and reliability of data from weather stations. This focus on data quality is supported by various techniques to distinguish between expected and unexpected data behaviors. WeatherXM utilizes three main types of devices to collect data: the WiFi-enabled WXM-WS1000, the Helium-powered WXM-WS2000, and the 4G/LTE-capable WXM-WB3000, catering to diverse connectivity needs and ensuring comprehensive coverage.

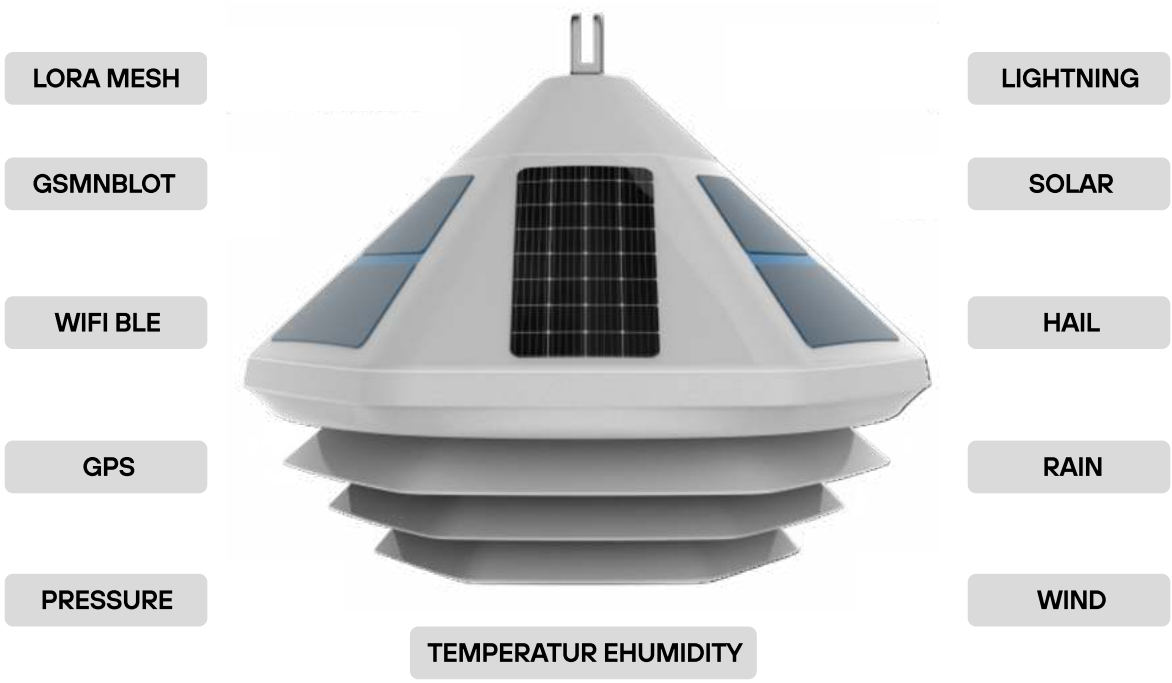
WSM WX2000

Product Updates

On November 13, 2023, core contributors established the WeatherXM Network Association in Zug, Switzerland, to govern the network, own/license network data, issue $WXM tokens, and reward station owners, marking a significant step towards evolving into a DAO.

WeatherXM introduced a solid-state weather station tailored for large-scale, dense network deployments. This maintenance-free, cost-efficient station boasts an innovative design that requires minimal upkeep, setting it apart from conventional weather stations. Its energy autonomy is assured through solar panels paired with industrial-grade batteries and low energy consumption, ensuring an extended battery life. Furthermore, the station has a comprehensive communications suite, including GPS, WiFi, Bluetooth, GSM NB-IoT, and LoRa technologies.

Weather Pyramid



In December, the $WXM smart contract was launched on Ethereum L1 and tokens were bridged to the Arbitrum mainnet, with plans to distribute test rewards on Arbitrum Sepolia this month and station rewards on the Arbitrum mainnet next month.

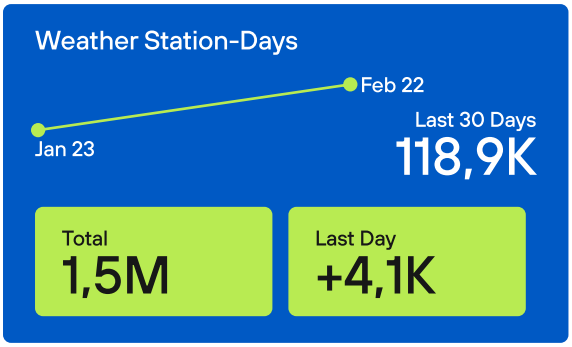
WeatherXM unveiled a new, cleaner website designed for better information organization and focused on promoting value-added services alongside an improved e-shop supporting crypto payments to enhance user and sales team experience.

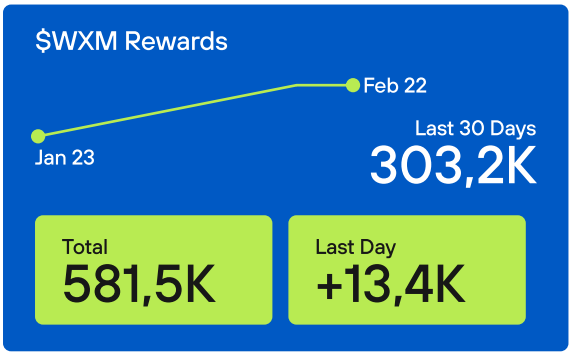
Pre-sales for the WB3000, a versatile 4G-LTE station supporting multiple connectivity options and expandable for future sensor additions, are now open.

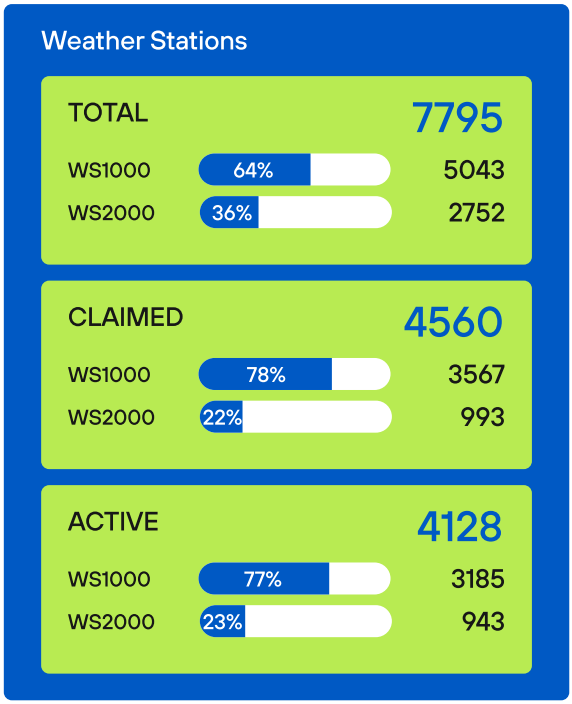
WeatherXM engaged with the developer community and showcased at Devconnect IST in Istanbul and AthensDAOx, sharing insights on public infrastructure vision and token challenges for DePIN projects and strengthening connections within the Ethereum and Solana ecosystems.

Metrics

WeatherXM General Statistics





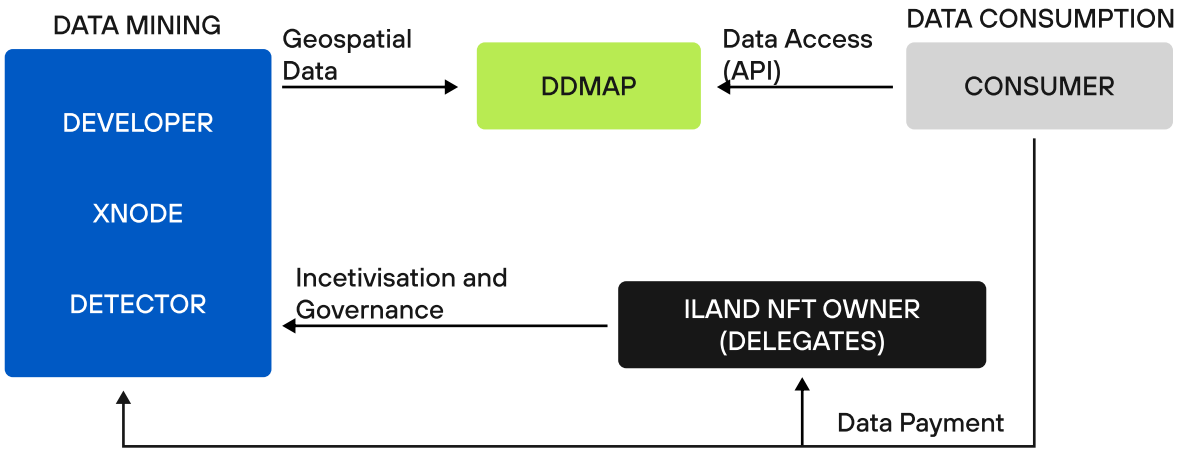


Natix

Key Concepts

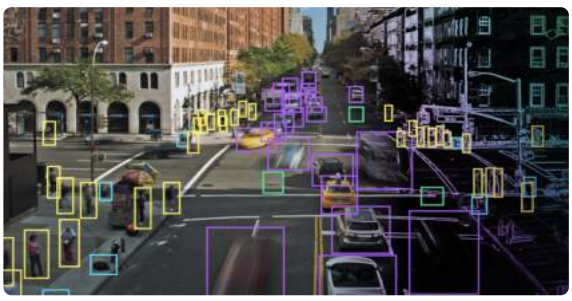
Natix is a decentralized network designed to facilitate data collection, sharing, and utilization across various sectors. At its core, Natix leverages distributed ledger technology to ensure the integrity, security, and accessibility of the data it handles. The platform is engineered to support various applications, from environmental monitoring to urban planning, by enabling users to contribute, access, and analyze data in real-time. Natix's architecture is built to accommodate the growing demand for reliable data by providing a scalable, efficient, and user-friendly infrastructure for data transactions.

NATIX High-level Architecture



The Natix ecosystem has several key roles: data providers, data consumers, and network validators. Data providers are individuals or entities that contribute data to the Natix network, utilizing sensors or other data-gathering technologies. They are rewarded for their contributions to the network's native token, incentivizing the provision of high-quality, valuable data. Data consumers are users or organizations that access and utilize this data for various purposes, paying for what they use in the network's token. On the other hand, network validators verify transactions and data entries, for which they are compensated with network tokens.

Preview of NATIX Solution

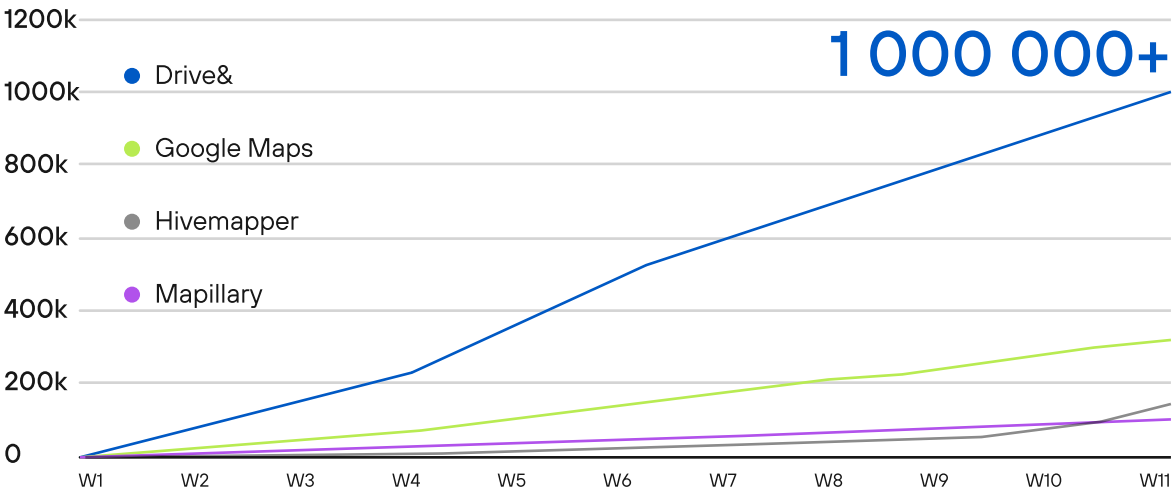


Product Updates

In 2023, NATIX launched the Drive&App to improve transportation and logistics through real-time traffic data, route optimization, and vehicle diagnostics. The app utilizes Natix's decentralized network for data sharing, targeting commercial and private users.

NATIX has rapidly mapped over 1 million kilometers in 11 weeks by the middle of 2023 through its Drive& app, outpacing competitors like Google Street View, Mapillary, and Hivemapper by utilizing a smartphone-based strategy without the need for additional hardware, now expanding with an iOS version to increase user base and data collection efficiency further.

NATIX results in first 11 weeks after launch



NATIX Network announced the Phase 1 launch of its token on February 1st, introducing a new reward system in the Drive& app with gamification features like missions, leaderboards, and the conversion of points to in-app $NATIX.

In January 2024, NATIX's Drive& app saw its user base grow to over 50K with a significant increase in daily activity, culminating in a record-breaking 18K kilometers driven and nearly 24K events detected on January 31st, contributing to almost 7 million kilometers driven and over 85 million total events detected by the community.

NATIX has partnered with DIMO and Peaq Network to enhance its data collection and distribution capabilities, leveraging DIMO's vehicle data platform and Peaq Network's decentralized network technology for improved efficiency and broader application reach.

Metrics

10km+
Drive& Milestone

100M+
Events Detected

50K+
Drive& Users

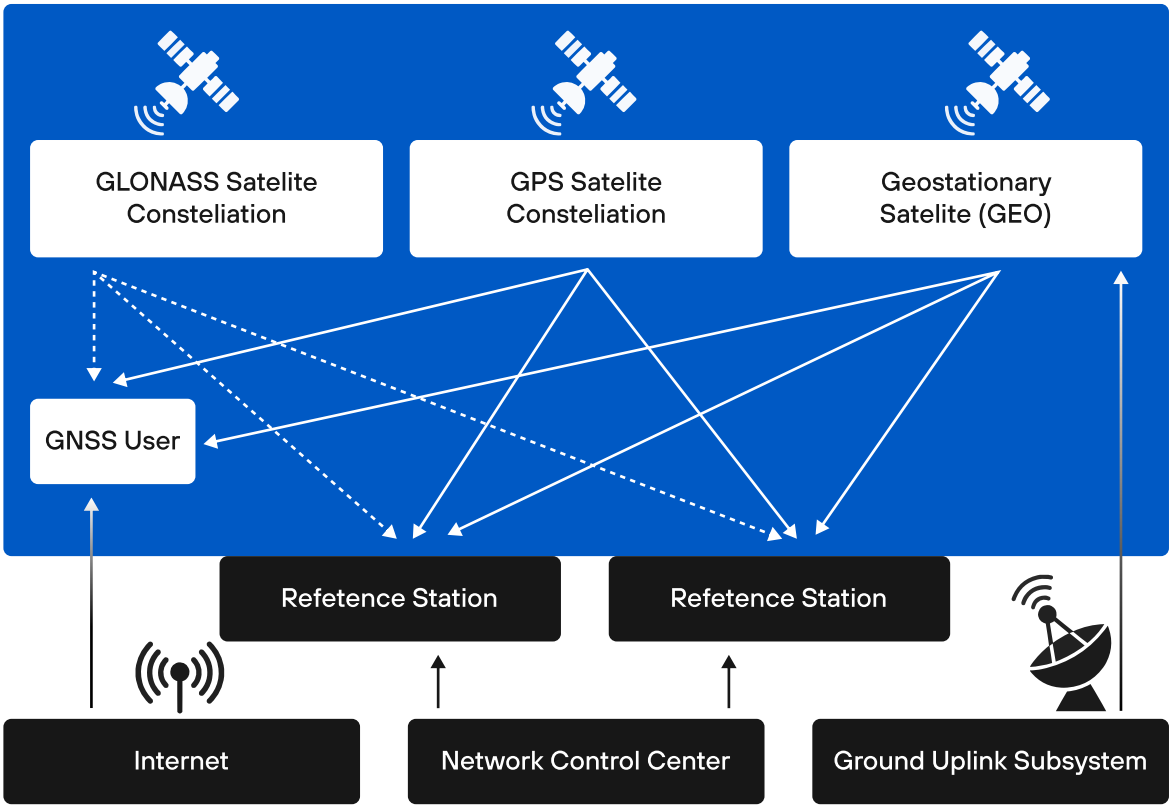
GEODNET

Key Concepts

The Global Earth Observation and Data Network is a technical infrastructure to collect, analyze and share earth observation data. It integrates a variety of data sources, including satellites and ground-based sensors. This data undergoes initial processing to correct errors and standardize formats, after which it is stored in a centralized database designed for large-scale data accommodation and efficient retrieval based on specific search criteria. The system's design facilitates the efficient management and use of large datasets for specific applications such as climate research, environmental monitoring, and agricultural management.

The network supports collaboration, open data exchange, and specific findings among scientific communities and policymakers. For analysis and user interaction, GEODNET provides analytical tools that apply basic and advanced methods to transform raw data into actionable insights. Users access this data through a simplified interface, enabling information extraction, analysis, and sharing.

GEODNET High-level Architecture



GEODNET includes a Real-Time Kinematic feature that boosts positioning accuracy using a base station and a mobile rover. The base station sends precise corrections, which the rover applies to its satellite signals, improving accuracy from meters to centimeters. This process works well because the base and rover are close, ensuring accurate corrections.

GEODNET is a community-based network. It enables everyone to contribute and benefit from the world's number one decentralized GNSS network by mining GEOD tokens without high-power CPU or GPU-intensive equipment.

Product Updates

Deep Sand Technology and the GEODNET Foundation have partnered to offer affordable precision agriculture RTK services in rural North America to enhance farming efficiency and reduce costs. This collaboration introduces a GEODNET-compatible RTK base station for tractors, promising centimeter-accurate operations without additional equipment, potentially saving farmers up to $2500.

GEODNET announced a Real-Time Kinematic GNSS Corrections Service aimed at OEMs and Systems Integrators in the agricultural robotics sector, offering centimeter precision. This service, compatible with numerous GNSS receivers, facilitates enhanced accuracy for various applications including automated steering and drones. It leverages GEODNET's extensive network of reference stations to ensure fast, reliable performance. Free trials are available for qualified entities in major agricultural regions.

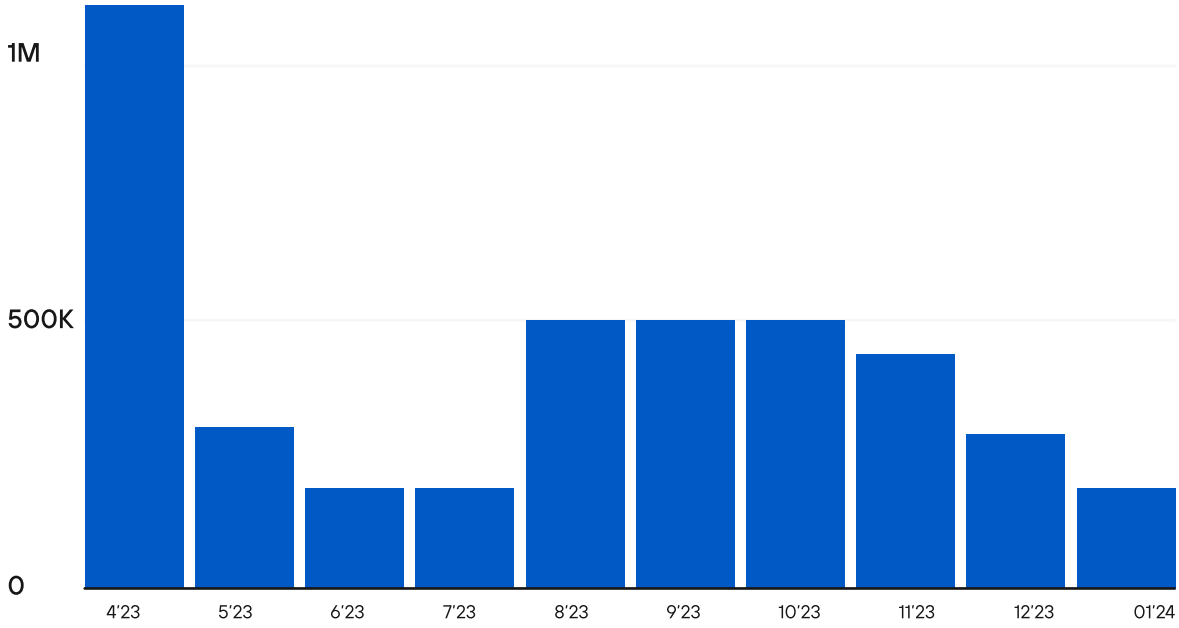
HYFIX.AI has introduced a new line of RTK Rovers, utilizing the Quectel LC29H GNSS module, to enhance IoT and Mobile Robotics with centimeter-level accuracy. Available for pre-order on Crowd Supply, these Rovers come in two versions: a USB interface model priced at $195 and a more feature-rich Raspberry Pi4B Ethernet model with data logging, priced at $395. Both offer a 30-day trial to GEODNET's GNSS corrections service, supporting centimeter-accurate positioning.

HYFIX.AI rovers

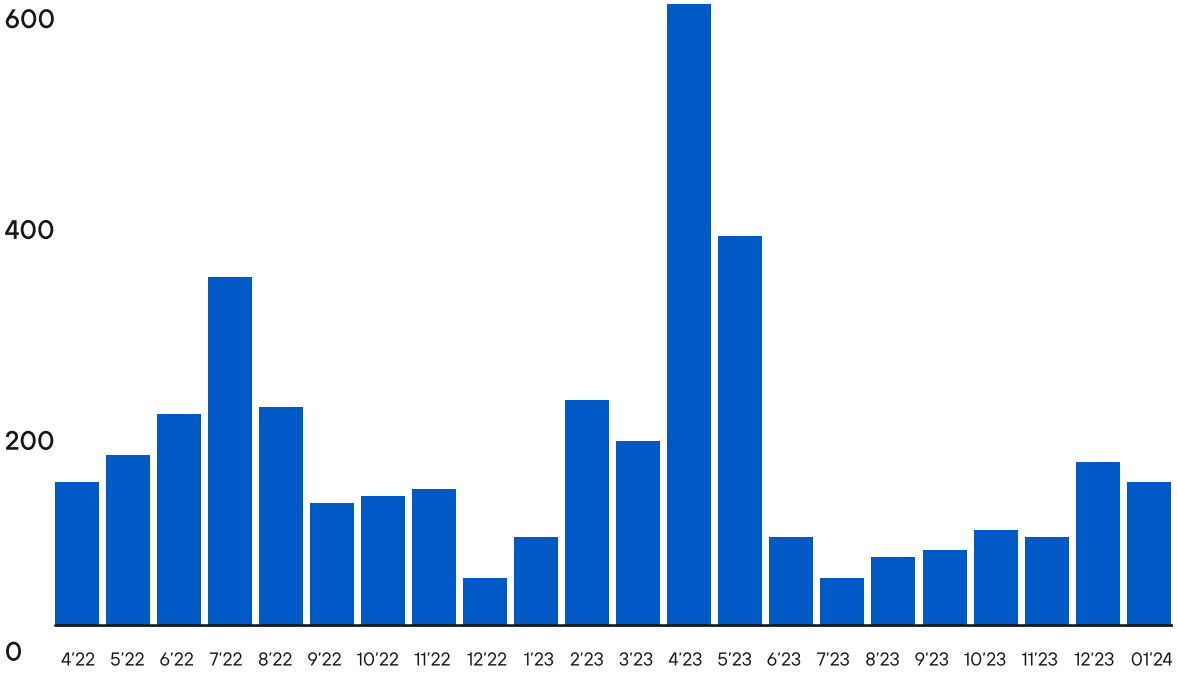
In 2023, GEODNET Foundation secured a $1.5M investment led by Borderless Capital to support its decentralized location service, leveraging a network of over 3000 web3 GNSS base stations for RTK applications. This funding aims to expand GEODNET's global coverage and develop a mobile operating system SDK, enhancing its offerings in AI, IoT, and blockchain-based mobile applications.

Metrics

Monthly Token Burn



Monthly Miner Adds



3,899
Number of Miners

757
Number of Cities

98
Number of Countries

Silencio

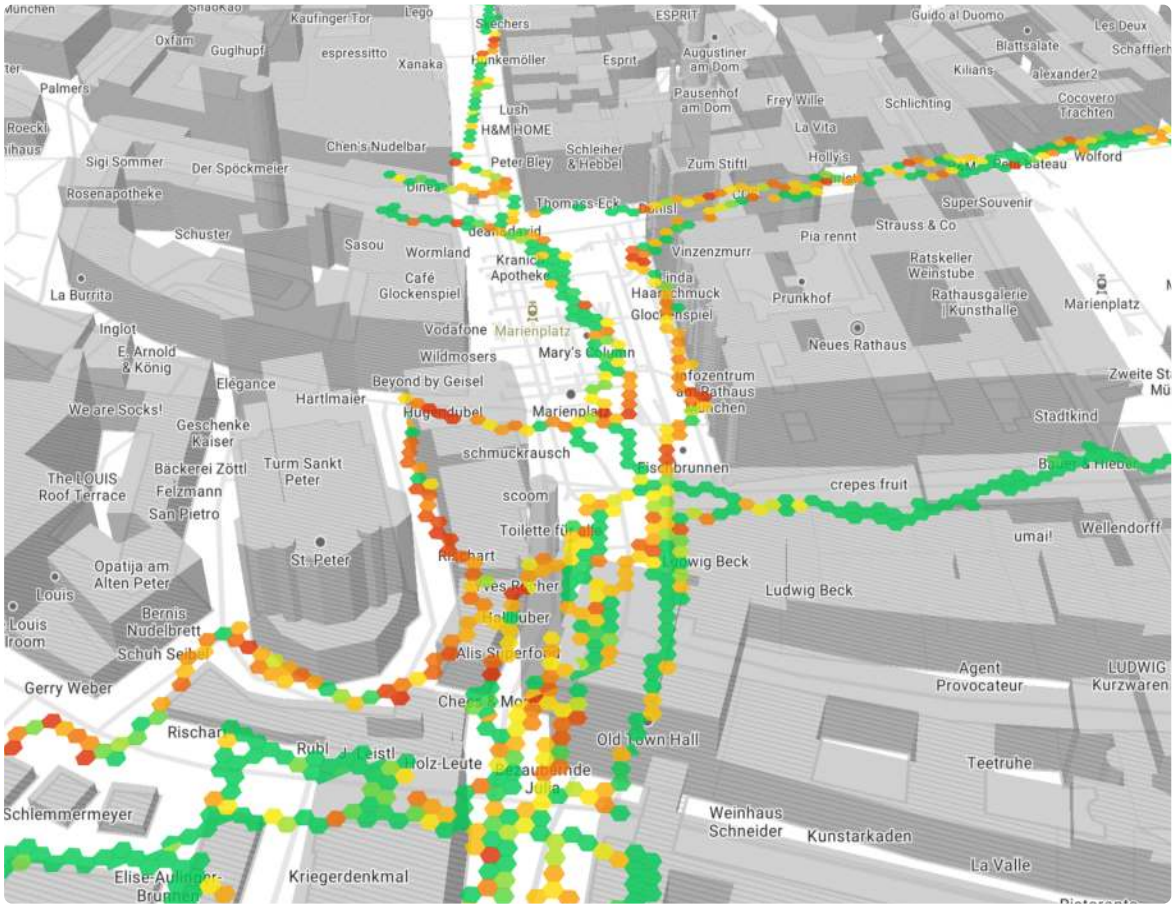
06

The Silencio Network utilizes IoT devices and mobile applications for real-time noise pollution monitoring, relying on community contributions to collect data across various locations. This network employs sensors, including smartphones with dedicated apps, to record environmental noise levels, which are then anonymized and uploaded to a centralized database for analysis. The processed data contributes to a detailed global noise map, highlighting pollution hotspots and trends.

Key components of the Silencio Network include the deployment of noise-capturing sensors by users, a data aggregation system that analyzes sound measurements, and an accessible platform for data visualization. Recent updates have introduced advanced algorithms for noise source differentiation and expanded sensor deployment through community engagement and institutional collaborations. The network's primary users—data contributors, software developers, and researchers—interact within this ecosystem to enhance data collection, refine analytical tools, and utilize noise pollution insights for environmental health studies and urban planning.

> Silencio has raised $1M in a Pre-seed funding round led by Borderless Capital, with participation from Moonrock Capital, Master Ventures, Cogitent Ventures, and NxGen in February 2024.

Silencio noise pollution tracking



Soarchain

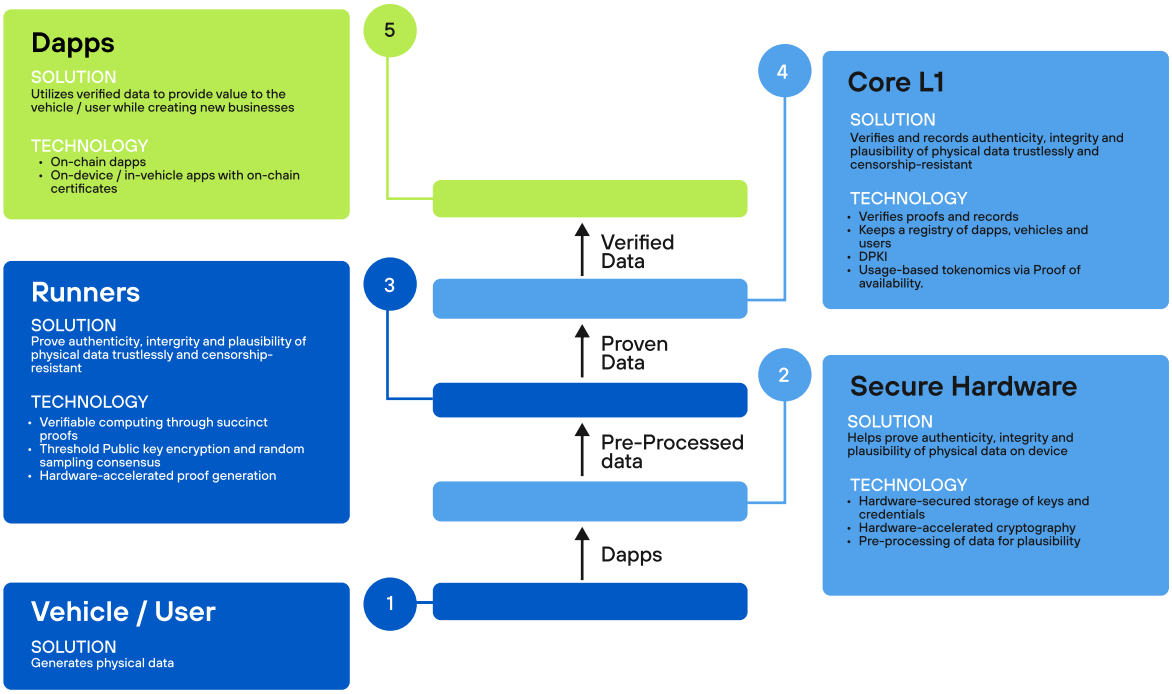
07

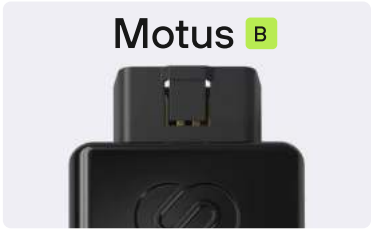
Soarchain is a platform designed for the mobility sector, utilizing blockchain and cellular-V2X technologies to facilitate a decentralized data and identity infrastructure. It enables secure data exchange among vehicles via a Cosmos SDK-based Layer 1 network, allowing vehicles to share and access data as mobile servers in real-time, incentivized through token rewards. Critical developments in Soarchain include the rollout of an incentivized testnet with enhanced performance and user experience and introducing the MOTUS hardware for vehicles, enabling cryptographic network participation.

The Soarchain ecosystem comprises vehicle owners as data providers, developers creating mobility-focused dApps, data consumers like organizations using the data for mobility solutions, and validators ensuring network security and data integrity. This framework supports Soarchain's goal of improving vehicle connectivity and fostering innovation within the mobility sector through secure, decentralized data exchange.

> The company has previously raised $2.3 million during its Pre-Seed with Republic, Emurgo Ventures, Block Builders, Plug and Play, and Cogitent Ventures among others.

Soarchain High-level Architecture





Spexigon

08

Spexigon is a "Fly-to-Earn" drone imagery platform that incentivizes drone operators to capture and share high-resolution aerial images. The platform is built on a decentralized network, employing a blockchain-based reward system for contributors and providing an API for organizations to access the imagery. Its architecture ensures consistent, secure and accessible aerial data collection across various regions.

The Spexigon ecosystem involves drone operators, who capture and upload aerial imagery; developers, who maintain and upgrade the platform; organizations using the API to access data for monitoring or analysis purposes; and administrators, who manage the reward system and ensure data quality.

When Spexigon launches in new regions, anyone can download the app to their phone, create an account or connect their wallet, connect a supported drone (more details below), and view a map of hexagonal zones we call Spexigons. Spexigons ready for capture will be color-coded so pilots can easily see them in their area. Each Spexigon will also display a value in points (to start) that can be earned once flown and the imagery is uploaded and verified.

> Spexi has raised $5.5 million in seed funding, with Blockchange Ventures leading the financing round, with participation from Protocol Labs, founders of the Filecoin protocol, and Dapper Labs.

Spexigon App Preview

Drife

09

Drife positions itself as the decentralized platform in the ride-hailing industry. The architecture of Drife enables a direct connection between drivers and riders, bypassing the traditional intermediaries that dominate the current market. This model allows 100% of the fare to go to the drivers, a stark contrast to the commission-based models of existing ride-hailing services. The platform's operational model is further enhanced by using its native DRF tokens, which facilitates transactions, rewards, and governance.

Drife's system architecture introduces a zero-commission model and empowers users with open governance and market-dictated pricing, leveraging blockchain to ensure transparency and fairness. The platform incentivizes participation through a blockchain-based loyalty and incentive program, strengthening its community-driven approach.

The ecosystem of Drife encompasses various stakeholders, including drivers, riders, community developers, franchise operators, and participants in the DAO. Drivers benefit from receiving the full fare without deductions, while riders enjoy competitive pricing and transparent transactions. Community developers can contribute to the platform's growth and innovation by developing dApps. Franchise operators can establish local operations by leveraging Drife's franchise model, which is enabled by NFT technology and allows for rapid scaling and efficient governance. The DAO facilitates a participatory governance model, allowing token holders to influence decisions and contribute to the platform's direction.

A collaborative and participatory approach characterizes the interactions within Drife's ecosystem. Drivers and riders engage directly through the platform, supported by blockchain technology for secure and transparent transactions. Community developers enhance the platform's offerings by creating dApps that add value to the ecosystem. Franchise operators expand Drife's presence and operational efficiency in different regions, while the DAO ensures that the platform remains responsive to the needs and interests of its community. This integrated ecosystem reflects Drife's commitment to redefining the ride-hailing experience by prioritizing fairness, transparency, and community empowerment.

General Drife statistics

Experience the future of ride-hailing with DRIFE, the decentralized platform empowering drivers, commuters, and community developers through blockchain technology.

30K
Drivers Onboarded

100K+
Riders Sign up

250K
Rides Completed

Arkeen

10

Arkreen represents a digital infrastructure initiative to integrate and monetize globally distributed renewable energy resources.

Arkreen's architecture is distinctly bifurcated into Supply and Demand sides to streamline the interaction between energy producers and consumers. On the Supply Side, participants such as owners of solar photovoltaic systems can declare their energy contributions—whether generated, stored, or consumed—and are rewarded for their participation.

The Demand Side, conversely, leverages the data made available by the Supply Side to develop applications and services that promote the use of renewable energy. This includes the issuance of Renewable Energy Certificates, operating Virtual Power Plants, and green computation services.

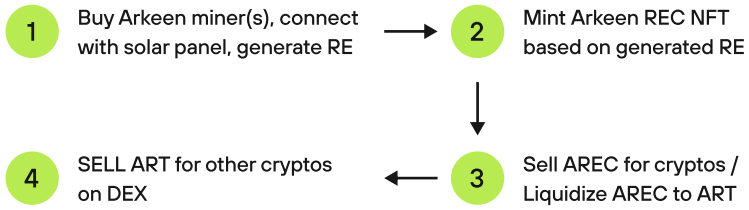
The interplay between the Supply and Demand sides is facilitated by Arkreen's infrastructure, which employs blockchain to ensure data integrity and security. This, coupled with the platform's token economy, forms a cohesive ecosystem where participants are motivated to engage in energy-saving practices and contribute to the proliferation of Distributed Energy Resources. By digitizing energy facilities' parameters and creating a digital twin in the blockchain, Arkreen ensures a transparent and tamper-proof system that benefits all stakeholders involved in the renewable energy domain.

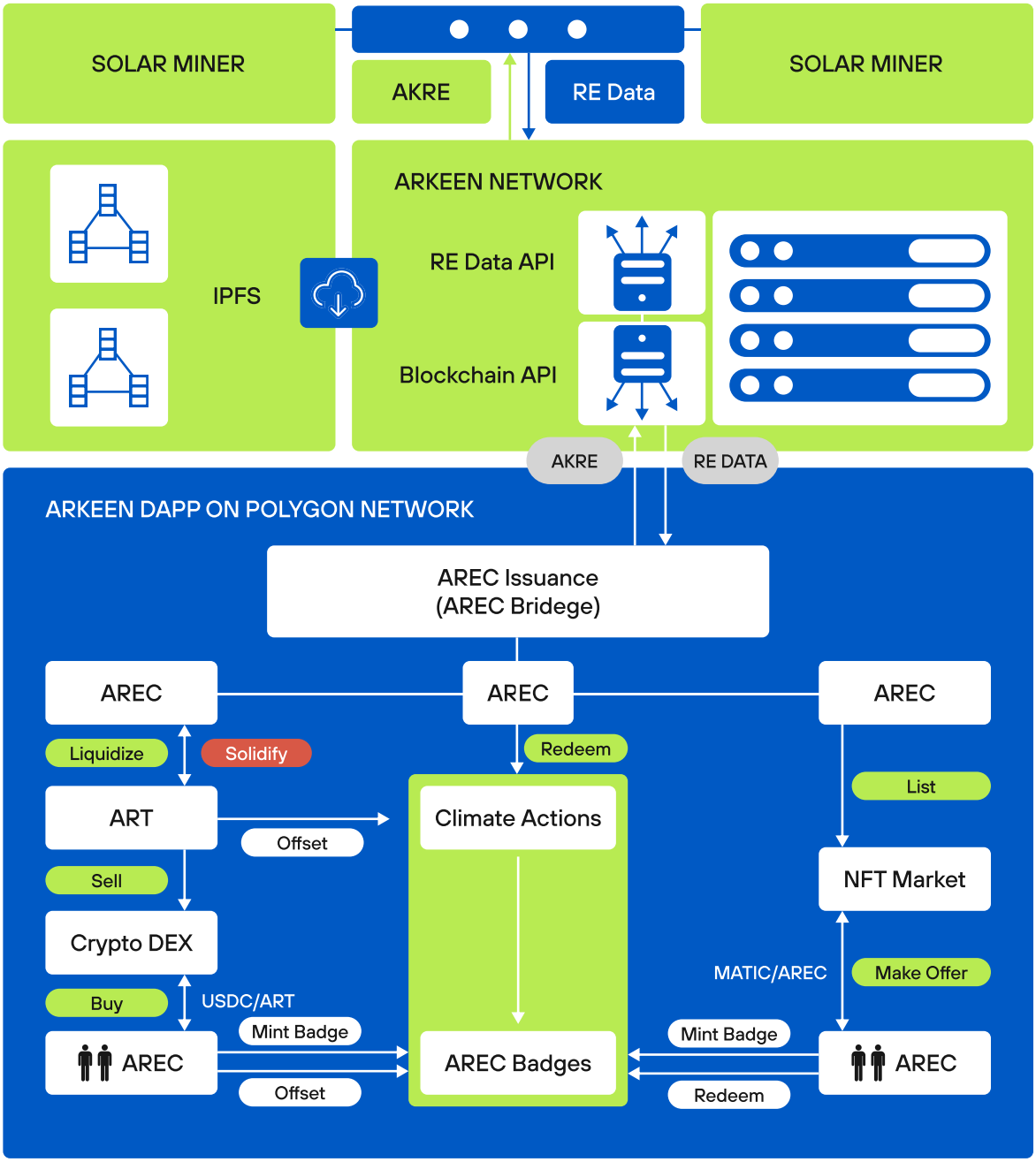
Arkreen's vision extends beyond mere technology deployment; it aims to cultivate a harmonious ecosystem of Distributed Energy Resources by incentivizing climate actors to participate actively in the renewable energy space. Arkreen addresses the challenges faced by the renewable energy sector and lays down a scalable and efficient framework for the future of decentralized energy resource management.

> Arkreen is launching its Mainnet with a conversion plan from tAKRE to AKRE, token holder governance, and a miners migration strategy aimed at moving towards a carbon-neutral Earth. The process started with the conclusion of the Testnet on February 27th, followed by the Mainnet launch on February 28th, during which AKRE tokens were distributed, marking the beginning of vesting and the conversion plan. Miners from the Testnet will migrate to the Mainnet, with their lifespan adjusted accordingly. Additionally, the "Road to DePIN+ReFi" campaign, which started March 1st and lasted until the end of March, offers incentives to encourage community participation in Arkreen's sustainable journey.

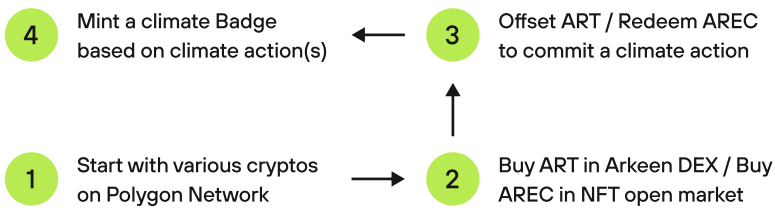
AREC Framework

For RE Generators: generate renewable energy, mint ***Arkeen REC*** (AREC), sell ***AREC*** for cryptos / liquidize ***AREC*** to ART, swap ART for desired cryptos.



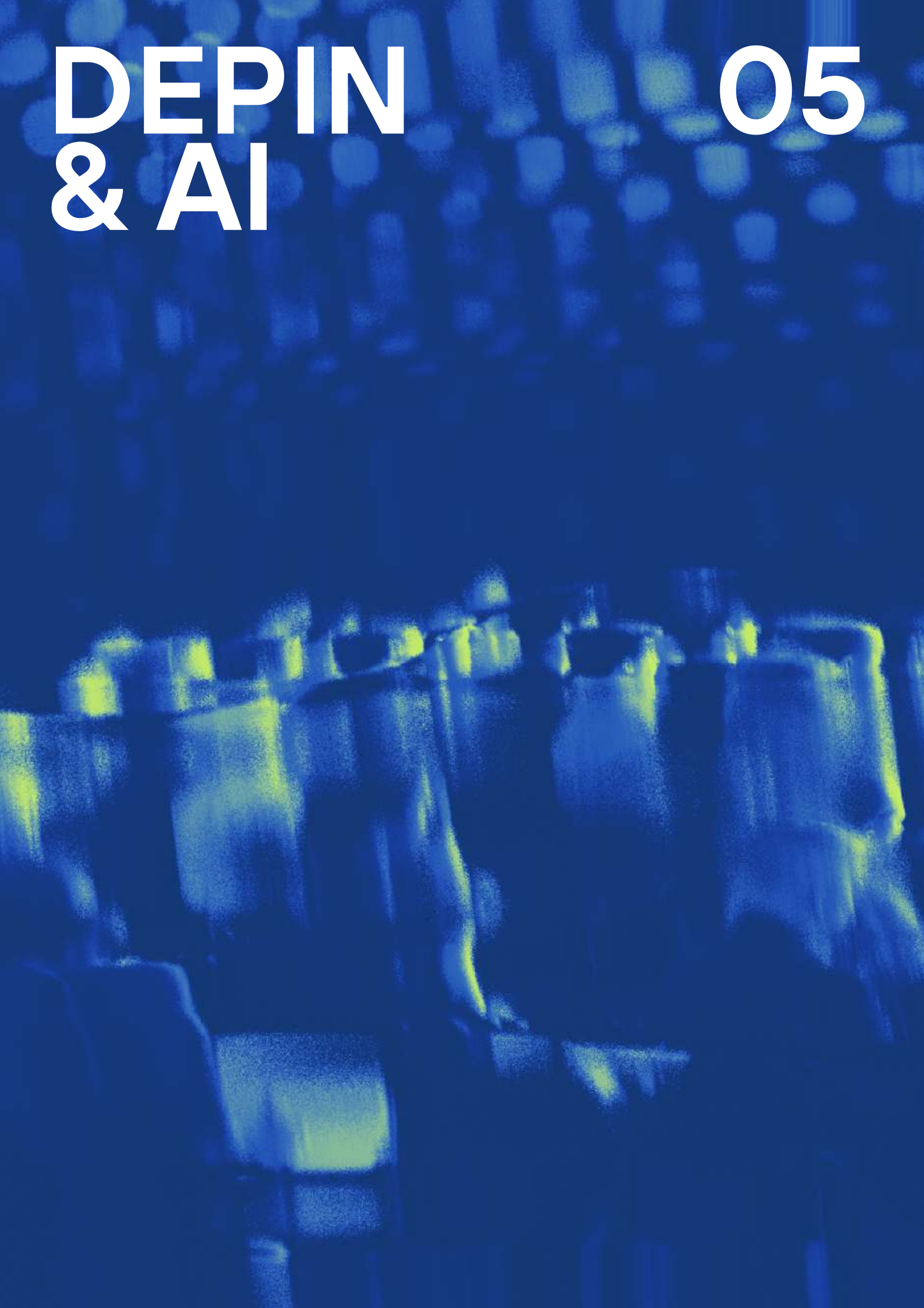


For Climate Actors: buy ART/ ***AREC***, offset ART / redeem ***AREC***, mint a climate Badge.



DEPIN & AI

05



Vision of dePIN in AI

Exploring DePIN reveals a significant area of development: integration with AI offering practical applications across multiple sectors. This collaboration is notably impactful in healthcare, where AI algorithms analyze encrypted patient data stored in storage provided by Storage projects for diagnosis and treatment optimization while maintaining data privacy.

In supply chain management, AI utilizes DePIN for secure and transparent tracking, enhancing logistical efficiency. Similarly, smart city initiatives employ AI to process data from IoT devices on DePIN, optimizing urban infrastructure management.

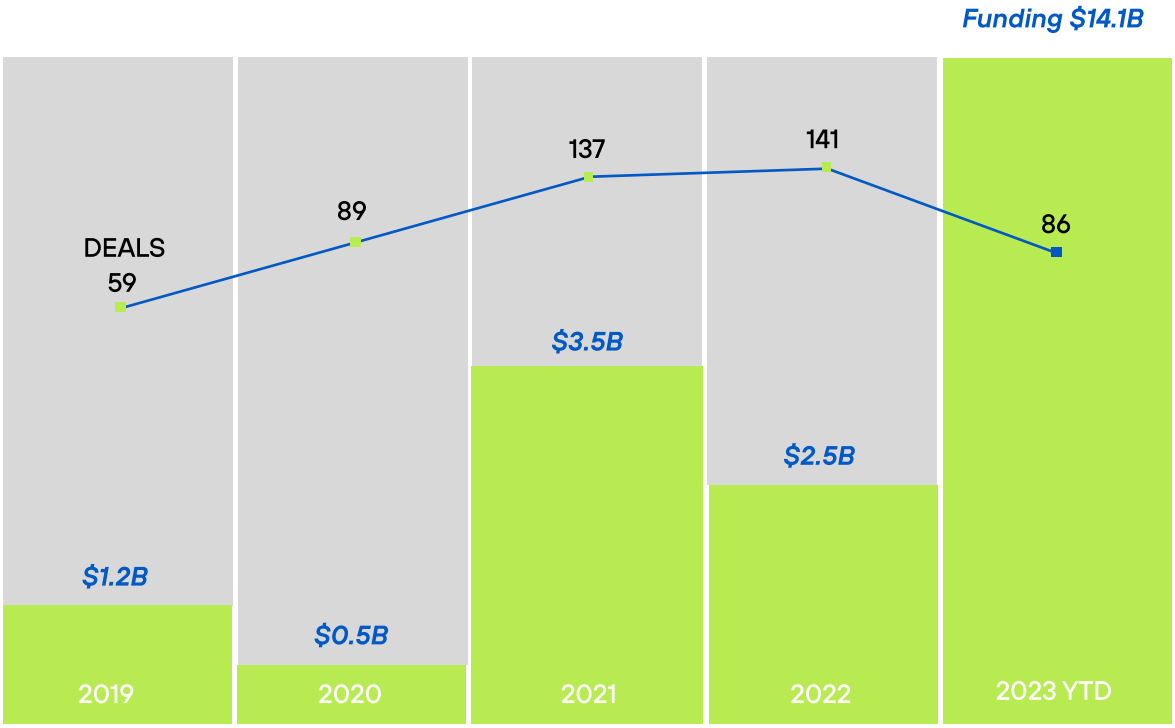
Financial services utilize AI to analyze transaction patterns on DePIN to detect fraud and automate trading. Meanwhile, decentralized marketplaces and autonomous networks incorporate AI for personalized services and decision-making automation. This synergy between DePINs and AI requires storage space and computing power to process data, leading to a heightened demand for Computing and Storage.

The synergy between DePINs and AI is recognized for its potential to enable machines to operate as independent economic units. This combination aims to address the constraints of centralized computing by supplying the computational power needed for AI algorithms. The convergence of DePINs and AI is expected to catalyze innovation across various sectors, promoting a competitive market environment.

The investment focuses primarily on three sectors: decentralized computational networks, distributed storage architectures, and AI-centric infrastructure frameworks. These investments are based on their utility in facilitating AI research and applications.

Investor interest in generative AI soars in 2023

Disclosed equity funding & deals (as of 06/30/2023)



> Decentralized Compute Networks address the increasing demand for GPU resources for machine learning model training and AI applications. This demand has contributed to a notable GPU shortage. Crypto-coordinated GPU networks offer an alternative to traditional cloud services by aggregating idle GPU resources across a distributed network.

> Notable projects in this sector include io.net and Nosana, both operating on the Solana blockchain. Io.net claims to integrate GPUs from existing networks like Render and Filecoin, purportedly accessing nearly 20,000 high-end GPUs, including 860 A100 models.

> Innovation in computational resources has become imperative, evidenced by Taiwan's dominance in the semiconductor foundry market and geopolitical tensions affecting GPU supply. The demand for GPUs has surged as computational requirements for AI models double every 3-6 months, surpassing supply and infrastructure capabilities. Market dynamics compound the challenge, with the prohibitive cost of enterprise GPUs limiting cloud providers despite offering only 20-25% more power for up to 15 times the cost of consumer versions.

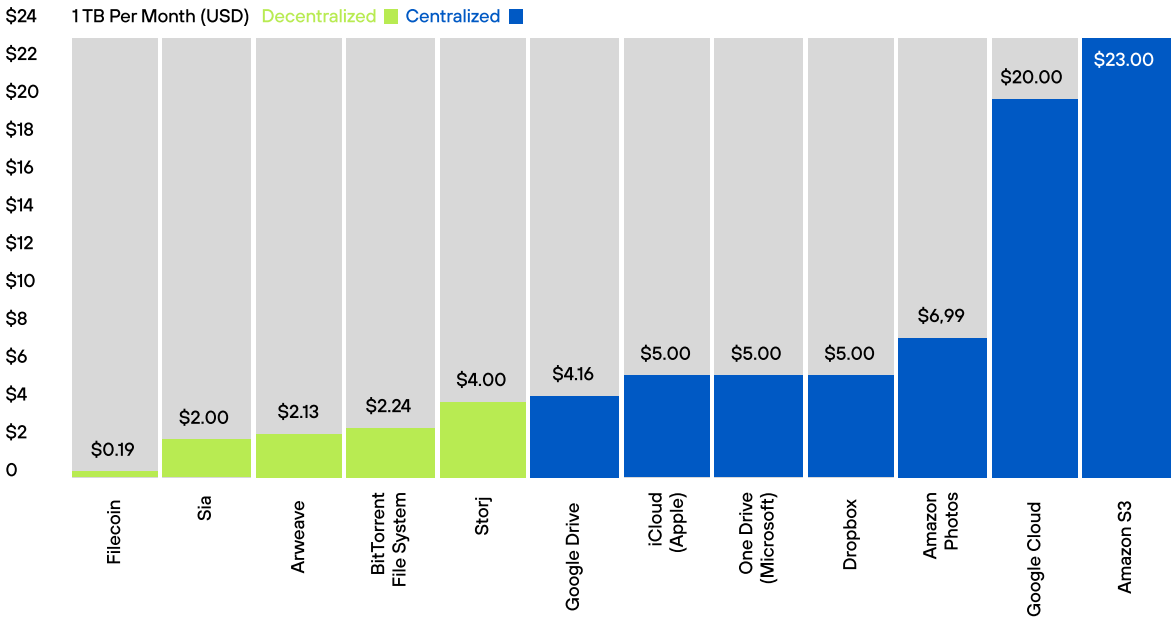
> Storage networks have garnered attention amid a surge in data production, notably from synthetic data and AI-generated content. To ensure AI models accurately predict future outcomes, data transfer from cloud storage must facilitate rapid downloads for timely updates. However, frequent download requests can result in high egress costs, emphasizing the importance of securing data to avoid compromising AI models and associated business operations.

The escalating generation of synthetic data and AI-generated content underscores the need for advanced storage solutions. In healthcare, secure and accessible storage is essential for training AI models using synthetic patient data while preserving privacy. Similarly, the development of autonomous vehicles relies on substantial, scalable storage capacity to utilize synthetic data for algorithm training. The entertainment industry's use of AI-generated content, such as personalized videos and virtual experiences, further underscores the need for efficient storage networks to manage large data volumes.

Integrating storage networks with AI optimizes data management, enhancing scalability, security, and cost efficiency. AI algorithms dynamically manage and distribute data across networks, adapting to demand and improving security through real-time anomaly detection. This integration reduces operational costs by optimizing storage and retrieval processes, ensuring data accessibility and efficient management.

Cost of Decentralized Storage vs Centralized Storage in 2023

Storage provider pricing for 1TB per Month



In recent years, many decentralized storage and computing platforms have seen increased demand, primarily due to the development of AI/ML, confirming that both narratives can complement each other and contribute to developing a modular data infrastructure with flexible settings. This allows them to compete with major companies like OpenAI, democratizing progress for AI startups. DePIN, combined with FHE solutions, enables data processing without disclosure, thus enhancing the positions of AI/ML models in terms of trust and expanding the market for available data.

AI Infrastructure Networks are developing as a new category, with Bittensor emerging as one of the leading players. Bittensor enhances the integration of specialized digital marketplaces or 'subnets' under a unified token economy, targeting the decentralized allocation of computational resources critical for AI research. It offers a platform that facilitates trustless transactions for computational power, data storage, and Oracle services, essential for AI development. Bittensor uses distributed computing to make AI development less dependent on central entities and more accessible. It allows developers to build marketplaces for specific computational resources, improving AI production efficiency.

The goal is to support open collaboration in AI research by offering a scalable and cost-effective infrastructure for processing data and training algorithms. Other recent entrants in the AI infrastructure space include Ritual, Upshot, Modulus Labs and platforms like Autonolas and Delysium.

Autonolas and Delysium provide decentralized platforms for AI agents, enabling automated task execution such as data analysis and customer interactions. These platforms allow AI agents to operate independently, facilitating scalable and secure applications across various sectors by automating processes without central oversight.

Modulus Labs specializes in applying zero-knowledge proofs to machine learning, allowing data processing and model training while keeping the data itself hidden. This method is essential for maintaining privacy in sensitive sectors, enabling AI for analysis and predictions without exposing confidential information.

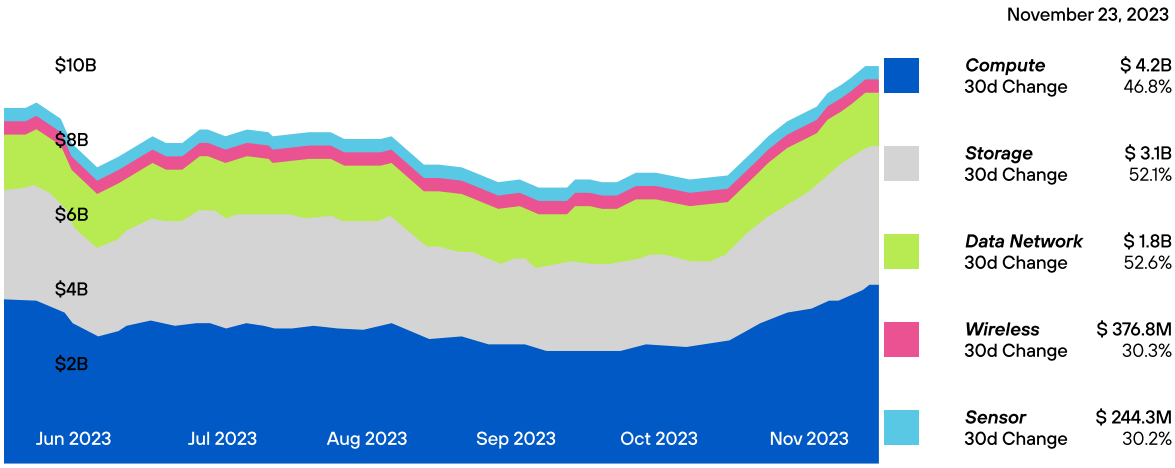
Ritual develops technology for verifiable AI model inference, ensuring the accuracy and reliability of AI-generated outcomes. This is crucial in areas requiring high trust levels, enabling third-party verification of AI processes and ensuring decisions are based on valid, transparent reasoning.

Upshot presents a decentralized network for financial AI applications, leveraging AI technology to furnish market analysis and investment insights. The network encourages data submission and analysis, democratizing access to financial information and enhancing market prediction accuracy through collective intelligence.

According to a market analysis conducted by MessariCrypto, the DePIN market is estimated to be worth around $2.2 trillion, with projections indicating growth to $3.5 trillion within the next four years. This surge is propelled by the heightened interest in AI over the past year.

AI narrative drives $3 billion DePIN marketcap growth

Global DePIN circulating market cap by sector



> Vitalik Buterin recently highlighted artificial intelligence's significant potential in the cryptocurrency sector, outlining its application across four key areas: as a main player, interface, rule, and goal within blockchain interactions. He emphasized the symbiotic relationship between AI's data requirements and blockchain's transparency and storage capacities. Nonetheless, Buterin warned about the dangers posed by adversarial machine learning, particularly in open-source settings, and calls for the constructive utilization of AI across all domains.

DEPIN & ZK

06

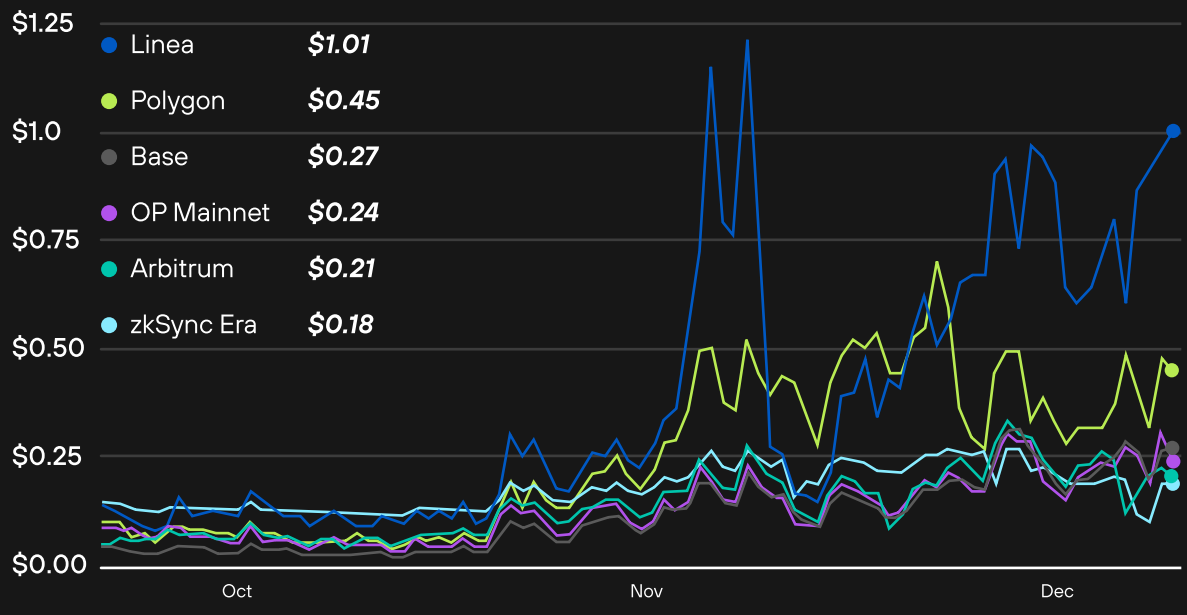
ZK Stats and Challenges

The cost of supporting ZK-Rollup infrastructure presents a significant challenge in competing with Optimistic Rollups, which have already garnered substantial popularity. Optimistic Rollups offer cost-effective solutions and a straightforward interaction model with the Ethereum data layer, enhancing developers' capabilities and streamlining dApps interaction.

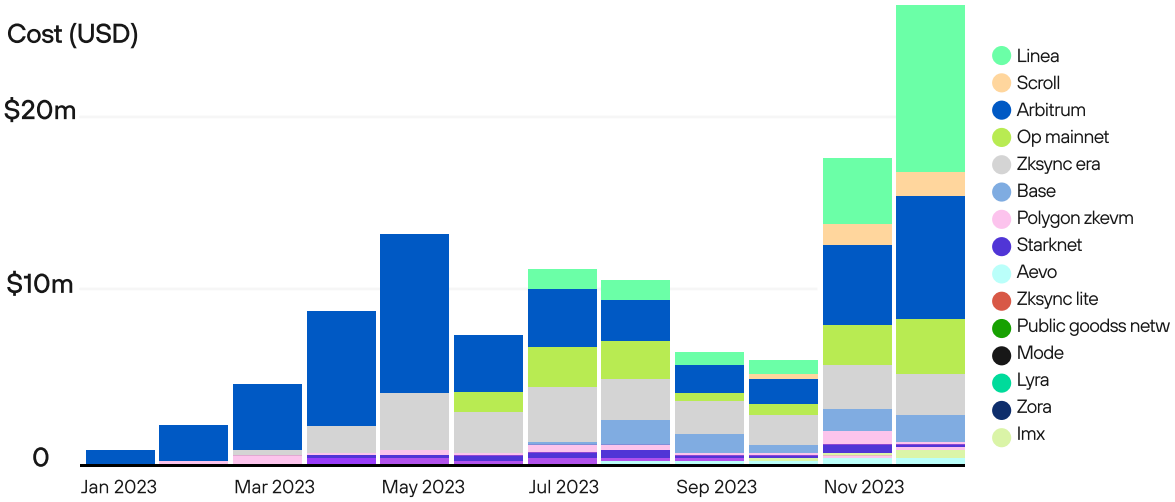
However, ZK-Rollups, which operate without the need for trust, is anticipated to witness a reduction in per-unit costs as they scale, benefiting from cost amortization across a broader spectrum of transactions. Nevertheless, this cost reduction only extends to the expenses of generating and verifying ZK-proofs, which demand substantial computational power. This underlines the intricacies involved in ZK-Rollup infrastructure costs.

Consequently, Layer 2 teams are actively exploring various approaches, including data compression, new cryptographic schemes, native programming frameworks, enhancements to proof verification and transaction validation logic. These endeavors aim to diminish costs and enhance the user experience of ZK-Rollup infrastructure, all while upholding privacy and reliability standards.

L2 Fees before Dencun, Feb 24



Cost: Publishing Txn Data to L1 (USD), Feb 24



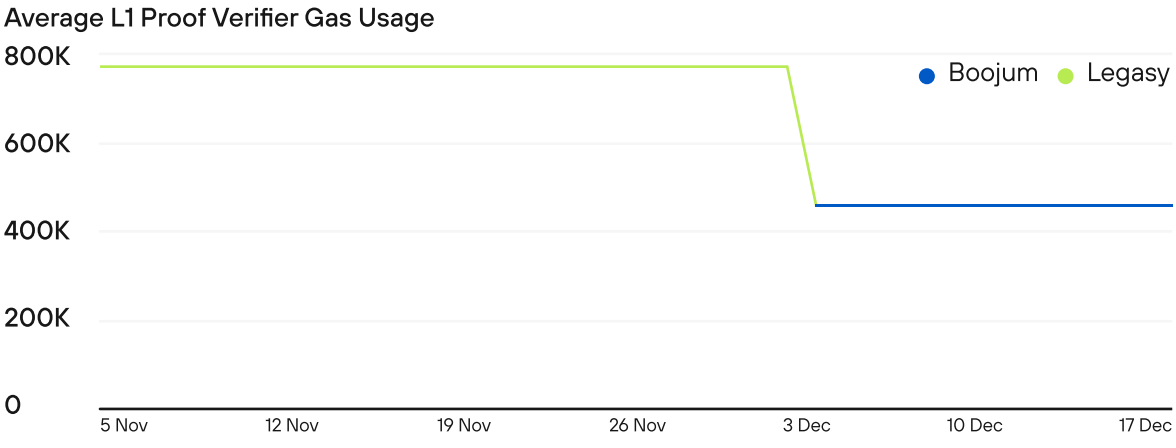
> Typically done on-chain, publishing transaction data is the primary factor in increasing transaction costs. Verifying ZK-proofs often also occurs on Ethereum's L1, like for Polygon zkEVM, zkSync Era, etc.

In ZK-Rollups, transaction fees are determined by the total number of transactions in a batch requiring a single ZKP, with costs shared among all participants. Expanding transaction batches holds promise, yet scalability remains constrained, and user fee prices are too volatile.

Optimization use-cases

By the way, optimisation of the data compression and publication of the state outputs instead of full data can significantly reduce Tx costs for L2 networks. For example, the recent zkSync Era Boojum update, which optimized not only the ZKP scheme but also reduced the average number of bytes per transaction and expanded the block space, resulting in a 40% reduction in gas fees:

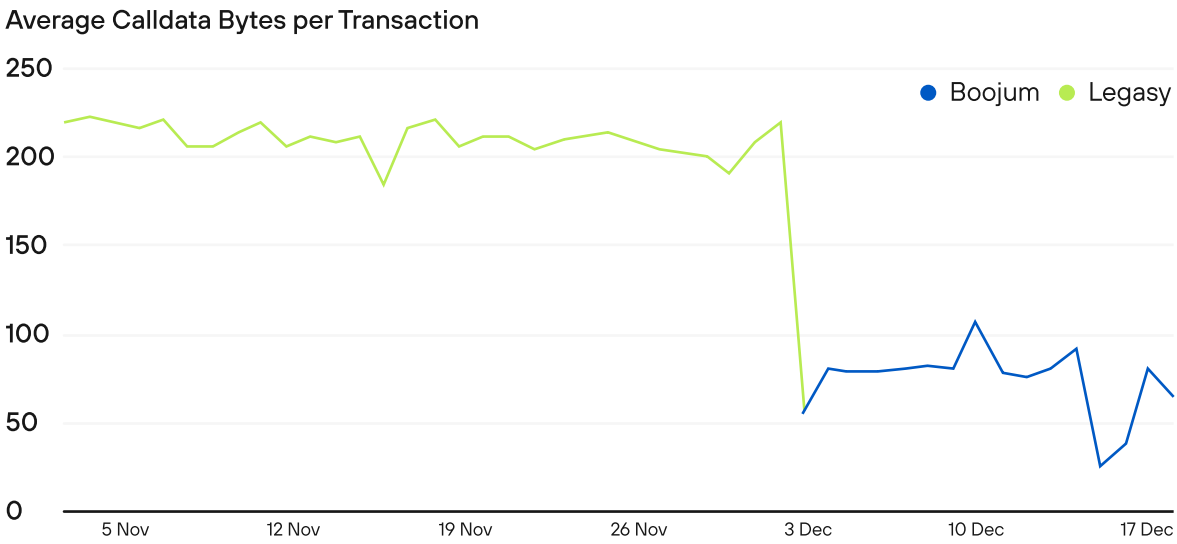
zkSync Boojum upgrade reduces prove verification costs by 40%



40%
Reduction in Proof Cost

~458K
Gas per Proof Transaction

Calldata Bytes per L1 Commit Transaction



Another case of the data publication to the off-chain DA layer further reduces the final cost and speeds up transactions with high customisation. In this way, L3 solutions such as Starknet's StarkEX and gaming network XAI (based on Arbitrum Nitro), are already successfully utilizing this approach. The second one even have implemented gas subsidy from the box.

However, despite these facts and lower cost of infrastructure support, such solutions have a number of drawbacks that do not yet allow L3 to be classified as a universal solutions. First of all, it is the isolation of liquidity and data, lower reliability, and limited scalability.

The combination of these factors makes L3 and off-chain DA a good choice for dApps with specific needs, but requires additional developments for interaction with the on-chain worlds. Therefore, Sovereign Rollups and App-chains often face similar challenges.

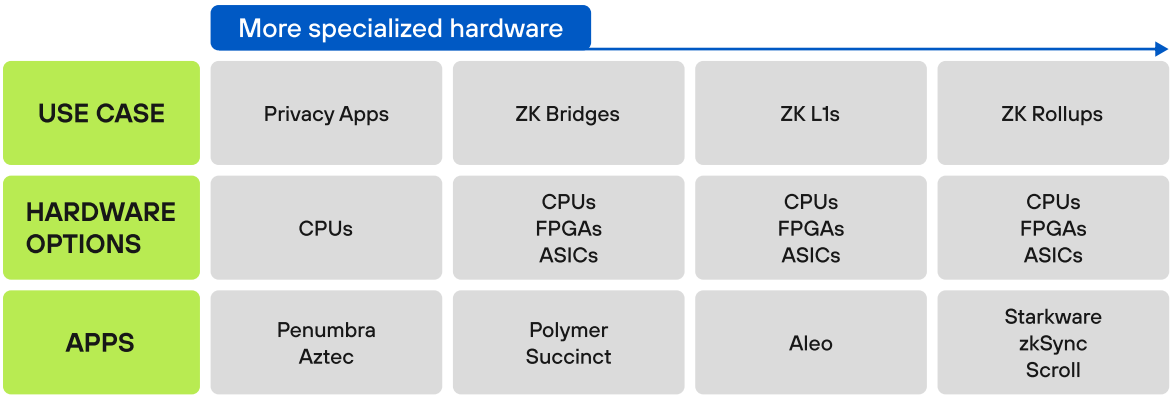
> In 2024, the blockchain industry anticipates a surge in new Data Availability (DA) applications, with the immediate future promising significant cost relief for Ethereum-based rollups. This relief is attributed to the EIP-4844 update, which aims to slash data publication costs by up to 90%, addressing a critical cost barrier for rollup transactions.

Modular DA and dePIN approaches

Modular Data Availability solutions such as Celestia and Eigenlayer are gaining traction as optimized layers for data availability, addressing the need for efficient and scalable storage in blockchain networks. In parallel, dePIN Storage Networks are positioned as versatile alternatives, capable of providing both public and private transaction data storage options customized to the requirements of different rollups.

These blockchain-based data storage solutions also offer a robust backup mechanism for off-chain data and network states associated with Layer 2 and Layer 3 solutions. This approach not only aims to mitigate the risk of failures but also facilitates a more straightforward process for recalling funds, enhancing the resilience and reliability of the overall blockchain ecosystem.

Hardware for ZK applications



These blockchain-based data storage solutions also offer a robust backup mechanism for off-chain data and network states associated with Layer 2 and Layer 3 solutions. This approach not only aims to mitigate the risk of failures but also facilitates a more straightforward process for recalling funds, enhancing the resilience and reliability of the overall blockchain ecosystem.

Given this development, dePIN-based Storage Networks are poised to serve primarily as supplementary support for EVM-compatible blockchains but can become more attractive for non-EVM solutions. For EVMs, dePIN Storage could work as emergency backup infrastructure and external DA for Rollups, with their adoption and utility being closely tied to their cost-effectiveness.

> ZKP Markets emerge as a novel market segment showcasing the synergy between dePIN and ZKP, allowing participants to offer their computational resources to generate ZKPs. Economically, these markets tend to be P2P and may be susceptible to manipulation, similar to MEV scenarios for provers. Therefore, it's suggested that ZKP Markets evolve towards decentralized networks featuring equitable incentive and restriction systems within the on-chain economy. This evolution aims to guarantee continuous access to services and fair distribution of rewards, ensuring the integrity and sustainability of the ecosystem.

DePIN Computing Networks already operate this way, and many dePIN Storage Networks are beginning to implement distributed computing as an additional revenue stream based on a current nodes network and a sustainable economic model. Until L2 solutions implement a native optimal solution, dePIN computing as ZKP Markets may become the primary alternative for ZKPs.

> In ZK-acceleration, notable developments include Gevulot, a decentralized network designed for generating and verifying zero-knowledge proofs. It empowers users to deploy provers and engage a network of advanced hardware operators without permission. Gevulot aims to streamline proving tasks across various applications, enhancing economic efficiency for all participants. Additionally, Axiom stands out as a protocol enabling smart contracts to access and compute over the entire history of Ethereum using ZK-proofs.

> Furthermore, the integration of ZK technology holds promise for many data privacy solutions, including those in AI and cybersecurity domains. Noteworthy examples include Nosana, a ZK-based decentralized crowd-computing network, and Zorp, a platform pioneering a new PoW blockchain architecture atop a novel ZKVM.

CONCLU-SIONS

07

Storage

The DePIN sector stands at the forefront of revolutionizing cloud data storage and addressing the challenges of an increasingly digitalized world. As we head towards 2025, with cloud computing expected to host around 100 zettabytes of data and over 75 billion IoT devices coming online, the need for scalable and secure storage solutions has never been more pressing. The ongoing shift of corporate data to the cloud, with a notable increase from 30% in 2015 to over 60% by 2023, underscores the growing reliance on cloud technologies for efficient data management.

Most companies' move towards multi-cloud and hybrid cloud strategies highlights the importance of these models for enhancing operational flexibility and information security despite the inherent complexities. Yet, the current landscape reveals a significant security gap, with a low adoption rate of Zero Trust models, particularly in cloud environments, signaling the need for a comprehensive approach to data security.

Enter DePIN technologies, leveraging blockchain to decentralize data control and enhance security through rigorous access controls and verification processes. This aligns with the principles of Zero Trust, offering a promising alternative to traditional cloud storage by addressing key concerns around security, privacy, and data integrity. Beyond Web2, DePIN storage solutions hold potential across various sectors, including AI/ML, healthcare, and finance, and are poised for growth in the Web3 space, driven by the need for scalable, secure storage solutions.

Among the projects focused on decentralized cold and hot data storage in the coming years, we can expect to see expanded functionality, taking into account the growing needs in cloud computing and the democratization of AI/ML developments. Existing ecosystems like Filecoin, Arweave, and other specialized L1/L2 solutions will be utilized as a foundation or one of the available storage options.

Meanwhile, intermediary platforms offering additional flexible services can carve out their niche in the sector and enhance existing user onboarding systems. The transition from Web2 cloud storage needs to be as straightforward and intuitive as possible, an area where there is still much room for improvement. The same can be said for the payment systems, which are often too volatile due to their dependence on the native token's price. Therefore, tokenomics in such projects must not only support the infrastructure of storage providers (SPs) and miners but also enable users to access more competitive offerings than Web2 services.

In summary, as the digital landscape evolves, DePIN technologies represent a key advancement towards more secure, decentralized storage models, offering a solution to the challenges of modern data management and the risks associated with the exponential growth of data and connectivity.

Computing

Decentralized computing is reshaping cloud computing by addressing high costs, scalability issues, and security concerns associated with traditional cloud services. The cloud computing market's expansion to $917 billion underscores the rising demand for such resources. Decentralization distributes tasks across networks, reducing costs and improving performance, evidenced by the lower GPU hourly rates on decentralized platforms compared to traditional providers like Amazon AWS, Microsoft Cloud, and Google Cloud.

Decentralized computing platforms are diversifying and specializing in distinct areas. Render Network focuses on blockchain-based GPU rendering, Livepeer on decentralized video streaming, and Golem on peer-to-peer computing resource sharing. These platforms demonstrate the application of decentralized networks to specific computing needs, aiming to improve efficiency and reduce costs.

Notably, GPUs critical for AI and ML, such as the NVIDIA A100 and RTX series, are cheaper on decentralized platforms, indicating a shift towards more cost-effective cloud computing solutions. This trend is driven by the growing computational requirements of advanced AI and ML models, which decentralized computing better accommodates through enhanced efficiency and scalability.

Technical innovations such as Render Network's transition to the Solana blockchain for enhanced scalability and Livepeer's use of Arbitrum to optimize video streaming processes illustrate the technical depth behind these platforms. The integration of specific computational approaches, like Dynex's application of neuromorphic computing, addresses the increasing computational demands of AI and ML workloads.

The trend towards aggregating computing resources, as seen in Gensyn's development of a global computational supercluster, signals a strategic effort to make computing power more accessible and cost-effective. This approach seeks to lower barriers to entry for computational-intensive tasks, with implications for innovation in technology sectors reliant on computing resources. Governance through DAOs in some platforms points to an emphasis on community-driven development.

In summary, decentralized computing offers a more economical and scalable alternative to traditional cloud computing, particularly for AI and ML model development. It stands as a key development in cloud computing, promising lower costs and higher performance. Monitoring leading and emerging decentralized computing platforms will be crucial for understanding future cloud computing trends.

Wireless

As we move into 2024, the wireless industry is undergoing a transformation characterized by the successful implementation of 5G and the integration of blockchain, marking a significant shift towards enhanced connectivity and security. The sector, rich in wireless communication technologies from 5G to IoT, stands on the brink of innovation, spurred by the emergence of the Wireless DePIN sector, which signifies a move towards decentralized privacy and integrity in wireless networks.

The adoption of blockchain within this sector promises a new level of security and privacy, with decentralized solutions like the Tor browser offering robust alternatives for data protection. This year is set to witness notable trends such as deploying Open RAN architecture for more flexible networks, using AI to optimize network operations, and increasing network densification to support low-latency connections.

Blockchain technology is crucial in enhancing data integrity, privacy, and scalability while fostering secure identity management, data sharing, and IoT connectivity. However, the sector faces challenges, including the need for revenue diversification and stronger cybersecurity measures, amidst the backdrop of a 5G rollout slowdown.

In essence, 2024 marks a period of opportunity and innovation for the wireless industry, with blockchain technology at the heart of efforts to secure and privatize wireless communication, signaling a pivotal shift towards more secure, efficient, and decentralized network infrastructures.

Wireless dePIN projects currently represent a unique opportunity to compete with telecommunications giants and make connectivity more accessible where it's needed most. Initiatives like Helium have been proving this possibility for several years now. There's a diversification in connectivity options ranging from 5G infrastructure and LoRaWAN networks to WiFi, with the concept of decentralized bandwidth sharing and CDN within public-run networks gaining popularity.

In summary, these projects create incentives for users who wish to support the infrastructure and contribute to a collective endeavor, earning a share of the profits when the solution succeeds, thus having "skin in the game." While some projects may utilize blockchain solely to reward participants or not at all, opting for other incentives, we believe that dePIN is not just about incentivization methods but fundamentally about infrastructure. Therefore, we anticipate the emergence of more new specialized infrastructural solutions in the Wireless sector.

Sensors

Sensor networks, essential to IoT, have seen significant growth, notably with IoT devices outnumbering non-IoT devices since 2020. This increase points to a trend towards greater device interconnectivity, impacting sectors like healthcare, smart cities, and transportation. The IoT market, valued at $374.39 billion in 2023, is projected to grow substantially, driven by advancements in sensor technology, networking capabilities, and demand for data-centric applications.

Challenges in energy networks critical to IoT's functionality include outdated battery technology, lack of regulatory support, inadequate investment in renewable energy infrastructure, and outdated power systems. These issues hinder the efficient deployment of IoT solutions in energy management despite IoT's potential to enhance energy efficiency and reduce CO2 emissions through optimized energy use and support for renewable energy sources. In the mapping and navigation sector, emerging technologies are surpassing traditional services in speed and data accuracy, contributing to a market expected to reach $36.6 billion by 2028. Innovations in this space offer more efficient data collection and real-time updates, which are crucial for enhancing IoT applications' functionality and reliability.

Decentralized networks such as Hivemapper and DIMO utilize blockchain to facilitate data collection and sharing, focusing on specific applications like mapping and vehicle data integration. Hivemapper, for example, has mapped over 5 million kilometers, leveraging user-contributed dashcam footage. DIMO connects vehicles to gather and analyze data, enhancing vehicle management and maintenance services. These platforms incentivize user participation through token rewards, ensuring a steady flow of data for continuous improvement.

Technical advancements within these networks are aimed at enhancing functionality and expanding capabilities. WeatherXM's Real-Time Kinematic service targets the agricultural sector with precise positioning technology, while Soarchain focuses on secure data exchange for the mobility sector. Such updates reflect the platforms' dedication to applying decentralized technology to solve industry-specific challenges.

In summary, integrating IoT, energy networks, and mapping into a cohesive system faces obstacles related to power supply, regulation, and technology infrastructure. Solutions to these challenges include improving storage and computation capabilities and adopting blockchain for enhanced security and scalability, underscoring the need for systemic updates and investments across these interconnected sectors.

dePIN & AI

The integration of DePIN with AI is being applied in healthcare, supply chain management, smart cities, and financial services. In healthcare, AI analyzes encrypted patient data from decentralized storage for improved diagnostics and treatments, ensuring privacy. Supply chains benefit from transparent tracking via AI and DePIN, enhancing efficiency. Smart cities use AI to process IoT device data on DePIN for infrastructure management. At the same time, financial services use AI to scrutinize transaction patterns on DePIN for fraud detection and trading automation.

Demand for decentralized computing and storage is surging, driven by AI's need for data processing and storage. Decentralized Compute Networks like io.net and Nosana address GPU shortages by pooling idle resources for AI tasks, indicating a shift towards distributed computing resources for AI model training. Storage Networks are crucial as the volume of synthetic data and AI-generated content grows, requiring scalable, secure storage solutions to accommodate the increase in data generation.

AI Infrastructure Networks, including Bittensor, Ritual, and Modulus Labs, are emerging to support AI research and application needs. These platforms provide decentralized computational power, data storage, and secure data processing, enabling more autonomous and secure AI operations and facilitating scalable applications. This shift aims to democratize AI research by making resources more accessible and encouraging innovation.

The DePIN market, valued at approximately $2.2 trillion with a projection to grow to $3.5 trillion within four years, highlights the impact of AI integration. This growth reflects the complementary relationship between DePIN and AI, with decentralized networks meeting AI's infrastructure demands and fostering innovation across various sectors.

In summary, Vitalik Buterin's commentary on AI in the cryptocurrency domain underscores AI's potential to enhance blockchain functionalities in several roles. However, Buterin also points out the risks associated with adversarial machine learning in open-source settings, emphasizing the importance of cautious AI integration into decentralized environments to leverage its advantages while minimizing potential negatives.

dePIN & ZK

The intersection of ZK and dePIN sectors represents a pivotal evolution in blockchain technology, focusing on enhancing scalability, security, and efficiency. While ZK-Rollups face initial cost barriers compared to Optimistic Rollups, advancements in data compression, cryptographic schemes, and native programming are paving the way for reduced costs and improved scalability without sacrificing privacy.

Efforts like the zkSync Era Boojum update have significantly lowered transaction costs through optimized data handling, showcasing the potential for cost-effective scalability in blockchain networks. Despite challenges in liquidity isolation and scalability limits, ongoing development aims to bridge these gaps.

Modular Data Availability solutions and dePIN Storage Networks are emerging as vital for efficient, scalable blockchain storage. This positions dePIN Storage as a crucial support for emergency backup on-chain/off-chain data states and external Data Availability layers.

ZKP Markets introduce a peer-to-peer model for sharing computational resources for ZK-proof generation, highlighting the need for equitable incentive systems to ensure a fair and sustainable ecosystem. Innovations such as Gevulot and Axiom demonstrate the potential for decentralized networks to optimize ZK-proof generation and smart contract computations.

In summary, the synergy between ZK and dePIN technologies is driving significant improvements in blockchain infrastructure, focusing on creating more efficient, secure, and scalable solutions. This collaborative effort marks a significant stride towards overcoming technological limitations and setting a new standard for blockchain innovation.

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About Cryptomeria Capital

Cryptomeria Capital is an early-stage VC firm based in Dubai with presence in Singapore and HongKong. The firm believes decentralized projects, cryptocurrencies, and Web 3.0 will dramatically reshape economic relations and focuses on ventures, tokens, and projects related to blockchain technology and crypto assets. Cryptomeria Capital supports transformation by providing early-stage financing for ambitious projects in a rapidly developing industry.

About Axon Partners, BME:APG

With international presence and global reach, Axon has 2 different business units: alternative investment and strategic consulting that offer their services in more than 70 countries, with high exposure to the Americas, Europe, Middle East and Southeast Asia.

2006
Year founded

>50
Companies backed

12
Funds

+100
Years of accumulated experience of the partners

+85
Employees

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