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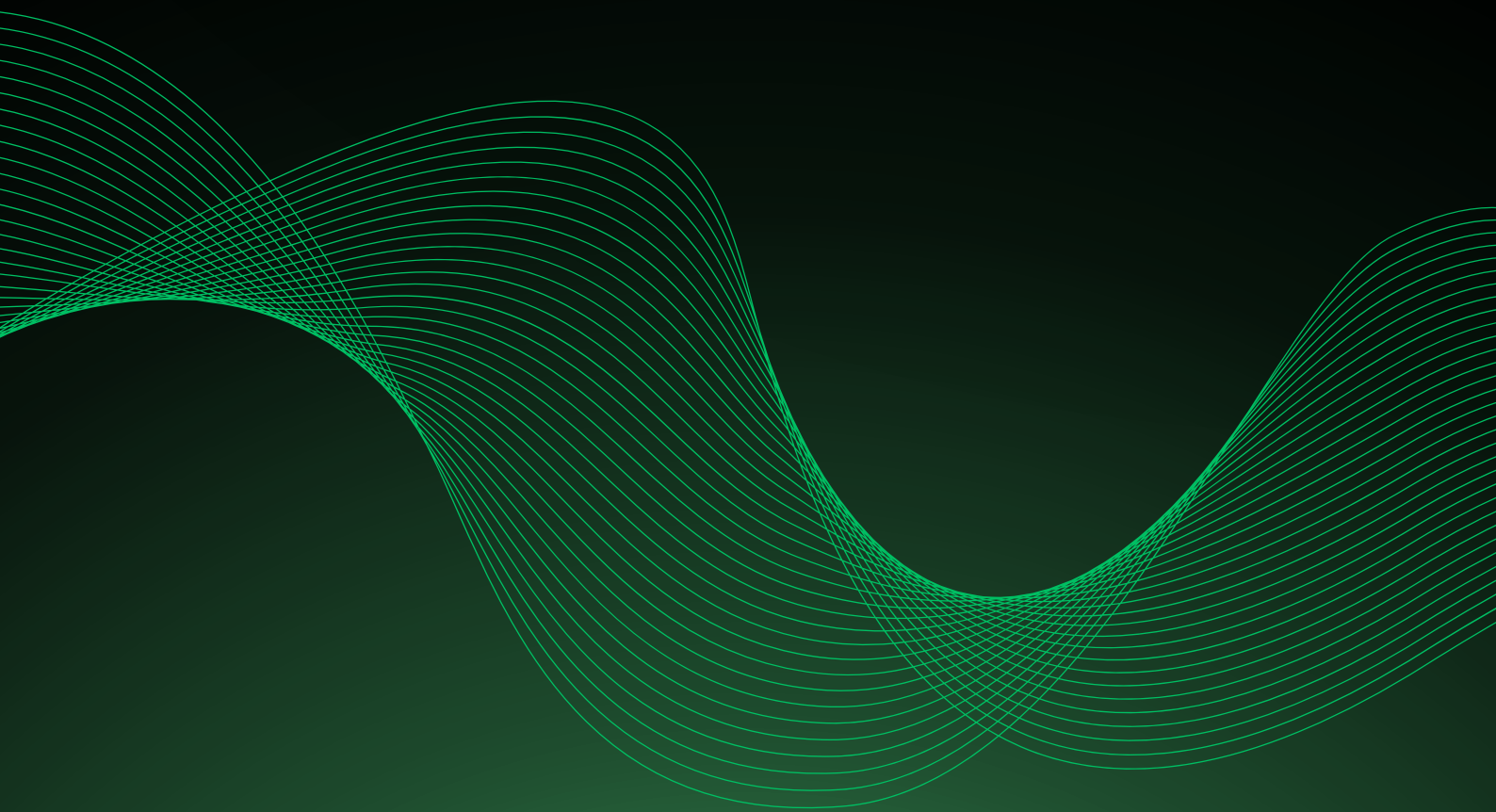
DePIN+AI REPORT FOR Q2

Unlocking new use cases



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Definition and Concept
DePIN 定义及概念

DePIN stands for"Decentralized Physical Infrastructure Networks", DePIN aims to collaborate and manage physical infrastructure in a decentralised way, and use tokens to incentivize users to contribute resources to the network, build the networks together.

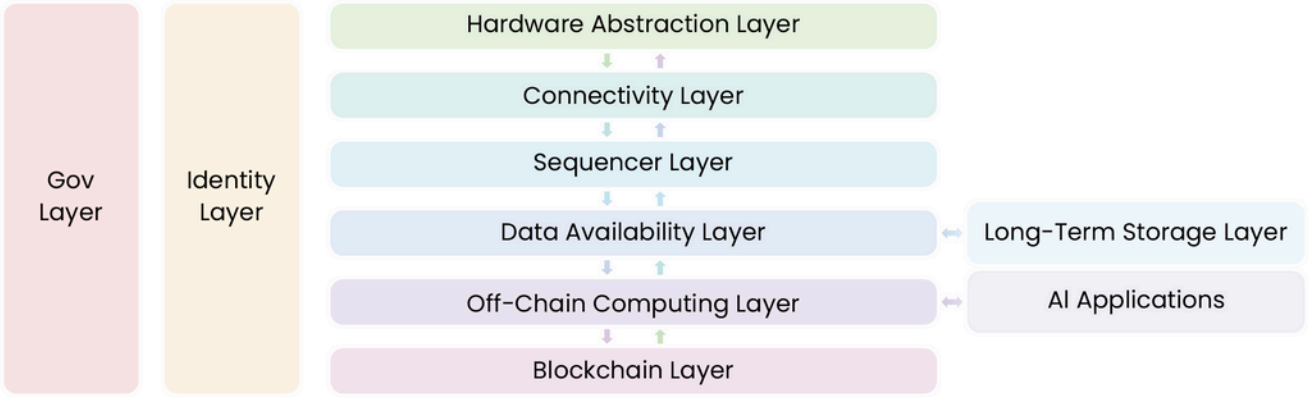
The concept as DePIN coined by Messari in November 2022. After that,it's quickly gaining consensus among large and crypto native infrastructures that share the same vision.

IoTeX Showed a modular DePIN architecture might look like. Building a DePIN application involves:

DePIN 是 Decentralized Physical Infrastructure Networks 的简称，即「去中心化网络硬件基础设施」。旨在以去中心化的方式进行物理基础设施的协作和管理，并通过代币激励鼓励用户直接参与或共享资源，共建基础设施网络。

DePIN 一词由研究机构 Messari 在 2022 年 11 月提出，并快速获得了拥有相同愿景的、早期大型原生基础设施们的共识。

参考 IoTeX 给出的 DePIN 的模块化架构，一个 DePIN 应用的多层技术栈包括：



(Source: IoTeX)

DePIN aims to enable distributed computing and On-Chain interactions. It reduces the cost of customer acquisition and presents a more efficient collaboration network.

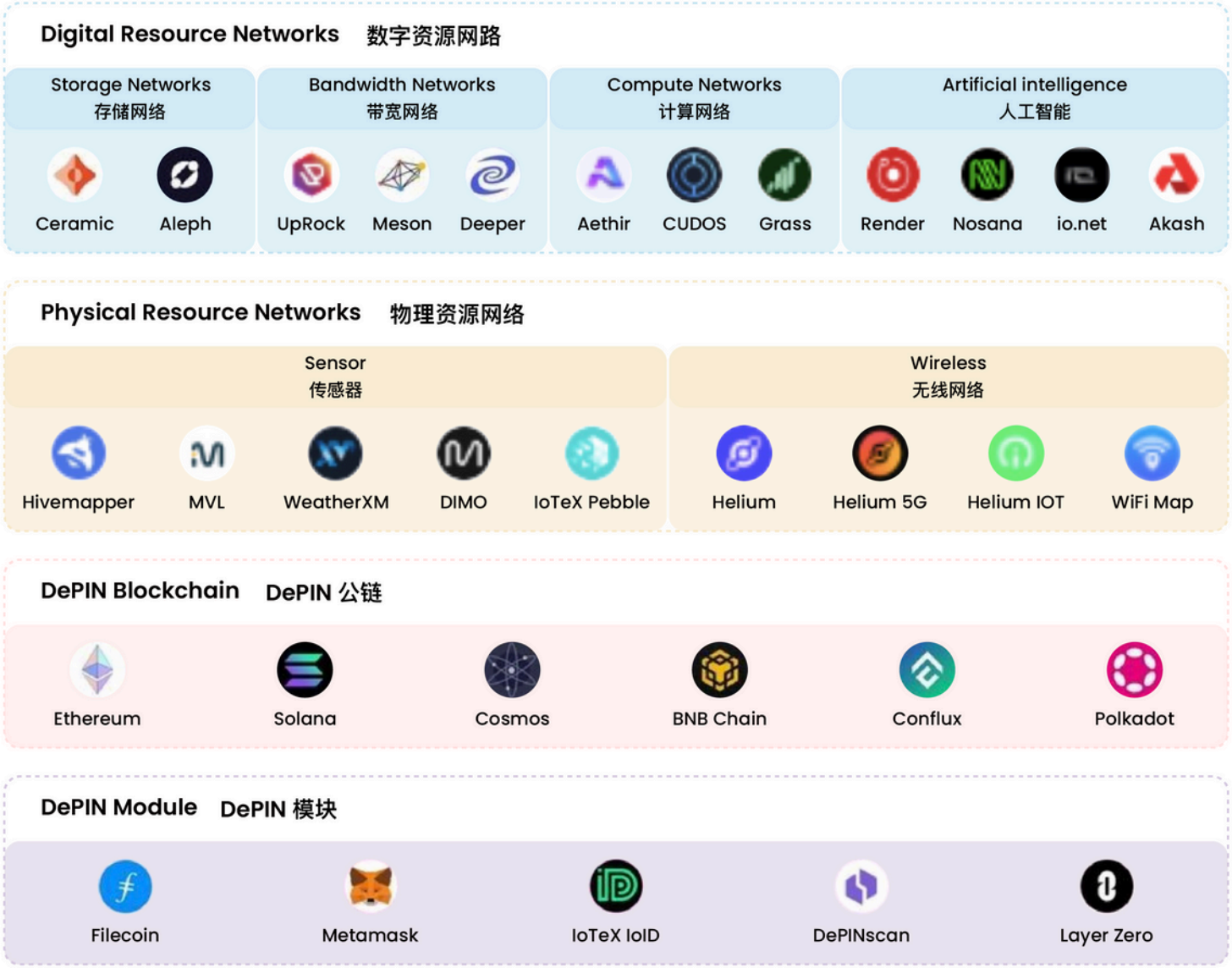
Hence, every phase of technological advancement and narrative evolution predominantly centers on the 3 components:'decentralization', 'physical infrastructure' ,and 'economic model' . The incorporation of AI technology into dePIN stands out as a segmented concept deserving of careful consideration.

DePIN 旨在通过去中心化网络实现分布式计算及上链，降低获客成本，呈现更高效的协作网络。因此，每轮技术进展及叙事创新主要围绕「去中心化」、「物理基础设施」、「经济模型」三个要素展开，DePIN 叠加 AI 技术，是值得关注的细分概念之一。

DePIN: Categories and Panorama
DePIN 分类及全景图

Physical Resource Networks (PRNs) and Digital Resource Networks (DRNs) are the two main categories of DEPIN. Refer to Depinscan. the more granular overview of the track is presented below:

广义的 DePIN 主要分两类： 物理资源网络（Physical Resource Networks，PRNs）和数字资源网络（Digital Resource Networks，DRNs）。更细分的领域参考 depinscan，该赛道目前的全景图为：



An overview of DePIN + AI is as follows

DePIN + AI 方向概览如下：

Project	Token	Category	Social Following	Market Cap	Token Price	24h Trade VOL	1D	7D	30D	Total Devices	Last 7 days
Render	RNDR	Server AI	192,952	$2,679,921,422	$6.85	$137,480,889	+4.3%↑	-9.3%↓	-25.1%↓	-	
Theta	THETA	Server AI	271,757	$1,392,309,081	$1.39	$18,239,525	+7.2%↑	-8.4%↓	-28.1%↓	5,885	
Akash	AKT	Server AI	116,928	$888,358,029	$3.63	$12,240,041	-0.9%↓	-0.6%↓	-13.2%↓	389	
Aethir	ATH	Compute AI	900,368	$270,173,234	$0.071	$20,397,792	+2.4%↑	+1.3%↑	-	-	
Nosana	NOS	Compute AI	49,670	$250,864,963	$3	$1,313,347	+1.8%↑	-8.4%↓	-30%↓	-	
io.net	IO	Compute AI	538,774	$235,899,841	$2.48	$158,509,677	+7.8%↑	-15.6%↓	-	-	
Hivemapper	HONEY	Sensor AI	46,630	$159,889,652	$0.077	$2,249,522	+34.4%↑	+36%↑	+2.7%↑	8,037	
Phoenix	PHB	AI Compute	122,338	$80,828,925	$1.59	$8,712,676	-0.4%↓	-14.4%↓	-34.5%↓	1	
UpRock	UPT	Bandwidth AI Mobile	382,509	-	$0.015	$21,163	+2.2%↑	-31.3%↓	-	594,731	
Network3	-	AI	126,571	-	-	-	-	-	-	235,038	-
Inferix	-	Compute AI	19,975	-	-	-	-	-	-	189	-
CUDOS	CUDOS	Server AI Compute Cloud	48,600	$163,857,654	-	-	-	-	-	11	-

Project	Token	Category	Social Following	Market Cap	Token Price	24h Trade VOL	1D	7D	30D	Total Devices	Last 7 days
Grass	-	Compute AI	418,424	-	-	-	-	-	-	-	-
Fetch AI	FET	Server AI	237,751	$3,100,434,493	$1.23	$142,431,328	+2.5%↑	-6.4%↓	-27.4%↓	-	
BitTensor	TAO	Server AI	24,567	$1,844,934,109	$263.28	$66,215,342	+10.6%↑	+11.1%↑	-26.2%↓	-	
Arweave	AR	Server AI	99,745	$1,504,152,300	$22.92	$51,174,167	+2.8%↑	-14%↓	-38.3%↓	-	
Golem	GLM	Server AI	170,058	$320,268,815	$0.32	$13,537,351	+2.3%↑	-4.9%↓	-27.3%↓	-	
OriginTrail	TRAC	Sensor AI	158,797	$262,931,403	$0.645	$2,053,383	-3.7%↓	-16.6%↓	-25.7%↓	-	
Ocean	OCEAN	Server AI	195,660	$231,272,135	$0.53	$1,613,910	+4.6%↑	-4.7%↓	-29.1%↓	-	
PAAL AI	PAAL	Server AI	71,942	$177,033,570	$0.207	$3,579,595	-5%↓	-18.8%↓	-30.5%↓	-	
iExec	RLC	Server AI	87,756	$130,954,948	$1.81	$4,798,735	+3.8%↑	-11.1%↓	-36.3%↓	-	
Phala Network	PHA	Compute AI	122,420	$93,034,148	$0.126	$4,881,401	+2.7%↑	-17.4%↓	-32.7%↓	29,478	
Dynex	DNX	Compute AI Services Chain	90,065	$51,795,137	$0.561	$691,699	-6.5%↓	-10.5%↓	-27.9%↓	140,322	
Autonolas	OLAS	Server AI	25,821	$50,305,981	$1.21	$1,282,326	+3.8%↑	-23.1%↓	-40%↓	-	

(Source：https://depinscan.io/ai)

DePIN Industry Chain
DePIN 产业链

DePIN has undergone the early development period and has established a comprehensive industry chain both upstream and downstream.

DePIN 赛道发展时间相对较长，已形成比较完整的产业链上下游：

Upstream	Midstream	Downstream
Hardware Vendor Foundry IoT equipment Power & Energy Equipment Suppliers	DePIN network operators Software developer Data Processing	Enterprises Consumer apps

上游供应链	中游供应链	下游供应链
硬件供应商 芯片制造商 物联网设备 电力及能源设备供应商	DePIN 网络运营商 软件开发商 数据处理工具	企业平台 消费者应用

Market capitalization scales & Growth Potential

板块规模及增长空间

Based on information from Cryptoslate, the DePIN sector's total market capitalization stands at approximately $26.39 billion as of June 30, 2024. This constitutes 1.18% of the overall cryptocurrency market capitalization and encompasses about 64 projects. The leading projects by market capitalization are identified as ICP (Internet Computer), Render, Filecoin, Bittensor, and The Graph.

The historical market capitalization share of the DePIN segment is referenced below:

据 Cryptoslate，截止 2024 年 6 月底，DePIN 板块的总市值约 $26.39 B，占加密总市值的 1.18%，统计的项目数量约 64 项。市值排名前五的是：ICP（Internet Computer），Render，Filecoin，Bittensor，The Graph。

DePIN 板块市值历史占比参考如下：

Project	Bull Markets / $b (2021.11)	Bear Market / MCP/$b (2023.1)	Relative to BTC MCP (bull)	Relative to BTC MCP (Bear)
BTC	1260	450	-	-
ICP	9.61	1.54	0.76%	0.34%
Render	1.2	0.22	0.10%	0.05%
Filecoin	7.83	1.62	0.62%	0.36%
Bittensor	4.66	1.18	0.37%	0.26%
The Graph	5.26	0.78	0.42%	0.17%

(Source：https://coinmarketcap.com/，Bittensor 以最高/最低价参考)

项目名称	牛市 MCP/$b(2021.11)	熊市 MCP/$b (2023.1)	牛市相对 BTC MCP	熊市相对 BTC MCP
BTC	1260	450	-	-
ICP	9.61	1.54	0.76%	0.34%
Render	1.2	0.22	0.10%	0.05%
Filecoin	7.83	1.62	0.62%	0.36%
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(Source：https://coinmarketcap.com/，Bittensor 以最高/最低价参考)

As per data from CoinMarketCap as of the end of June, the overall market capitalization of the crypto market stood at $2.26 trillion, with its previous peak reaching $3 trillion. Analyzing the Bitcoin stock-to-flow model alongside the historical average annual increase in Bitcoin's price over the past 12 years, experts widely project the forthcoming peak of BTC to hover around $10w. This projection suggests that Bitcoin's total circulating market capitalization is anticipated to reach $1,940 billion at its next zenith. Additionally, factoring in the DeFi segment's market share, this particular segment's potential scope in a bullish market scenario could surpass $43.973 billion.

In DePIN, numerous Tier-1 projects consist of crypto-native infrastructures that have undergone years of evolution. These projects have been reimagined and enhanced under a new narrative, positioning them within a prospective trillion-dollar market.

Messari estimated in a report that the potential market size of the DePIN sector is about 2.2 trillion US dollars, and it may reach 3.5 trillion by 2028.

据 coinmarketcap，截止 6 月底，Crypto 市场总市值在 2.26 万亿美元规模（前高 3 万亿）。通过参考比特币 Stock-to-flow 存量-流量模型、以及过去 12 年比特币价格年平均涨幅等方式，市场普遍预估的 BTC 下一高点约在 10w 美元的位置。基于这项预估，BTC 总流通市值有望在下一个高峰达到 19400 亿，参考 DePIN 板块的市场占比，该板块牛市中可能的规模将大于 439.73 亿美元。

DePIN 概念中的多个头部项目，是历经数年发展的 Crypto 原生基础设施，后在新叙事下获得推进和重塑，这一赛道被视为万亿规模的市场。参考 Messari 的报告，DePIN 板块总可寻址市场（Total Addressable Market）规模约为 2.2 万亿美元，并预测有望在 2028 年达到 3.5 万亿美元规模。

Swanchain

Projects	Swanchain
Token symbol	Swan
Positioning Orientation	The DePIN Built for AI
Fundraising	In 2023,Swanchain raised $3m in funding. The round was led by Binance Labs and SNZ holdings

项目名称	Swanchain
代币符号	Swan
项目定位	分布式 AI+DePIN 基础设施 2023 年获
募资情况	Binance labs 领投的 300 万美元融资

Project Overview

SwanChain (formerly FilSwan), initiated in 2021, is a decentralized infrastructure designed to accelerate AI adoption. Utilizing OP Stack's Ethereum Layer 2 technology,offering comprehensive solutions across storage, computing, bandwidth, and payments.

Swan Chain constructs a marketplace catering to decentralized storage, AI vendors, and ZK vendors. In addition to this, it offers services such as Multichain IPFS storage (Multichain.Storage) and an AI model sharing platform (Lagrangedao.org). These services aim to reduce barriers for accessing decentralized AI network resources, thereby enhancing ecosystem interoperability and streamlining accessibility and affordability. The initiative focuses on improving ecosystem interoperability for increased user ease and cost-effectiveness.

项目概述

Swan Chain 是一个加速 AI 应用的 DePIN 以太坊 2 层网络，利用 OP Stack 的以太坊 Layer 2 扩展方案，提供跨链存储、计算资源、带宽资源和支付方式等全面的解决方案。

Swan Chain 建设了去中心化存储，AI 供应商和 ZK 供应商的三大资源交易市场，并在此基础上提供了诸如多链 IPFS 存储（Multichain.Storage），AI 模型共享平台 (Lagrangedao.org) 来降低用户使用去中心化 AI 网络资源的门槛，进一步增强了生态的互操作性，使其变得更为简便和经济。

Solutions

SwanChain leverages OP Stack's Ethereum Layer 2 to provide a decentralized and scalable infrastructure for storage, computing, bandwidth, and payments.

By leveraging the underutilized computing power within community data center networks, SwanChain optimizes resource utilization, leading to significant cost reductions.
The solution effectively tackles the elevated computing expenses linked to conventional cloud computing, thereby rendering AI and Web3 projects more cost-effective and reachable. Additionally, it diminishes dependence on centralized providers while augmenting application flexibility and security.

Universal Basic Income (UBI) model

SwanChain's innovative approach introduces a Universal Basic Income (UBI) model for computing providers, ensuring stable income and incentivizing continuous contributions.
Through the provision of consistent rewards, this solution guarantees the accessibility and dependability of computing resources, effectively tackling the difficulties associated with upholding a secure and resilient decentralized network.Furthermore, it motivates providers to sustain active engagement within the ecosystem.

DePIN + AI

The DePIN includes a diverse array of Crypto-native cloud storage, cloud computing, and hardware sectors, effectively merging with storage/computing, wireless networking, modularity, and PoW themes.

When integrated with artificial intelligence, DePIN emerges as a noteworthy avenue for widespread adoption in the web3 sector, following DeFI.

In the realm of decentralized finance (DeFi) integrated with AI, Messeri's top 10 flagship projects within the DeFi sector demonstrate that over 80% incorporate AI concepts.

DePIN 板块广泛收录了 Crypto 原生的云存储、云计算及硬件领域，并且不断与存储/计算、无线网络、模块化及 PoW 叙事的进行融合。

与 AI 结合后，DePIN 成为继金融市场之后的、又一类可大规模采用的场景。在 DePIN + AI 方向，参考 Messeri 关于 DePIN 板块的前十大头部项目，80% 以上均涉及 AI 概念。

	Asset	Price (Live)	Real Vol 24H Sum	Mcap Today	Sector
1	Fetch.ai FET	$1.20	$69.90M	$3.02B	Machine Learning
2	Render RNDR	$6.40	$86.66M	$2.50B	Streaming and Rendering
3	Filecoin FIL	$4.01	$69.89M	$2.28B	File Storage
4	Bittensor TAO	$252.70	$35.76M	$1.79B	Machine Learning
5	The Graph GRT	$0.187	$23.15M	$1.78B	Indexing
6	Arweave AR	$23.31	$26.34M	$1.52B	File Storage
7	Theta Network THETA	$1.38	$16.09M	$1.38B	Streaming and Rendering
8	Akash Network AKT	$3.50	$13.09M	$846M	General Compute
9	Helium HNT	$3.13	$5.50M	$523M	Wireless and Sensor Networks
10	IOTA MIOTA	$0.157	$3.57M	$522M	Smart Contract Platform

(Source：https://messari.io/screener/screen/depin-jyf2?view=61f5f72f-c1dd-4ec9-b0fa-2895f8b58bbf)

Distributed AI computational networks, such as Render Network and Akash Network, have demonstrated strong performance.
Bittensor has secured a competitive edge as a pioneer in the Web3 AI large model category.
Fetch.AI and SingularityNET have emerged as prominent entities in the AI agent sector.
Theta Network possesses a GPU cluster and is integrating AI narratives through strategic partnerships.
The Graph has expanded its application of AI by implementing automated decision-making tools.
DePIN + AI, as a hot topic, is gaining attention in the Sector Rotation. Before there is sufficient liquidity to sustain a full-fledged bull market.

During a bull market, when there's enough market consensus, there's more potential to drive a positive cycle with the flywheel's assistance.

DePIN + AI,as a hot topic, is gaining attention in the Sector Rotation, before there is sufficient liquidity to sustain a full-fledged bull market.
In a bull market, with enough market consensus, there's more potential to drive a positive cycle with the flywheel Effect.

Render Network、Akash Network 等分布式 AI 算力网络表现亮眼；Bittensor 在 Web3 AI 大模型赛道取得先发优势；Fetch.AI、SingularityNET 成为了人工智能代理赛道的头部标的；Theta Network 拥有 GPU 集群，并通过相关合作增加 AI 叙事；The Graph 通过“部署自动决策工具”，增加了 AI 用例。

DePIN + AI 作为热点板块，在尚未有足够的流动性支持全面牛市之前，已经在局部板块轮动中进行表受到市场关注；在牛市期间，有足够的市场共识，更具潜力借助飞轮效应推动良性循环。

After analyzing the list, the following significant elements of DePIN + AI stand out:

Realigning AI Computing Resource Allocation Framework:

Emerging distributed arithmetic networks like Render and Io.net are creating tangible data and application contexts for AI.
They are also revolutionizing the conventional resource allocation system through the integration of accessible AI data resources.

AI and DePIN Hardware

The increasing level of automation correlates with a deeper integration into the Internet of Things. This amplifies the impact of data-informed decision-making on profit, services, operational efficiency, and more, resulting in a surging need for autonomous networking of AI hardware.

Moreover, various DePIN initiatives, especially those with significant resources such as CPU/GPU miners, are gaining momentum. Established enterprises and conventional capital might soon join the fray. The narrative surrounding AI and DePIN could potentially gain recognition in the mainstream market, drawing increased funding, resources, and interest.

AI + DePIN + PoW

The convergence of AI and DePIN has catalyzed the emergence of a novel category of POW-based peojects, frequently linked with notions of artificial intelligence, numerical services, and the Internet of Things.

In the realm of economic modeling, these initiatives underscore the significance of Proof of Useful Work (PoUW), incentivizing miners for their investment in computational resources and energy consumption.The rise of benchmarking projects is expected to catalyze the growth of more projects into the market.

Establishing Consensus Between Eastern and Western Regions.

In various regions, the development of DePIN,AI, and IoT is progressing along distinct trajectories. The Eastern regions hold a significant edge in the manufacturing industry chain and product capabilities, whereas the Western regions excel in capital resources and technological environment.

As the East and West advance the DePIN + AI concept, fostering collaboration and integration, a shared understanding of the optimal trajectory is anticipated to solidify.

Path to AI Startup Development

Small and medium-sized AI teams aiming to compete with established AI model vendors must have access to top-tier data and computing resources to establish a strong presence. The introduction of DePIN could present a viable solution for such endeavors.

In terms of funding, AI startups commonly obtain financial support through equity within the AI industry. With the introduction of DePIN and economic modeling, AI startups have the opportunity to explore an alternative avenue for funding, potentially leading to accelerated development cycles.

经过梳理，DePIN + AI 以下关键因素值得关注：

重置 AI 算力资源分配结构

Render、Io.net 等分布式算力网络为 AI 带来了真实数据和应用场景，同时对传统资源分配体系进行重塑，引入开放式 AI 数据资源。

AI + DePIN 硬件

自动化程度越高，与物联网的连接性越强。数据驱动的决策对收入、服务、运行时间等影响也越大，这增加了 AI 硬件自主联网的必要性。

同时，众多带有重资产的 DePIN 项目背后，尤其是 CPU/GPU 矿机。能够看到传统企业和传统资本的进入。AI+DePIN 的叙事能够获得传统市场的认可，带来更多的资金、资源和热度。

AI + DePIN + PoW

AI + DePIN 方向催生出了新一批基于 POW 的项目，这类项目通常与人工智能、算力服务、物联网等概念相关联。在经济模型上，强调“有用的工作证明”（PoUW），对于投入计算能力和电力消耗的矿工进行奖励。标杆式项目的出现将催生更多项目进入市场。

东方与西方的共识融合

由于 DePIN 、 AI 、及物联网在不同地区的发展路径有所区别，相对而言， 东方的制造产业链和产品能力更具优势，西方在资本及技术环境上占优。当双方都在 DePIN + AI 上概念有所推动，合作与融合继续增多，将产生对该赛道的更大的共识。

AI Startups 发展路径

从资源上看，面对大型 AI 模型厂商，中小型 AI 团队需要有竞争力的数据及计算资源，并寻求差异化竞争，引入 DePIN 是一个具有潜力的解决方案。

从投资角度来看，AI 原生领域中，初创企业通常通过股权进行融资。引入了 DePIN 及经济模型之后，给出了 AI Startups 可选择的、发展周期更快的另一种选择。

Several innovative Depin + AI solutions are emerging. Review the following exemplary new use cases:

众多涉及 AI 技术的 Depin + 解决方案正在涌现，参考以下代表性的新用例：

AR + AO full-stack DePIN
AR + AO 全栈 DePIN

Projects	AO Computer
Token symbol	AO
Positioning Orientation	A decentralized, Actor-Oriented computing system
Token Allocation	Fair launch

项目名称	AO
代币符号	AO
项目定位	基于「Actor」模型的全球计算机
Token 分配	Fair launch

Project Overview

The ao computer is the actor oriented machine that emerges from the network of nodes that adhere to its core data protocol, running on the Arweave network.

In the realm of AR as a decentralized storage solution, AO serves as an infinitely progress, decentralized CPU & GPU hybrid.

The computing capabilities of AO are layered upon the enduring storage capacity of AR, operating as a worldwide, immensely concurrent processing unit which allows any Dapp to leverage Arweave and access a cost-effective, vastly efficient, decentralized computational service.

项目概述

AO 计算机是基于「Actor」的机器，组成该计算机的网络节点遵循核心数据协议，并将各个进程的全息状态储存至 Arweave 主网上。在 AR 作为去中心化存储硬盘的背景下， AO 可视为一个无限线程、去中心化的 CPU/GPU。AO 的计算能力与 AR 的永久存储能力是叠加互补关系（而非取代），实际上让其成为一个全球性高并发计算机，让任意 Dapp 接 Arweave 并获得低价、高效、去中心化的计算服务。

Solutions

Key parts of AO

Decentralized: Ao as a single-systerm image(SSI,), it is a distributed computing method. And it's hosted on a heterogenous set of nodes in a distributed network.

Concurrent Computation: Actor Model is addressed to system design and programming in the highly concurrent environment, Enhanced by pertinent blockchain technology.

AO components: Messenger Units are nodes that relay messages, Scheduler Units are responsible for the messages assignment, Compute Units are nodes calculate the state of processes.

Actor Model

Actor model is a mathematical model of concurrent computation that treats "actors" as the fundamental units of computation.

Each Actor has the ability to function as an autonomous entity in order to: (1) Create new actors (2) Send messages to other actors, and (3) Decide on the behaviour to be used for the next message it receives.

Key features of the Actor model:

1.Thread-based Concurrency：Actors can be thought of as isolated units of computation, with no shared state, communicating only through message passing.

2.Decentralized：No central point of control to manage interactions between actors, making the system easy to scale.

3.Fault-tolerance：Robust fault tolerance.The failure of each Actor does not directly affect other Actors, and mechanisms can be designed to monitor/recover failed actors.

4.Asynchronous communication：Asynchronous message passing between actors，so actors will be asynchronous and non-blocking, the sender actor doesn't wait for the message from the receiver.This will enhance operational efficiency.

Key functions of AO

1.Arbitrary numbers of processes ('contracts') running in parallel: In AO, applications are built of any number of communicating processes. AO does not allow processes to share memory between one another, but does allow them to coordinate via a native message-passing standard. Each of these processes can then be operated at the full speed of the computing resources that are available, without interfering with one another.

2.Unbounded resource utilization in processes；AO computer reaches consensus through a “holographic state,”nodes in the ao network do not need to perform any compute at all in order to reach consensus about program state transitions.

Here,State is implied 'holographically' by the Arweave-hosted log of messages to the process. AR handles immutable storage to ensure the security and the verifiability. AO can compute the ordered data on AR and generate states, but cannot alter the order of data on AR. This means AO cannot change the consensus.

3.Access Arweave, a native unbounded harddrive: ao processes can seamlessly load and execute data of any size directly into their memory and write back to the network.

This configuration negates common resource limitations and facilitates Parallel Cypher Execution.

4.Autonomously activating contracts

AO allows contracts to have scheduled 'cron' interactions that automatically wake them up and execute compute at set intervals. This removes the limitation of traditional smart contract environments (like Ethereum) contracts 'wake up' to perform compute at the request of a user transaction.

5.Modular architecture supporting extensions

Ao's core architecture is an open data protocol that anyone can build an implementation of. This flexibility will allow the existing smart contracting systems in the Arweave ecosystem to plug into ao and be able to send and receive messages from the unified network.This making for a more coherent experience of compute on Arweave.

AR + AO full-stack DePIN

The current DePIN infrastructure primarily consists of Solana, Ethereum, Cosmos, and other leading public chains.AO adopts "Decentralized Supercomputer" as its development vision，can offer a dependable and effective decentralized physical infrastructure for this vision. Arweave functions as a distributed persistent data storage layer, utilizing SPoRes, a proof-of-work mechanism, to optimize CPU and hard disk storage capabilities for establishing consensus storage of holographic state data on AO. In contrast, AO, with its high-performance computing framework, can encompass the complete physical arithmetic capabilities of GPUs and CPUs to deliver dispersed arithmetic resources for decentralized applications and LLMs like Llmar 3.

Under the AR + AO full-stack DePIN, it presents advantages in facilitating put AI models on-chain , verifiable computing of AI models, and interact with smart contracts.

AO has a memory limit of 16GB and a protocol-level cap of 18EB, and there are still plans to upgrade.AO offers a novel design realm for Compute-Intensive Applications within a high-performance computing environment.parallel computing solutions is essential to address the interdependencies between tasks preceding and following AI implementation.

Some AI tasks need to be achievable by executing a set of interdependent, this requires a more parallelized solution.

解决方案

AO 关键词

分布式框架：单系统映像（SSI,single-systerm image），是分布式计算的一种模式，托管在分布式网络中的异构节点上。
并行计算：通过 Actor 模型来处理高并发环境，结合区块链相关技术。
通信调度组件：AO 由三个组件组成，Messenger Units 负责传递信息，Scheduler Units 负责进程调度， Compute Units 负责并行的计算进程。

Actor 模型

Actor 模型是一种并行计算的数学模型，通过引入“Actor”的基本计算单位来实现并发计算的复杂问题。每个 Actor 都可作为独立实体，进行：（1）创建更多的 Actors（2）发送消息（3）响应/处理接收的消息。

Actor 模型的关键特点：

（1）并发性：每个 Actor 可以独立处理消息，没有共享状态，仅通过消息传递进行通信。
（2）去中心化：无中心化控制管理 Actors 之间的交互，系统更易于扩展
（3）容错性：每个 Actor 的失败不会直接影响其他 Actors，可设计机制监控/恢复失败的 Actor，增强容错能力。
（4）异步通信: Actors 之间传递消息是异步的，不会在发动消息后阻塞或等待响应，可以继续处理其他消息，高效进行。

AO 核心功能

（1）并行计算任意数量的进程（合约）：AO 中，应用程序由任意数量的通信进行构建。AO 不在进程之间共享内存，但允许其通过原生消息传递标准进行协调。每一个进程均可用计算资源全速运行，无互相干扰。

（2）进程中的无限资源利用：AO 计算机通过在 AR 中对消息日志的全息态存储来达成共识。AO 不需要对通过计算对状态达成共识，只需要对交互日志在 Arweave 中的顺序和存储达成一致即可。

这里，Arweave 被当作一个持续且不可变的日志记录册来存储所有消息日志，以确保安全性和可验证性。AO 计算 AR 上的有序数据并生成状态，但不能改变 AR 上数据的顺序，即 AO 不能改变全息态数据的共识。

（3）访问原生无限硬盘 Arweave：可无缝将任何大小的数据直接加载到内存中、执行并写回网络。这种设置消除了典型的资源限制，并实现了完全并行执行。

（4）自动激活合约：AO 通过允许合约进行预定的“cron”交互，按设定的时间间隔进行计算，消除了传统主流的智能合约环境中（如以太坊）合约根据用户交易请求“唤醒”来执行计算的限制。

（5）支持扩展的模块化结构：AO 核心架构为开放数据协议，允许任何人构建。种灵活性可将 AR 生态系统中现有的智能合约系统接入 AO 网络，发送及接收消息，并允许这些智能合约系统共享相同的基础设施和工具，提供更连贯的计算体验。

AR + AO 全栈 DePIN

当前 DePIN 公链基础设施主要包括 Solana、Etherem、Cosmos 等头部公链。AO 以“去中心化的超级计算机”为发展远景，可以为该愿景提供可靠且高效的去中心化物理基础设施，其中 Arweave 作为分布式永久数据存储层，使用 SPoRes 这种工作量证明机制，充分发挥 CPU 与 硬盘存储的性能潜能，为 AO 上的全息态数据提供共识存储服务。而 AO 则以其高性能计算模式，可以包括所有 GPU、CPU 的物理算力供应，为去中心应用，甚至如 LImar 3 这样的大语言模型提供分布式算力资源。在 AR + AO 全栈 DePIN 叙事下，其在支持 AI 模型上链、以及 AI 模型可验证性的计算、集成智能合约上更具优势。

AO 拥有提供 16GB 的内存限制，以及 18EB 的协议级上限，并仍有计划进行扩展。AO 通过高性能的计算环境，为计算密集型应用提供了更新的设计空间。由于 AI 前后任务之间的往往存在依赖性，这种依赖关系更需要并行化解决方案来实现。

预期 AO 生态将作为技术底座，将 AI 技术与原生资源进行组合。预计生态内将出现更多基于可验证计算、大规模并行计算等特有技术的 AI 设施和应用。

Swanchain

Projects	Swanchain
Token symbol	Swan
Positioning Orientation	Layer 2 cloud computing network
Fundraising	In 2023,Swanchain raised $3m in funding. The round was led by Binance Labs and SNZ holdings

项目名称	Swanchain
代币符号	Swan
项目定位	分布式 AI+DePIN 基础设施
募资情况	2023 年获 Binance labs 领投的 300 万美元融资

Project Overview

SwanChain (formerly FilSwan), initiated in 2021, is a decentralized infrastructure designed to accelerate AI adoption. Utilizing OP Stack's Ethereum Layer 2 technology,offering comprehensive solutions across storage, computing, bandwidth, and payments.

Swan Chain constructs a marketplace catering to decentralized storage, AI vendors, and ZK vendors. In addition to this, it offers services such as Multichain IPFS storage (Multichain.Storage) and an AI model sharing platform (Lagrangedao.org). These services aim to reduce barriers for accessing decentralized AI network resources, thereby enhancing ecosystem interoperability and streamlining accessibility and affordability. The initiative focuses on improving ecosystem interoperability for increased user ease and cost-effectiveness.

项目概述

Swan Chain 是一个加速 AI 应用的 DePIN 以太坊 2 层网络，利用 OP Stack 的以太坊 Layer 2 扩展方案，提供跨链存储、计算资源、带宽资源和支付方式等全面的解决方案。

Swan Chain 建设了去中心化存储，AI 供应商和 ZK 供应商的三大资源交易市场，并在此基础上提供了诸如多链 IPFS 存储（Multichain.Storage），AI 模型共享平台 (Lagrangedao.org) 来降低用户使用去中心化 AI 网络资源的门槛，进一步增强了生态的互操作性，使其变得更为简便和经济。

Solutions

SwanChain leverages OP Stack's Ethereum Layer 2 to provide a decentralized and scalable infrastructure for storage, computing, bandwidth, and payments.

By leveraging the underutilized computing power within community data center networks, SwanChain optimizes resource utilization, leading to significant cost reductions.

The solution effectively tackles the elevated computing expenses linked to conventional cloud computing, thereby rendering AI and Web3 projects more cost-effective and reachable. Additionally, it diminishes dependence on centralized providers while augmenting application flexibility and security.

Universal Basic Income (UBI) model

SwanChain's innovative approach introduces a Universal Basic Income (UBI) model for computing providers, ensuring stable income and incentivizing continuous contributions.

Through the provision of consistent rewards, this solution guarantees the accessibility and dependability of computing resources, effectively tackling the difficulties associated with upholding a secure and resilient decentralized network.Furthermore, it motivates providers to sustain active engagement within the ecosystem.

Premium market for decentralized services

SwanChain has launched specialized marketplaces for decentralized storage, AI computation, and zero-knowledge (ZK) proofing. These dedicated marketplaces facilitate the seamless deployment of AI models via LagrangeDAO, significantly streamlining the processes and expenses associated with deploying and overseeing AI models.

In these markets, solutions are provided for the challenges related to elevated deployment expenses and intricacy, offering developers a simplified process for deploying and overseeing AI models. Moreover, these markets open avenues for the monetization of underutilized computing resources, thereby enhancing the global utilization of computing power.

Collateralization and reduction

In order to engage within the network, computing providers are required to furnish collateral, which could be decreased in the event of fraudulent actions. This protocol guarantees dedication and credibility, diminishing the likelihood of deceitful conduct.

This particular solution augments network security and confidence, effectively tackling issues related to privacy and security. It verifies the involvement of solely trustworthy and dependable providers, thereby lessening the probability of fraudulent activities and elevating the overall integrity of the network.

Comprehensive AI Model Deployment Solutions

SwanChain provides sophisticated tools and infrastructure, such as LagrangeDAO, designed to streamline the deployment and supervision of AI models. These resources cater to various deployment requirements, ranging from modest applications to extensive AI endeavors.

Through the simplification of the deployment procedures, this offering tackles intricacy hurdles, fostering increased developer involvement in AI advancement. It expedites the integration and evolution of AI, rendering it readily available to a broader audience of users.

Innovative Pledging and Governance Mechanisms

Participants have the opportunity to engage in governance and decision-making by pledging Swan tokens. This approach fosters decentralized oversight of the network and guarantees alignment with community consensus.

The initiative fosters an all-encompassing and collaborative environment that caters to robust community involvement and governance. It guarantees alignment with user requirements and choices, enhancing the network's longevity.

解决方案

SwanChain 利用 OP Stack 的以太坊第 2 层技术为存储、计算、带宽和支付提供去中心化且可扩展的基础设施。通过利用社区数据中心网络中未充分利用的计算能力，SwanChain 优化了资源使用率并显著降低了成本。

该解决方案直接解决了与传统云计算相关的高计算成本问题，使人工智能和 Web3 项目更实惠、更易于访问。它还减少了对中心化提供商的依赖，增强了应用程序的弹性和安全性。

全民基本收入 (UBI) 模型

SwanChain 的 UBI 模型将代币作为奖励分发给计算提供商（边缘计算提供商和雾计算提供商），以奖励他们的网络贡献。这确保了稳定的收入并鼓励持续参与。

通过提供一致的奖励，该解决方案确保了计算资源的可用性和可靠性，解决了维护稳定和强大的去中心化网络的挑战。它还激励提供商继续积极参与生态系统。

去中心化服务的高级市场

SwanChain 引入了专门用于去中心化存储、AI 计算和零知识 (ZK) 证明的市场。这些市场通过 LagrangeDAO 实现无缝 AI 模型部署，大大降低了部署和管理 AI 模型的复杂性和成本。

这些市场解决了高部署成本和复杂性的痛点，使开发人员更容易部署和管理 AI 模型。它们还创造了将闲置计算资源货币化的机会，促进了全球计算能力的更高效利用。

抵押和削减机制

要参与网络，计算提供商必须提供抵押品，如果发生欺诈活动，抵押品可能会被削减。该机制确保承诺和诚信，降低不诚实行为的风险。
该解决方案增强了网络安全和信任，解决了隐私和安全问题。它确保只有忠诚可靠的提供商参与，降低了欺诈风险并增强了整体网络完整性。

用户友好的 AI 模型部署工具

SwanChain 提供全面的工具和基础设施，包括 LagrangeDAO，以简化 AI 模型的部署和管理。这些工具支持各种部署需求，从小型应用程序到大型 AI 项目。
通过简化部署流程，此解决方案解决了复杂性障碍，使更多开发人员能够参与 AI 开发。它加速了 AI 的采用和创新，使其更容易被更广泛的用户所接受。

先进的质押和治理机制

用户可以质押 Swan 代币来参与治理和决策过程。这使网络控制民主化，并确保平台根据社区共识发展。
该解决方案促进了更具包容性和参与度的生态系统，满足了强大的社区参与和治理需求。它确保网络根据用户需求和偏好发展，增强长期可持续性。

io.net

Projects	io.net
Token symbol	IO
Positioning Orientation	decentralized computing network
Fundraising	IO raises $30 mln in Series A funding round$，with 1 billion token valuation

项目名称	io.net
代币符号	IO
项目定位	去中心化计算网络
募资情况	A 轮获得由 Hack VC 领投的 3000 万美元融资，估值 10 亿美元

Project Overview

io.net is a decentralized computing network that enables the development, execution, and scaling of ML applications on the Solana Blockchain.Its mission is to establish the world's largest GPU cluster.

IO NET is constructed on the Solana blockchain, offering an effective and scalable solution for AI and cloud computing requirements.

项目概述

io.net 是一个去中心化计算网络，是一个面向全球 GPU 算力的撮合交易平台。支持在 Solana 区块链上开发、执行和扩展机器学习应用程序。其愿景是“形成世界上最大的 GPU 集群”。

IO NET 建立在 Solana 区块链上，为 AI 和云计算需求提供高效且可扩展的解决方案。

Solutions

Distributed Cloud Computing Platform (Decentralized GPU Cluster)

Io.net endeavors to mitigate the escalating expenses associated with leasing GPUs/CPUs, a paramount privacy issue in the expansion of AI and ML capabilities. By decentralizing, Io aims to confront the mounting computational requirements for small and medium-sized model training in conjunction with the escalating costs of centralized computation.

Io leverages idle computing resources from IDC data centers, cryptocurrency mining farms, and individual users. By establishing standardized contractual norms and hardware specifications, Io can integrate cost-efficient computing power, stimulate collaboration, and optimize application performance.

Amidst a market landscape trending towards oligopolistic structures in centralized AI services, distributed computing platforms such as Io present a viable alternative. They offer accessible and adaptable service options to cater to medium to long-tail computational needs.

Illustrative Example of AI and DePIN

The project Io, serving as an exemplary endeavor in the realm of AI within the Web3 sphere, presents a pioneering model that intertwines the Crypto governance framework with the requisites of AI training. This platform adeptly caters to fundamental AI developmental necessities like batch inference, parallel training, and reinforcement learning, while facilitating the creation of specialized and diverse application scenarios by developers.

Within the framework of Tokenomics, Io enlists various stakeholders including providers of computing power, developers, users, and communities, fostering engagement with a broader spectrum of valuable participants and fostering collaborative efforts.

By responding to genuine AI needs, Io attracts a growing array of end-users, project collaborators, and liquidity to the Web3 indigenous sector.

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io.net Products

The feature portfolio includes: IO Cloud, IO Worker, and IO Explorer:

IO Cloud: the core business module of Clusters, it's a GPU Clusters with the ability to autonomously coordinate computational tasks. These Clusters offer tailored solutions for AI users and provide a user-friendly interface for effectively managing computing resources to meet clients' specific demand criteria.

IO Worker：IO Worker provides an interface designed for the efficient management of arithmetic devices catering to supply-side users. It enables comprehensive control over both supply and demand through a web-based application.

IO Explorer：IO Explorer is dedicated to offering users in-depth statistics and visual representations of the GPU cloud. It empowers users to effectively oversee, analyze, and comprehend the specifics of the io.net network by granting full transparency into network activities, essential metrics, data insights, and transaction rewards.

IO Cloud cluster's business model involves a direct comparison to industry leaders such as AWS and GCP. The cluster's GPU resources incorporate supply side like Filecoin and Render Network, enhancing its functionality with Web3-native attributes and robust scalability.

With its aforementioned features, io.net significantly lowers the entry barrier, facilitating power providers in sharing inactive computing resources. Meanwhile, demanders can swiftly establish the necessary GPU clusters without the necessity of formal contracts, enabling them to access cost-effective, efficient, and tailored computing services.

Roles in the ecosystem

In the broader ecological context, IO, functioning as a distributed cloud computing marketplace focused on bilateral supply and demand, encompasses a range of participants including miners, nodes, hardware, software components, and partners such as DePIN infrastructure, Crypto native storage facilities, middleware, and edge computing. The accomplishments of IO could potentially stimulate interest from additional partners, fostering collective engagement in the broader market expansion.

解决方案

分布式云算力平台（去中心化 GPU 集群）

随着计算资源的价值日益增加，Io.net 旨在降低租赁 GPU/CPU 的成本，是 AI 和 ML 的规模化的关键隐私。Io 旨在以去中心化的方式解决这样的矛盾：中小型模型训练产生的巨量算力需求，与中心化算力愈发增加的成本之间的矛盾。

Io 能够调动 IDC 数据中心、加密货币矿场乃至普通用户的闲置算力，通过合约标准以及硬件设备标准化，整合更低成本的算力，进行协作，进而产生应用效能。

在中心化 AI 服务逐步趋向寡头垄断的背景下。Io 等分布式算力平台给出了另一种解决方案，为中、长尾的算力需求端提供低门槛、更灵活的服务选择。

AI + DePIN 的代表性案例

Io 作为 AI 切入 Web3 领域的代表性项目，是 Crypto 治理框架和 AI 训练需求场景结合的首个、典型的刚需场景。平台支持批量推理、并行训练和强化学习等关键的 AI 开发需求，并协助开发者在更垂直、细分的应用场景进行构筑。

在 Tokenomics 的设计中，Io 将算力提供者、开发者、用户、社区等利益相关多方绑定，覆盖到更广泛的、有价值的用户进行激励，推动协作。

当平台能够汇集更多真实的 AI 需求时，则为 Web3 原生领域带来了更多增量用户、项目方、流动资金。

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io.net 产品结构

功能产品组合包括 IO Cloud、IO Worker、IO Explorer 等部分：

IO Cloud：基本业务模块为集群（Clusters），是一个可以自我协调完成计算任务的 GPU 集群，为 AI 用户提供自定义的集群解决方案，是针对需求端用户的算力设备管理界面。

IO Worker：针对供给端用户的算力设备管理界面。允许供需双方在 Web 应用程序上进行管理。

IO Explorer：主要为用户提供全面统计数据和 GPU 云的可视化图。它通过提供对网络活动、重要统计数据、数据点和奖励交易的完整可见性，使用户能够轻松监控、分析和了解 io.net 网络的各数据细节；

其中，IO Cloud 集群的基本业务基本直接对标 AWS、GCP 等云服务。其 GPU 资源端同时集成了 Filecoin 、 Render Network 等供应端，具备了更多的 Web3 原生特点，以及极强的可扩展性。

通过以上功能，io.net 极大地降低了准入门槛，让算力提供者更加便捷共享闲置的计算资源；而需求方可在短时间内、无需签订传统合同的情况下，组建所需 GPU 集群，获取更廉价、高效、定制化的算力服务。

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io.net 生态位

在更大的生态范畴中，io 作为面向供需双边的分布式云算力市场，除了矿工、节点、软硬件等组件，其合作伙伴包括且不限于 DePIN 基础设施、 Crypto 原生存储设施、中间件、边缘计算等等，io 的成功将有可能带动其他合作方的热度，共同催生更广泛的市场增量的参与。

The DePIN network has undergone evolution and iteration, resulting in a maturation of its underlying infrastructure. The flywheel dynamic characteristic in a DePIN project:

> Establishing the supply side of the service → The distribution of DePIN token sincentivion → The number of suppliers begins to increase → Competitive dynamics evolve, leading to additional advantages emerging → Organic demand for DePIN initiates, contributing to the growth of the token price → Supplier revenues experience an upsurge → The attraction of more suppliers reinitiates the flywheel effect.

In the early cold-start phase, users enter the picture as resource providers and also take on some of the investment risk. This gives DePIN the advantage of rapid scale-up and deployment, and builds a self-scaling, self-reinforcing ecosystem through incentives.

DePIN + AI represents an emerging decentralized network model. Its value assessment encompasses various dimensions, including market orientation, cost structure, early user adoption, network expansion level, quantity and caliber of nodes, developer landscape, token economic model, actual utility value, development timeline, and more.

When evaluating market capitalization, lower-quality networks are constrained by the FDV limit.It is crucial to prioritize monitoring the market capitalization of outstanding market value as a benchmark for investment transactions. dePIN projects ought to emphasize the comprehensive value of equipment and the market capitalization of outstanding market value, rather than solely focusing on FDV.

DePIN 网络经过发展与迭代，底层基础设施日趋成熟，在一个 DePIN 经济的典型飞轮中：

> 建立服务的供应端 → DePIN 分发代币激励 → 供应商数量开始增长 → 形成竞争动态，出现更多优势 → DePIN 的有机需求开始形成，代币价格增长 → 供应商收入增加→ 吸引了更多供应商并重新启动飞轮。

早期的冷启动阶段，用户以资源提供者的角色进入其中，也同时承担了一部分投资风险。这使得 DePIN 具备快速规模化部署的优势，并通过激励手段建设了生态自我扩展、自我增强的模式。

DePIN + AI 作为一种新兴的去中心化网络模式。其价值评估涵盖了更多维度：面向市场、成本构成、早期用户情况、网络扩展程度、节点数量及质量、开发者情况、代币经济模型、实际使用价值、发展周期等。

从市值上看，质量较低的网络会受到 FDV 上限制约，更需要注意流通市值对于投资交易的参考。DePIN 项目应该更加注重设备的总价值、流通市值，而非单纯看 FDV。

Close observation are as follows:

New high-performance public blockchain:

Leveraging GPU acceleration to increase the processing speed of large-scale language models, with stringent demands on memory, computation, and execution. Within the realm of AI+DePIN, advanced public blockchains with elevated requirements in memory, computation, execution, and beyond, will drive the development of superior applications.

ToC(To Customer) platforms/products

Various DePIN programs employ distinct strategies for managing both the supply and demand sides, ensuring a harmonious balance of supply, demand, and incentives.

In contrast, DePIN introduces consumers possessing genuine demand, thereby fostering ecosystem stability within a volatile market landscape.Elevated projections regarding project expansion and market valuation.

In the current discourse, new concepts revolving around PoC, PoW, and other forms of PoUW(proofs of useful work） are gaining prominence. These initiatives, which engage with ToC executives more directly, have the potential to secure heightened user's support.

AI + DePIN + Privacy

An effective method to ensure data privacy in distributed AI training involves maintaining data locality through training at the data source. In this process, model parameters are transmitted. This strategy aligns well with the exploration of the AI, DePIN, and Privacy domain. Consequently, adopting a modular project development approach and utilizing zero-knowledge proof methodologies represent potential trends within this sphere.

AI + DePIN + Social

This combination of Web3's native social system and DePIN is a more appropriate use of the Decentralized Social Network (DeSoc) concept. When real Web3 users interact through hardware such as cell phones and sensors, overlaid with AI technology, and more incentives, a new social paradigm may emerge.

Enhanced Vertical Segmentation:

AI models positioned downstream are extensively integrated with AIGCs across diverse domains, complementing various verticals. The DePIN hardware is frequently linked with highly valuable real-world data within specialized sectors. This real-world data serves as a substantial resource for AI model.

A detailed examination of the technological integration of DePIN + AI reveals a concentration on the following sectors:

- Biomedical industry
- Precision medicine
- Supply Chain Finance
- Personalized education

值得密切关注的方向有：

高性能新公链

GPU 的加速可提升大型语言模型的执行速度，对内存、计算、执行等都有较高的要求。在 AI+DePIN 方向，对内存、计算、执行等都有较高要求的高性能公链，将进一步催生优质应用产生。

更面向 C 端的平台/产品

不同的 DePIN 项目在引导供给侧、需求侧上各有不同，在供给、需求与激励之间进行平衡。相对而言，DePIN 引入真实需求的 C 端部分，能够让生态在多变的市场环境中增加稳定性，拥有更高的想象空间。

基于 PoC、PoW、 以及“有用的工作量证明”相关变种的概念，都在新叙事中涌现，这些与 C 端交互更多的项目有潜力获得更多用户的支持。

AI+DePIN + 隐私

在 AI 的分布式训练中，保障数据隐私的方式之一是：通过在数据源头进行训练，将数据留在本地，而模型参数进行传输。这种方式非常适合 AI + DePIN + 隐私 方向的探索。因此，模块化的项目构建方式、以及零知识证明技术的应用，都是这个方向可能出现的趋势。

AI+DePIN + 社交

这种 Web3 原生的社交体系与DePIN 进行结合，更合适使用去中心化社交网络（ DeSoc）的概念。当 Web3 的真实用户通过手机、传感器等硬件进行交互，叠加 AI 技术，以及更多的激励方式，可能产生出新的社交范式。

更垂直的细分领域

位于下游的 AI 大模型以各领域 AIGC 更加深入应用端，与各个垂直领域进行结合。DePIN 硬件往往绑定了专业领域极具价值的真实数据，这些数据是 AI 提供了极佳的营养。

可重点关注 DePIN + AI 与以下垂直领域的技术落地：

生物医药
精准医疗
供应链金融
个性化教育

Risk management insights
The widespread adoption of the IoT fails to meet anticipated outcomes.
Traditional physical facilities are relatively mature and well-established, and users are not sufficiently motivated to change their old habits.
The expansion of native application scenarios failed to meet expectations.
In certain well-defined scenarios, there exist notable gaps in user experience and a demonstrated willingness to pay that remains untapped.

风险提示
物联网普及不达预期。
传统的物理设施相对成熟完善，用户对于改变原有习惯的动力不足够。
原生场景拓展不达预期。
用户体验相对有差距，以及在某些明确场景下的用户付费意愿还有待培养。

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