State of DePIN

2023

State of DePIN: About the Authors

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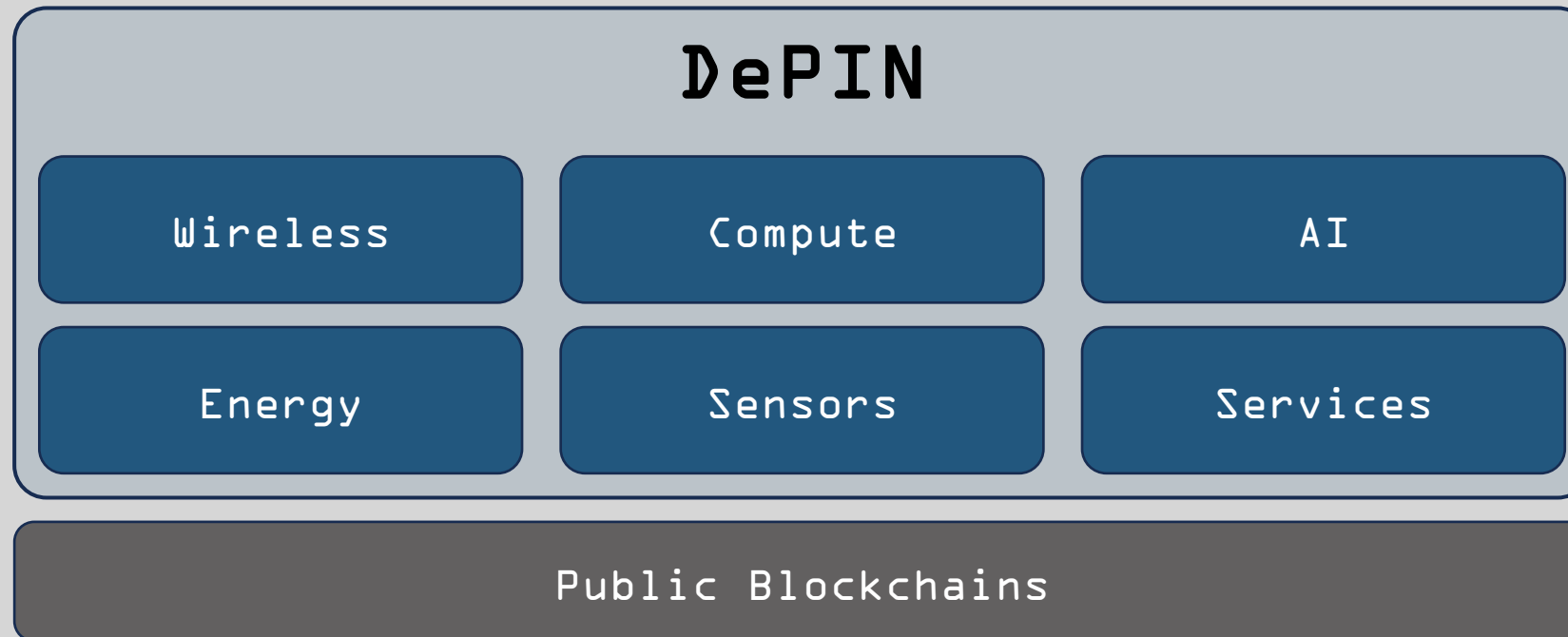
@EV3ventures

@Danconia_Crypto

DePIN = decentralized <u>physical infrastructure</u> networks.

Networks that use **crypto-incentives** to efficiently coordinate the **buildout & operation** of **critical infrastructure**.

DePIN

Wireless	Compute	AI
Energy	Sensors	Services

Public Blockchains

DePIN can be more <u>efficient</u>, <u>resilient</u> & <u>performant</u> than centralized infra.

DePIN is the **first-order correct** way to scale global infrastructure.

Centralized Infrastructure	DePIN

VS

Centralized Infrastructure

<u>CapEx</u>: massive up-front capital requirements ($ billions) creates significant barriers to entry.

<u>OpEx</u>: inefficient, bureaucratic processes in both marketing & operations depresses operating margins.

<u>Single points of failure</u>: security & reliability depend entirely on a handful of opaque infra providers.

<u>Stagnant</u>: zero innovation culture; new tech takes decades to rollout & integrate.

DePIN

<u>Crowdsourced CapEx</u>: users to contribute capital, assets, and labor towards a common objective, incentivized by transparent & fair token incentives.

<u>Onchain settlement</u>: blockchains reduce admin overhead by becoming the single-source-of-truth shared ledgers across all market participants.

<u>Decentralized resiliency</u>: decentralized networks reduce single-points-of-failure risks—or at least make them more transparent wherever they exist.

<u>Innovation</u>: the pace of experimentation in open, permissionless, global ecosystems is an order of magnitude higher than in centralized companies.
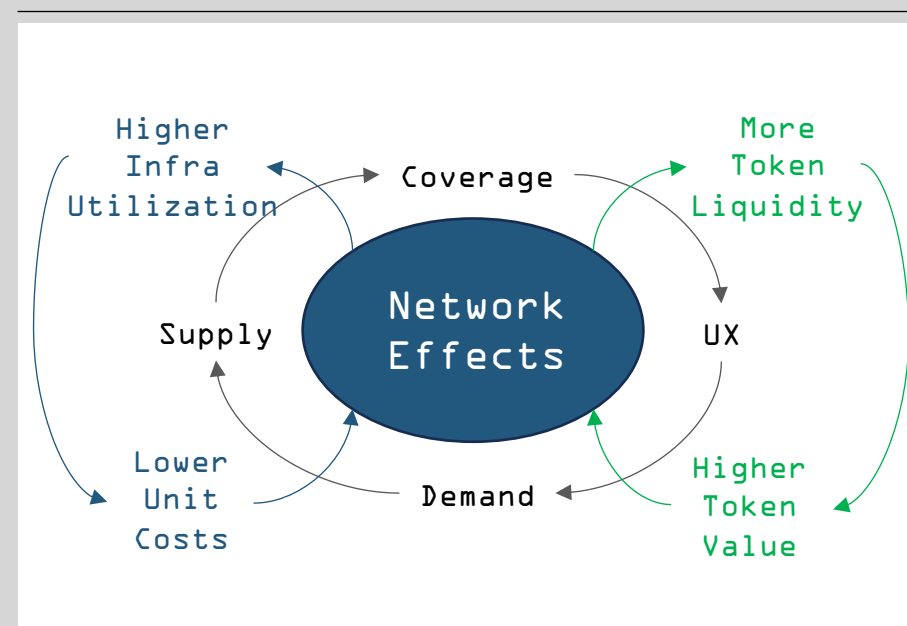
DePIN Flywheel = infrastructure networks that get <u>stronger</u> as they get <u>bigger</u>.

DePIN's flywheel is powerful enough to add **+$10T to global GDP** over the next decade and **+$100T in the decade after that.**

DePIN Timeline
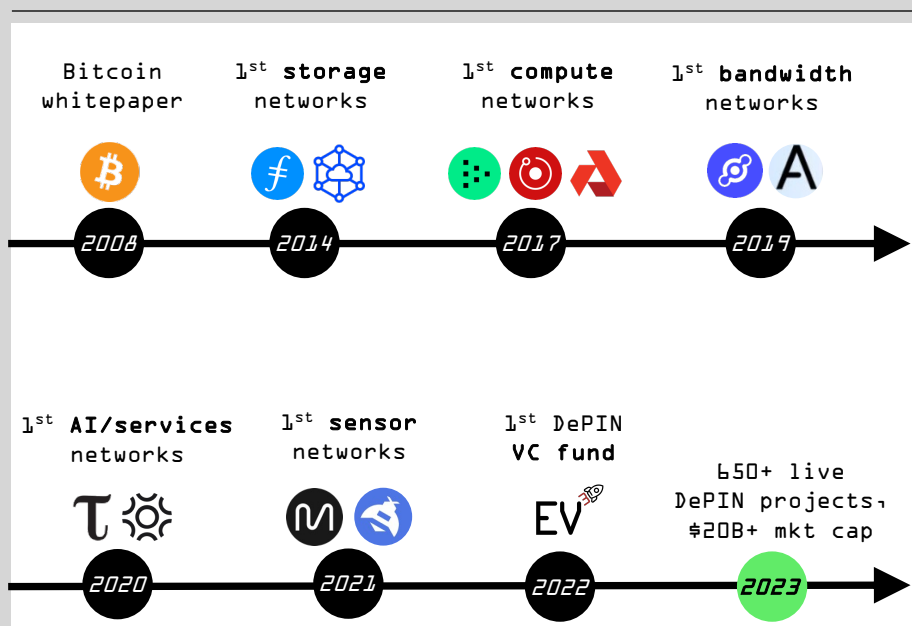
DePIN Flywheel
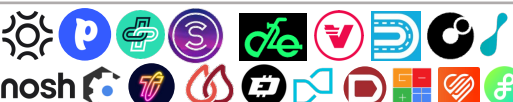
DePIN _empowers & incentivizes_ citizens to improve public infrastructure around them.

In a world of untrustworthy institutions & incompetent bureaucrats, **DePIN transfers wealth** & power back to citizens & communities.

Digital maps

Energy grid

AI

Telcos

Datacenters

Power plants

Carbon credits

Home internet

Food delivery

Knowledge work

Ride-sharing

Advertising

Mobility

Health & fitness

Pets & livestock

We classify <u>six categories</u> of DePIN, each disrupting a $1T+ industry.

RWAs (real-world assets) & blockchain infra networks (oracles & RPCs) are **DePIN-adjacent, but outside the scope** of this report.

	Projects	Market Cap ($B)	Revenue ($M)	
Compute	250+	$10	$8.0	
Wireless	100+	$2.0	$0.8	
Energy	50+	$0.2	$0.0	
AI	200+	$7.0	$0.8	
Services	25+	$0.3	$6.0	
Sensors	50+	$0.3	$0.5	

>650
active projects

>$20B
market cap

>$15M
onchain ARR
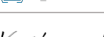
The <u>smart money</u> in crypto are making dozens of DePIN bets…

…with the top 10 projects amassing a **combined war chest of ~$1B.**

Top Crypto VCs by DePIN Investments
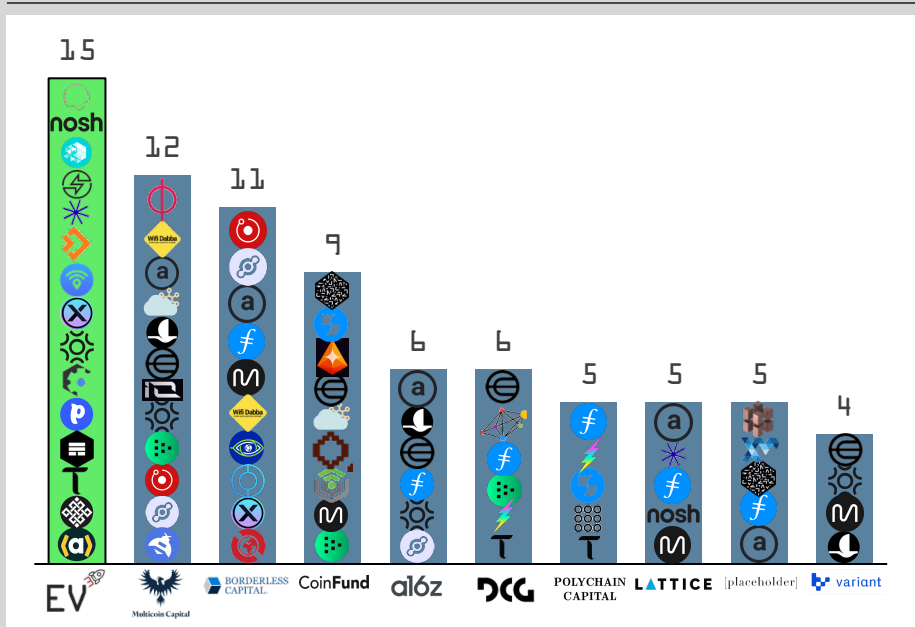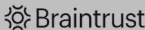
Top DePINs by Capital Raised

	Capital Raised[1]	Select Early Investors			
Filecoin	$250m	a16z	DCG	USV	BLOCKCHAIN CAPITAL · SEQUOIA
helium	$250m	a16z	Multicoin Capital	USV	khosla ventures · G/
rndr	$100m	DST GLOBAL	Multicoin Capital	HBO	Discovery CHANNEL · AUTODESK
fetch.ai	$75m	DWF LABS	Bitget	Outlier Ventures	BLOCKWALL · SPARK
livepeer	$50m	DCG	CoinFund	compound	Collab+Currency · Libertus Capital
REALLY	$35m	POLYCHAIN CAPITAL	MOONSHOTS CAPITAL	FLOODGATE	Habitat Partners
hivemapper	$25m	SPARK CAPITAL	Multicoin Capital	Haystack	G/
andrena	$25m	DRAGONFLY	EV	CASTLE ISLAND VENTURES	CMTDIGITAL
Braintrust	$25m	homebrew	Vy Capital	true Ventures	galaxy · HOF
DIMO	$20m	CoinFund	LATTICE	variant	SLOW VENTURES

DePIN infrastructure winners are beginning to emerge, with <u>Solana</u> in the lead.

Solana's **integrated infrastructure & performance-focused developer community** is attracting DePINs at every stage of the lifecycle.

Solana	Rollups	DePIN-focused L1s	
SOLANA	**Caldera** / **eclipse**	**IoTeX** / **peaq**	**BASE**

Value Prop:

Solana	Rollups	DePIN-focused L1s	
High throughput & low fees. Compressed NFTs. Rust developers.	Fast, custom deployments. ETH security and/or Solana VM. Flexibility & sovereignty.	High-throughput & low fees. DePIN-specific devtools. DePIN interoperability.	Braintrust will migrate 35k wallets to Base in Q1'24, making it the first (but certainly not the last!) DePIN to launch on Base. **Braintrust**

Solana:
- Render <u>started</u> Solana migration in Mar'23 and <u>finished</u> in Nov'23.
- Helium <u>started</u> Solana migration in Sep'22 and <u>finished</u> in Nov'23.
- Hivemapper <u>launched</u> on Solana in Nov'22 and mapped 10% of global roads.

grass · GenesysGo · NOSANA · Blockcast
io.net · DAIN · MapMetrics · SYNESIS ONE · SkyTrade
WiHi · STEP'N · mind+land · Media Network · SRCFUL

Rollups:

andrena
Deploy customizable rollups in 1 click.
<u>Thesis</u>: every dapp must eventually become a rollup to optimize for flexibility & long-term value capture.

Daylight ✴
Ethereum's fastest L2, powered by SVM.
<u>Thesis</u>: fixed costs to deploy individual app-rollups is too high; apps will deploy on fastest L2 that settles on ETH.

DePIN-focused L1s:

- EVM-based chain
- Raised $10m led by SamsungNext & Jump

<u>Thesis</u>: DePIN L1 with deep onchain liquidity

Depinscan.io (explorer) · Liquidity Hub (liquidity mining)
IIP-23 (vote-escrow) · W3bstream (verifiable compute)

DIMO · WiFi Map · WICRYPT · drop.of.release · GEODNET · XNET

Projects with bridged liquidity on IoTeX DePIN Liquidity Hub

- Substrate-based
- Raised $6m led by Fundamental Labs

<u>Thesis</u>: DePIN L1 with enterprise integrations

AIRBUS · BOSCH · NTT gaia-x · Continental · DENSO · Fraunhofer

2blox · charge · Brainstem · silencio · wingbits · penomo · ELoP · blox.move

Announced projects building on Peaq L1

Sources: project websites & press releases, EV³ research

Demand-Side

DePINs rely on onchain verification and/or settlement to provision critical network resources among consumers, developers, & agents that are willing to pay for them.

DePIN's North Star = revenues driven by <u>utility</u>—not speculation.

Onchain revenue means users **buy & lock/burn tokens** in exchange for a product/service/commodity.

	Volume	✖	Price	▤	Revenue
DeFi	- $ trading volume - $ borrow volume - $ insurance coverage		- % trading fee - % net spread - % premium rate		- $ trading fees - $ net interest - $ gross premiums
L1/L2s	- # onchain txns - $ MEV		- $ average gas fee - % extracted		- $ onchain revenue - $ MEV extracted
Crypto Infra	- # oracle calls - # RPC calls		- $ per oracle call - $ per RPC call		- $ for oracles - $ for RPCs
DePIN	- # GBs transferred - # GPUs rented - # kWs expended		- $ per GB - $ per GPU-hour - $ per kW		- $ for bandwidth - $ for compute - $ for energy

Correlation to crypto speculation cycles
high   low   none

Onchain Revenue Considerations

1 Are buybacks happening onchain, or "offchain"?
- Many DePINs do offchain buybacks, i.e. insiders claim to purchase tokens on CEXs (offchain) and then transfer them to a burn address (onchain).
- However, unless all insider wallet addresses are disclosed, <u>there is no way for tokenholders to know whether insiders are burning tokens from pre-mine allocations</u> vs market-buying on exchanges.

2 Are buybacks being burned, or "locked"?
- Many DePINs do not send buybacks to legitimate burn addresses: at best, tokens are locked in the protocol treasury to be redeployed after a long period of time; at worst, tokens are sent a <u>random wallet that may or may not still be controlled by insiders</u> and/or have timelocks.

3 Are buybacks oriented around a % of revenues, or "profits"?
- DePINs typically guide towards a target % of total network economics that accrue to tokenholders—the details of which are generally left hazy so as to avoid regulatory scrutiny (utility vs security tokens).
- However, <u>profit-sharing is very different from revenue-sharing</u>: in the former, insiders can increase salary or other expenses that reduce so-called "profits" and therefore token value, while enriching themselves.
- Since most DePIN expenses are offchain, "profits" cannot be verified onchain (yet); it is therefore impossible for tokenholders to ensure that they are receiving the appropriate % split of profits—only revenues.

DePIN generates >$15m annualized onchain revenue across six core business models.

In the last cycle, DePIN revenues proved to be the **most-resilient** of onchain revenues.

Sectors

Compute Marketplaces

Wireless Coverage

Wholesale Data

Services Marketplaces

Energy Services

Vertical Ad Networks

■ Hardware-focused   ■ Software-focused
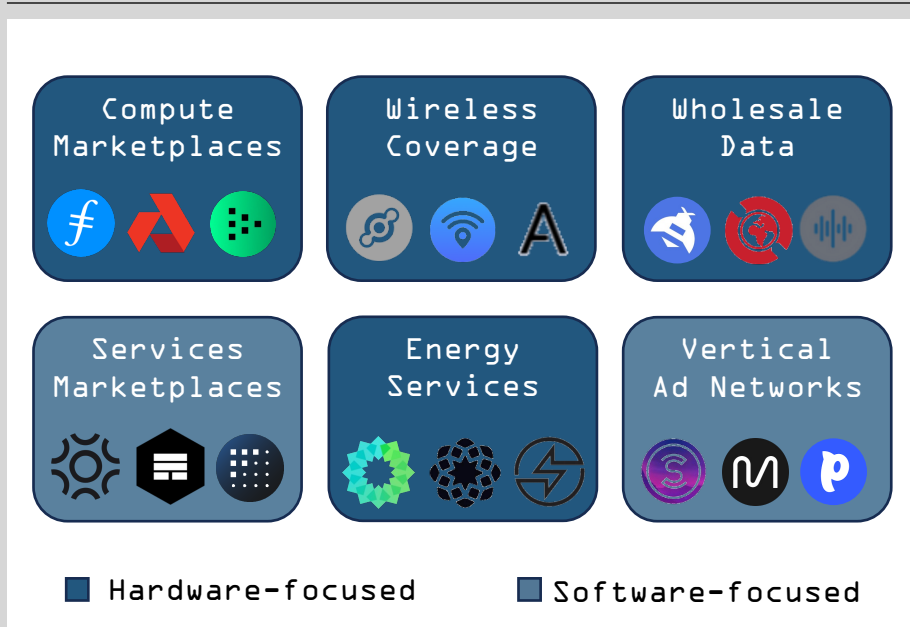
DePIN entrepreneurs create open source hardware & software that bootstrap useful onchain products/services.

Revenue Resiliency[1]

DePIN onchain revenues fell by 20-60% peak-to-trough in the last market cycle vs 70-90% for the rest of crypto.

L1s	DEXs	Money Markets	NFTs	Compute	Wireless
-76%	-71%	-88%	-90%	-57%	-19%

■ DePIN
■ Other Crypto
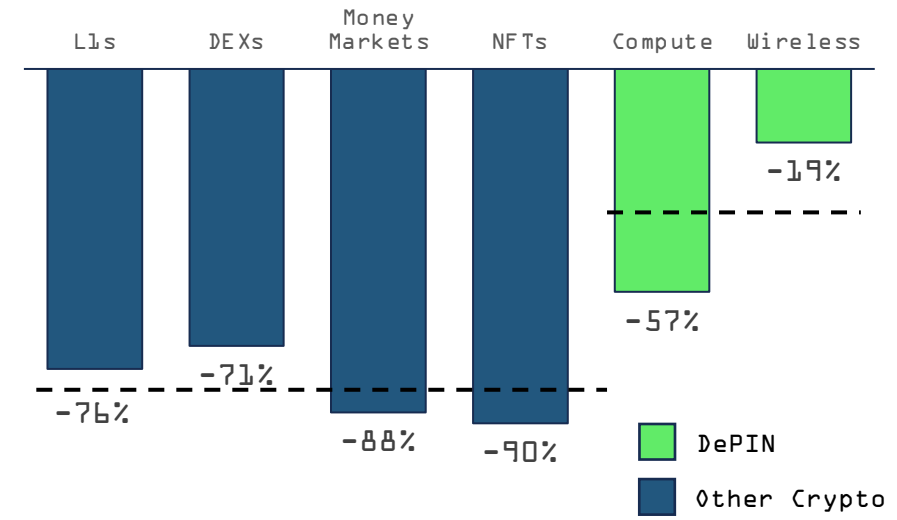
Median demand-side revenue decline for category leaders through cycles (1H'23 vs 2H'21)

The biggest DePINs are transforming into platforms with diversified use cases.

These are **no overnight successes**: platformization tends to happens in years 5-10 of scaling a global decentralized network.

Filecoin	**helium**	**rndr**	**bittensor**
FVM (Mar'23)	HIP-51/70 (Apr'23)	RNP-4/5/7 (Oct'23)	Revolution (Oct'23)
↓	↓	↓	↓
2.4k contracts	**2 subDAOs**	**4 clients**	**32 subnets**

Use Cases

Filecoin	helium	rndr	bittensor
stFIL liquid staking	Mobile cellular plans	Octane video rendering	Corcel chat-bot
Lighthouse perpetual storage	1663 IoT solutions	Beam python apps	ReplyTensor image-gen
Banyan backup storage	Senet IoT roaming	IONet general-purpose	TaoShi price prediction
Filemarket p2p filesharing	DIMO Macaron data	FedML federated learning	BitTranslate translation
Fluence serverless compute	Trackpac asset tracking		Sybil search
	Hivemapper location proofs		Model pre-training

Uni-token ecosystem (#FIL) transitioning to multi-token in 2024

Multi-token ecosystem (#HNT, #HST, #MOBILE, #IOT)

Uni-token ecosystem (#RENDER/#RNDR)

Uni-token ecosystem transitioning (#TAO) to multi-token (subnets) in 2024

EV

Compute marketplaces are the oldest & most successful DePIN business model.

Storage networks need more **demand**, compute networks need more **supply**, and retrieval networks need **density** to compete with web2.

	Storage	Compute	Retrieval	Full-Stack
What is uniquely enabled by crypto?	Novel products: enabled by onchain primitives, e.g. perpetual, encrypted, or verifiable storage	Flexibility: scale compute resources up & down as needed, with no overhead or contractual lock-in	Latency: a dense, global network of nodes enables faster/cheaper packet routing at scale	All of the above: accessible via a single network with strong economic security
Key stats	Utilization: 5-20% Onchain revenue: ~$2m Market cap: ~$1.5b	Utilization: 40-70% Onchain revenue: ~$2m Market cap: ~$2.0b	Utilization: n/a Onchain revenue: n/a Market cap: ~$1.5b	Utilization: Blended Onchain revenue: ~$4m Market cap: ~$5.0b
Key players	arweave, STORJ, JACKAL, CRUST, swarm, sia, BitTorrent	livepeer, rndr, IO.NET, NOSANA	THETA, AIOZ, fleek, MESON. NETWORK, MAWARI, Blockcast, HUDDLE01	Filecoin, golem, akash, Flux

Low prices by utilizing latent capacity

Low platform risk to credibly-neutral protocols

Onchain settlement on future-proof crypto rails

Source: depin.ninja

Data storage seems like an obvious use case for crypto, but has been slow to play out.

So far, the best customers for decentralized storage networks have been **other crypto networks.**

Web2 Institutions

- Filecoin has made the furthest inroads into storing web2 data

- Storate utilization is growing, but not yet driving meaningful onchain revenue growth

	'22 → '23	%
Supply (EB)	15 → 9	-40%
Demand (EB)	0.5 → 1.8	+275%
Utilization (%)	**3% → 20%**	**+650%**
Revenue (in FIL)	3m → 3m	+2%
Revenue (in $)	$34m → $16m	-54%
Revenue / TB ($)	**$68 → $10**	**-85%**

Web3 Users

- Consumer apps leverage onchain permanence & permissionlessness

- Despite VC funding, early attempts have failed to go viral

	Idea	Results
GLASS	Onchain video NFTs	- Raised $5m in Sep'22 - Shut down after 1 year citing 'no sustainable demand for video NFTs'
SOUND	Onchain music NFTs	- Raised $20m in Jul'23 - $50-100k monthly mint volume - Volumes down ~50% QoQ in Q4'23
PIANITY	Onchain music NFTs	- Raised $6.5m in Mar'22 - Top creator has <500 collectors
SARCOPHAGUS	Onchain estate plans	- Raised $5.5m in Jan'22 - <100 cumulative wills created

Web3 Protocols

- Blockchains are growing in size & complexity of data storage needs

- Expecting more storage partnerships with proliferation of new DA layers (Celestia)

Idea	Rationale
Oracle Nodes	- Posting oracle data onchain - Chainlink serves >10B datapoints today
L1 Validators	- Solving state bloat for next-gen L1s - Solana state size is ~200 TB today
Bridge Relayers	- Cross-chain txn signatures onchain - LayerZero sees 150-200k txns per day
ZK Provers	- Provers post proof results onchain - zkSync Era sees 1.5-2.0m txns per today

The end-game for storage has always been about compute-over-data.

Phase 3 of Filecoin's Master Plan began in Q1'23 with the launch of the **Filecoin Virtual Machine (FVM).**

1 Storage Supply

Supply grew >5x in a year

Mar'21 to Mar'22

2 Storage Demand

Demand grew >10x in a year

Mar'22 to Mar'23
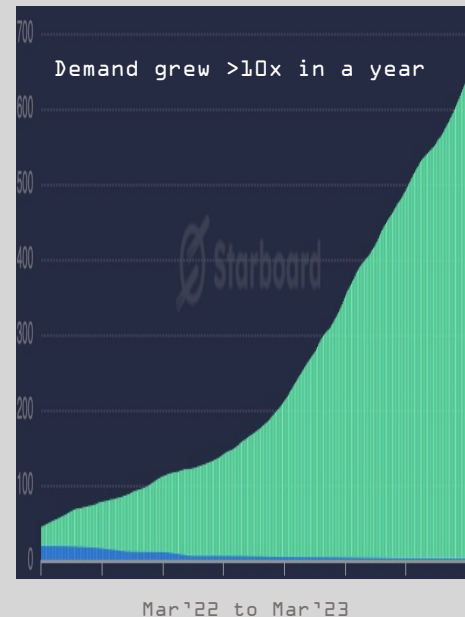
3 Making Data Useful

FVM activity has been slow to pick up in the first year, & the top contracts to date serve typical crypto use cases. This should change as Filecoin ecosystem startups launch in '24:

Bacalhau   IQ.NET   Lumino AI   fluence   Dosier

FVM Daily Contract Calls

Mar'23 to Dec'23

FVM Top Contracts

Memecoin
FilaDoge

NFTs
FileMarket &
FileBunnies

DEXs
Themis
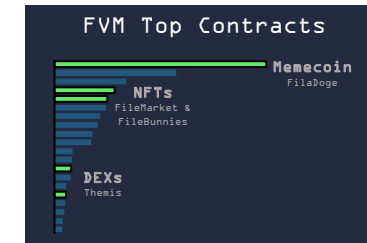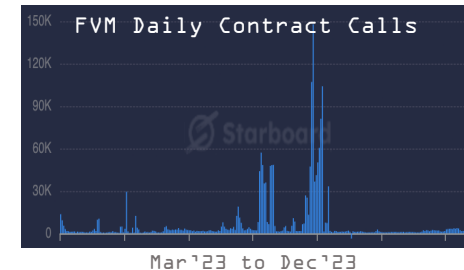
The Arweave ecosystem is also making strides in this direction:

WeaveVM
EVM-compatible
compute on Arweave

WeaveDB
Decentralized SQL
on Arweave

irys
Onchain provenance
on Arweave

Unlike most DePINs, <u>GPU Clouds</u> are constrained by supply rather than demand.

However, the **race-to-the-bottom** in GPU Clouds could be faster than any we've seen before.

GPU Utilization[1]

GPU clouds see utilization rates that are 4-5x higher than memory/storage
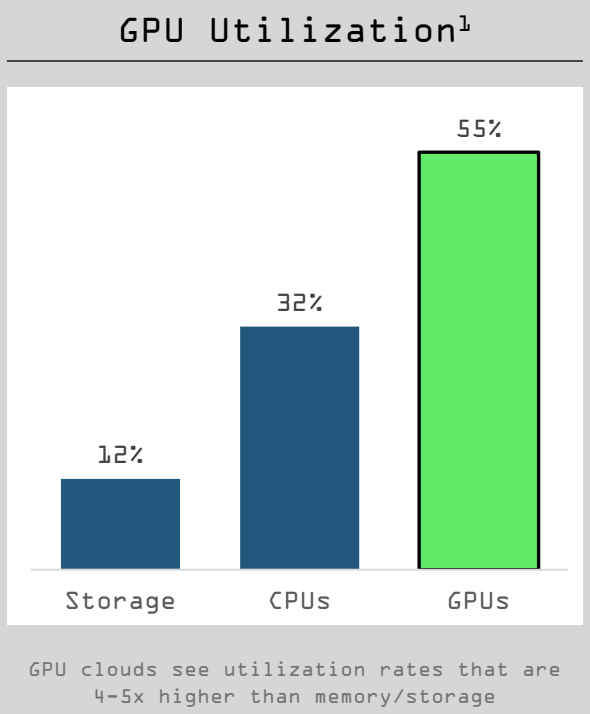
VC-Backed GPU Clouds

Raised	Edge
together.ai $125m	AI research
rndr $100m	OctaneRender integration
livepeer $50m	Web3 transcoding integrations
gensyn $50m	Decentralized ML training
Aethir $1-10m	Gaming integrations
akash $1-10m	Decentralized community
io.net $1-10m	Parallel compute
Hyperbolic $1-10m	AMD & other chip support
Lumino AI / NOSANA $1-10m	Filecoin & Solana ecosystem

Flux NETWORK3 · exaBITS · GPU · golem Monster API · Run:ai · RunPod · LeaderGPU · FluidStack · CUDO Paperspace · Arkane

Dozens of GPU Clouds raised money and/or bootstrapped to meaningful scale in 2023

Hosted LLM Pricing

Dec 10th	MISTRAL AI_	releases new model: €0.60 per 1m tokens
Dec 11th	together.ai	lowers prices to: $0.60 per 1m tokens
Dec 13th	ABACUS.AI	lowers prices to: $0.30 per 1m tokens
Dec 14th	deepinfra	lowers prices to: $0.27 per 1m tokens
Dec 22nd	Amazon SageMaker / databricks	available on **incumbent clouds**

Cost of prompting Mistral's new mixtral-8x7B-small model fell ~60% in four days

CPU Clouds are becoming escape valves for crypto's animal spirits.

Speculation on proof-of-work blockchains drives a **wealth transfer** from speculators to **arbitrageurs & DePIN tokenholders.**

Speculation

- Zephyr, a proof-of-work backed stablecoin project, saw token price rise +20x in less than a month

- At the peak, miners could rent CPUs on Akash for $25/mo and run Zephyr miners earning $30-40/mo in $ZEPH

$ZEPH token price ($)

Real-World Usage

- ZEPH mining on Akash went viral on Nov 21st, with a twitter tutorial attracting 16k+ viewers

- Users quickly began onboarding miners, driving Akash CPU utilization from 20% to 60%

Akash CPU utilization rate (%)

Efficient Markets

- Akash daily protocol revenues quintupled from $500 to $2,500 over the course of two weeks

- Since Nov 21st, **$AKT is up +60%** and **$ZEPH is down -50%** in token price

Akash protocol revenues ($/day)

<u>Decentralized CDNs</u> face tough competition: Cloudflare already has a DePIN-like flywheel.

Cloudflare benefits from **DePIN-like flywheel** through its free CDN service which powers 20% of websites globally.

Cloudflare Flywheel

Cloudflare Overview

- **DePIN-like growth:** Raised $1.0b through IPO in 2019; currently generating $1.3b ARR growing >30% YoY.
- **DePIN-like efficiency:** 18% operating cash flow margins; leaves the "rule-of-40" in the dust.
- **DePIN-like economics:** 75% of gross profits paid out as stock-based comp to employees in YTD'23.
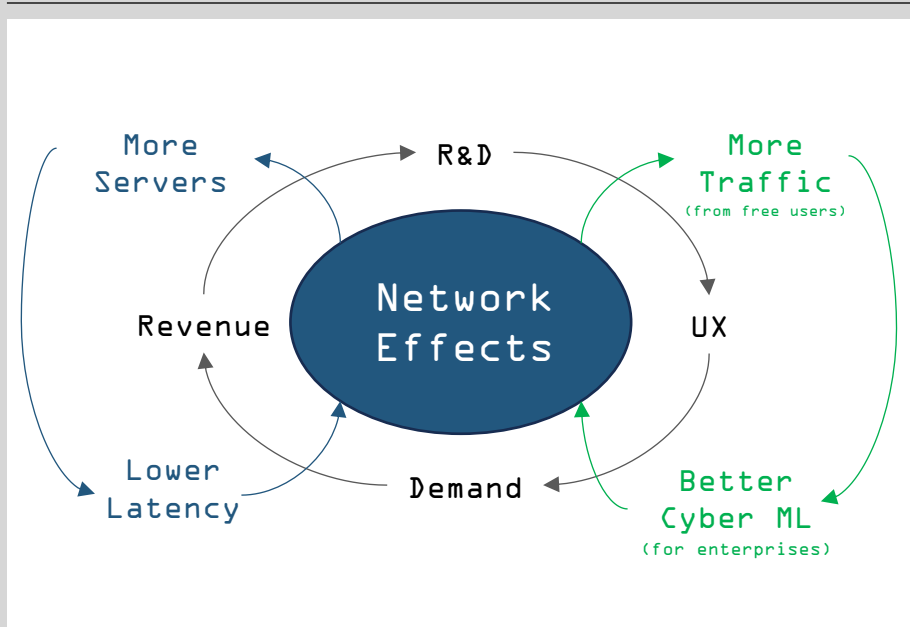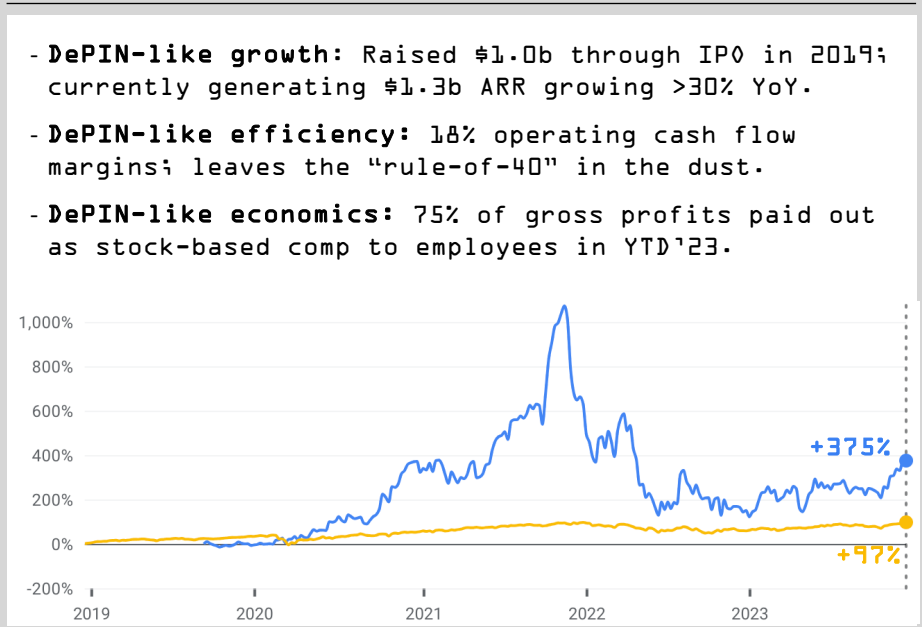
5-year returns for the S&P500 index (yellow) vs Cloudflare stock(blue)

<u>Retrieval</u> is the hardest piece to decentralize, but early signs are promising.

Early results in 2023 are proving that decentralized CDNs have the potential to **match & eventually beat** web2 performance.

DeCDN Challenges

Density: modern users expect <100ms time-to-first-byte (TTFB). Centralized CDNs beat this at scale.

Verification: is expensive in decentralized contexts; how can a miner prove their ability to serve content, without actually serving it?

Indexing: is expensive in decentralized contexts; how does a user find the closest node that hosts their content quickly?

Filecoin Saturn

- Launched Q1'23 and ending the year with 2.6k nodes globally

- Serving 50m daily requests with <90ms average TTFB (for IPFS content) and 350+ TB of bandwidth

- Community-run with funding from Filecoin Foundation and 15+ contributing teams
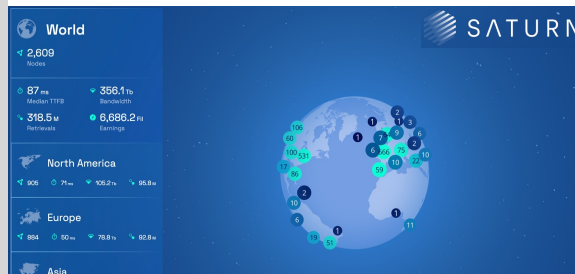
Saturn explorer

Fleek Network

- Testnet in Q4'23 saw 5k nodes running Fleek clients globally

- Global median TTFB: 70ms with geo-routing (300ms basic)

- Fleek's handshake, the incremental software for decentralization, adds only 1-2ms latency
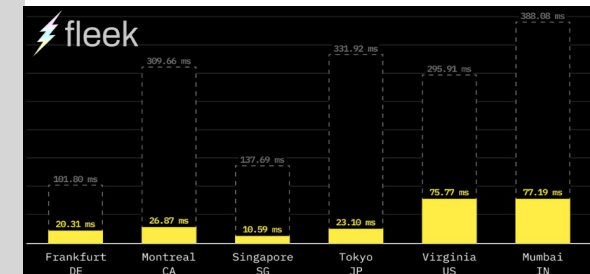
Median time to first byte (ms)

In the global economy, <u>wireless services</u> are an even bigger market than compute.

Global data transfer has compounded at **30-35% CAGR for the past 25 years** and shows no signs of slowing down.

Data Traffic

Global wireless data transfer grows at >25% CAGR, driven primarily by mobile video traffic.

Legend: Cellular | Fixed | Wi-Fi

Legend: Portable devices | Mobile handsets | Other devices

Petabytes
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
Forecast
2019 2021 2023 2025 2027

Petabytes
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
Forecast
2018 2020 2022 2024 2026

Global wireless data traffic by type (PB)

Device Connections

5G is (finally) at inflection point, growing from 30% to 70% of all wireless connections by 2027.

Legend: 3G and lower connections | 4G connections | 5G connections

Millions of connections
6,000
4,000
2,000
0
Forecast
2018 2019 2020 2021 2022 2023 2024 2025 2026 2027

Global wireless device connections by type (m)

Market Size

Wireless services represent >$1.5T of global annual revenues across mobile (~70%), fixed (~25%), and WiFi (~5%).

WiFi, <$0.1T

Fixed, $0.4T

$1.5T+
annual global revenue

Mobile, $1.1T

Global annual wireless services revenue ($T)

EV🚀

Each vertical of <u>DeWi</u> has different fundamental economic drivers.

Mobile is the biggest market by far (by $), but fixed internet & WiFi are the biggest by usage (by GBs & users).

	Mobile	**Fixed**	**WiFi**
Global Market Size	- $1.1T global annual revenue - 7.0B smartphones - Avg $13 per smartphone per month	- $400B global annual revenue - 1.5B broadband connections - Avg $23 per building per month	- $100B global annual revenue - 500m public hotspots - Avg $8 per hotspot per month
Pros	- Highest per-GB revenues - Low switching costs due to eSIMs	- Extremely sticky: high retention - Partner-driven GTM: property managers	- Most widely-used connectivity protocol - Large ecosystem of supported devices
Cons	- Extremely competitive: high CAC & churn - Users expect coverage everywhere - Highly regulated: need to buy spectrum	- $/GB revenue is ~10x lower vs mobile - QoS constrained by spectrum capacity - Competition from cablecos & telcos	- Difficult to monetize: users want free - Weak security at the protocol level - Lower power means <100m limited range
Key Unlocks	- <u>eSIM</u>: reduces the time it takes to switch carriers from hours to seconds - <u>Neutral host</u>: enables interoperability between telcos & equipment deployers	- <u>PtMP</u>: point-to-multi-point radios can beam at high-capacity in many directions - <u>mmWave</u>: high-frequency spectrum can provide high-capacity links over miles	- <u>WiFi7</u>: provides better throughput, latency, & energy efficiency - <u>MVNO offload</u>: enabling challenger MVNOs to use the offload as incumbent telcos
DeWi Players	helium · REALLY · X · KARRIER ONE	ANDRENA · althea · QUANTINIUM	WiFi Map · MetaBlox · Wifi Dabba · WICRYPT

EV

Crypto MVNOs use tokens to radically improve traditional wireless economics.

MVNOs **acquire & manage customer relationships** while paying a traditional telco (MNO) for wholesale network access.

Helium

- Nova Labs unlimited data mobile plans with for $20/mo nationwide ($5/mo in Miami), launched Dec'23

- Offloads traffic onto Helium 5G routers whenever possible, paying $0.50/GB in to hotspot owners

- Subscribers earn $MOBILE for mapping / validating wireless coverage

Really

- Really Wireless premium mobile plans for $200/mo, launching early 2024

- Includes privacy/safety features, custom deadzone coverage, & VIP concierge services and support

- Founded by Adam Lyons, co-founder of TheZebra insurance aggregator
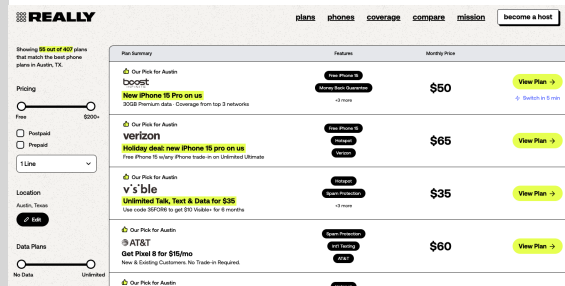
Fliggs

- Fliggs mobile phone plans with built-in DID & crypto integrations; launch date TBD

- Leverages Moflix whitelabel MVNO tech platform and Hedera blockchain

- Founded by Stefan Riedel, former marketing director at Orange telecom
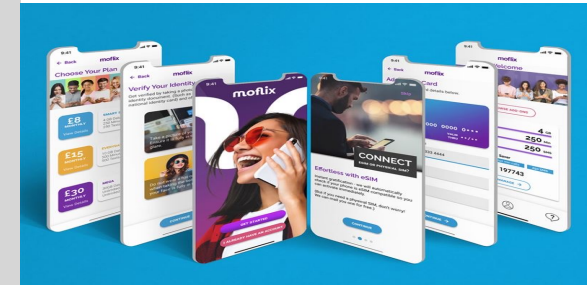
T Mobile
has partnered with every DeWi MVNO announced to date.

Helium Mobile's early momentum shows there is a path to millions of users.

The question is: can Helium start making money, before running out of money?… **We think the answer is yes.**

User Acquisition

- Helium Mobile added >20k subscribers in December, an annualized pace of >250k/yr

- Subscribers who opt-in to mapping split 20% of all $MOBILE issuance

- At Dec'23 prices, users are earning ~$6/day in $MOBILE for a $20/mo phone plan (9x returns)

Nationwide launch
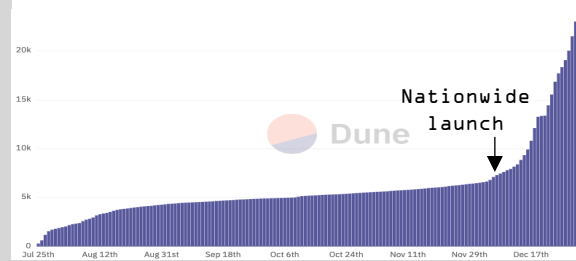
Helium Mobile subscriber mapping NFTs

Data Offload[1]

- Nova Labs pays $0.50/GB for traffic offloaded onto Helium hotspots, and a much higher amount (likely ~$2/GB) for traffic offloaded onto T-Mobile

- At $20/mo, Nova Labs must offload 70-90% of traffic onto Helium to achieve breakeven gross margins

- Currently offloading 55%+ in Miami

HM CBRS Traffic, GB: 12.66
HM WiFi Traffic, GB: 4.51k
T-Mobile Traffic, GB: 3.72k
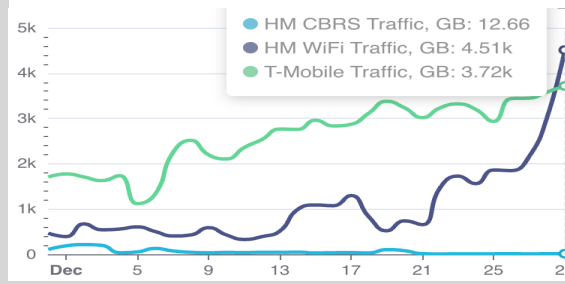
Helium Mobile traffic in Miami, by offload destination (Dec'23)

Cash Runway[2]

- Nova Labs raised $200m in Feb'22; we estimate roughly $150m remaining on balance sheet going into 2024

- Assuming 30-50% offload rates while scaling nationally, Nova Labs will pay $30-40/mo in total data transfer costs to Helium & T-Mobile (vs $20/mo revenue per subscriber)

- With basic assumptions around CAC / churn / burn, we believe Helium Mobile is on track to acquire 500k+ subscribers over the next 18-24 months on the current funding alone

- More capital, faster organic growth, or a faster ramp in offload rates would increase these estimates

Helium Mobile's illustrative growth path to 500k+ users

EV

Mobile internet connects person-to-person, <u>fixed internet</u> connects place-to-place.

The number of **ISPs in the US will grow from 3k to >15k over the next five years,** and the global opportunity is even bigger.

How ISPs Work

- ISPs buy wholesale internet access from fiber providers & datacenters, e.g., $2k/mo for a 10Gbps line

- ISPs deploys rooftop antennas that beam connectivity between nearby homes, apartments, & offices

- ISPs manage traffic, splitting 10Gbps capacity across 100-500 subscribers

Visualization of fixed wireless access

ISP Economics

- ISPs earn 90% lower $/GB revenues than telcos, but make up for it with lower churn & lower spectrum costs

- But, ISPs need 200+ subscriber scale to afford a single fiber connection

Type	Mobile	Fixed
	Person-to-person	Place-to-place
Avg revenue	$13	$23
Avg data usage	25 GB	500 GB
$ / GB	$0.50	$0.05
Monthly churn	2-3%	<1%
Spectrum	Private	Public

Illustrative monthly economics for telcos vs ISPs

ISP Opportunity

- Andrena has grown ISP revenues by >10x over the past three years with industry-leading NPS

Other DeWi ISPs: Wifi Dabba | VulaCoin TIME IS MONEY | QUANTINIUM
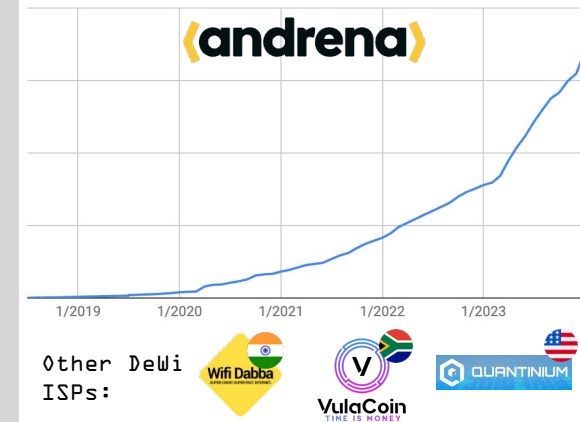
Andrena indexed revenue growth ('19-'23)

<u>Fixed internet</u> may be the most ambitious play in all of DeWi.

Andrena's testnet will enable consumers & SMBs to become micro-ISPs with **owners' econonomics** over last-mile internet infrastructure.

2 Enable ISPs to <u>share & rent excess wholesale internet</u> capacity.

$ANET

1 Enable homeowners, small businesses, and property managers <u>to own their wireless infrastructure</u>.

3 Enable <u>new wireless services</u> on the same infrastructure.

mobile offload | public WiFi | edge compute
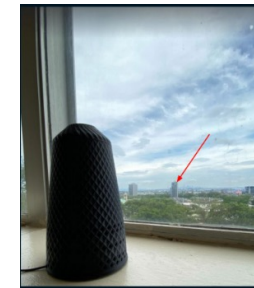
With billions of DAUs, <u>WiFi</u> is the most widely-used connectivity protocol on earth.

In 2023, WiFi Map airdropped $WIFI tokens to **225k of its most active contributors** across 190 countries globally.

WiFi Map

WiFi Map is the world's biggest wifi mapping community:

- <u>2m+ monthly active contributors</u>: people who add new hotspots or run speed tests
- <u>5m+ monthly active users</u>: people who use the app to find & connect to nearby free WiFis
- <u>$1m onchain ARR</u>: from upselling eSIM plans, VPNs, & offline maps
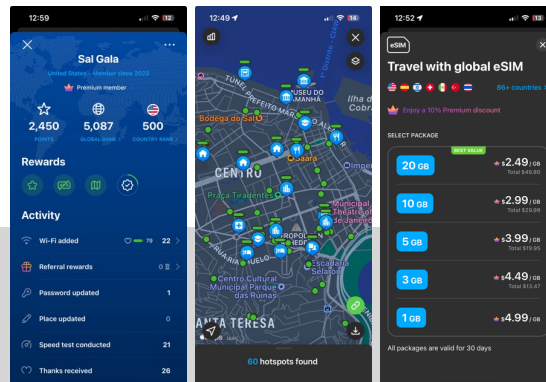
Global Community

WiFi Map is one of the biggest global user bases in crypto:

- 175m+ app downloads
- 15m+ community-mapped hotspots
- 2b+ WiFi connections facilitated
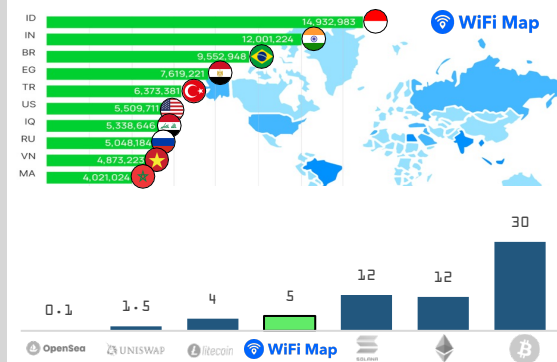
WiFi Map monthly downloads by country (top) & monthly active users/wallets comparison (bottom)

Crypto-Led Growth

$WIFI is a utility token that rewards contributors who help grow & validate the network, and can be redeemed for eSIMs & other connectivity services.

Since launching $WIFI in Apr'23:
- 20m+ app downloads
- 500k+ speed tests
- <0.5% of token supply airdropped
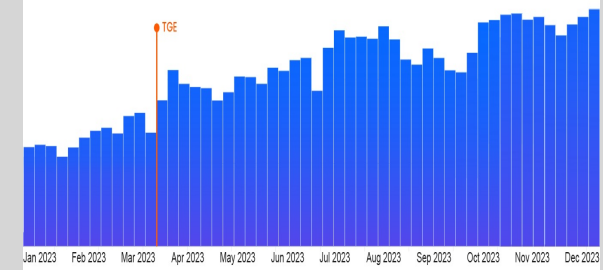
WiFi Map weekly speed tests performed ('23)

EV

<u>Data sales</u> can take many different forms, some more valuable than others.

Data is **most valuable** when: 1) there are many buyers for it, 2) those buyers make lots of money off it, & 3) better data is the limiting factor to them making even more money.

	Mapping	**Positioning**	**Climate**
Data Buyers	NATIX hivemapper spexi Navigation & ADAS Local governments Logistics & supply chain Real estate & insurance Hedge funds & PE AR & VR	GEODNET ONOCOY FOAM Agriculture Surveyors & construction Navigation & ADAS AR & VR Drones & robotics	WEATHER XM PlanetWatch dClimate Energy & utilities Insurance & loan underwriters Governments & nonprofits Construction & real estate
Are there lots of buyers for the data?	YES	YES	YES
Do the buyers make a lot of money from the data?	Often	Often	Sometimes
Is better data the limiting factor to making more money?	Often	Sometimes	Rarely

<u>Mapping</u> is arguably the most powerful real-world example of global crypto-coordination.

The Hivemapper community made more progress in scaling supply, demand, and validation in 2023 **than most networks make in 3-5 years.**

Supply

- Hivemapper sells $300-$650 dashcams which earn $HONEY rewards for sharing footage & metadata with the network

- In 2023, the Hivemapper community mapped >10% of global roads while earning <5% of total token supply

Total km mapped: 103m

Unique km mapped: 6.8m
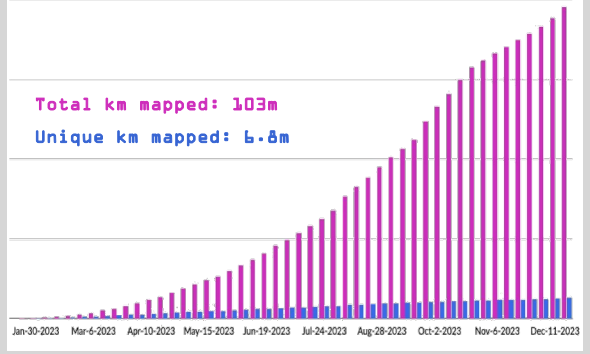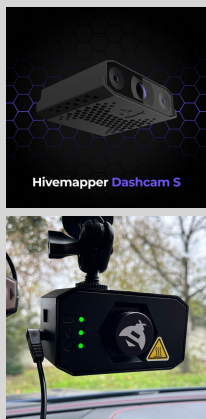
Hivemapper global km mapped ('23)

Validation

- Hivemapper's AI training community earns $HONEY for classifying map features correctly

- Short feedback loops between map contributors & map customers, enabled by token rewards, is the key to creating highly-useful digital maps
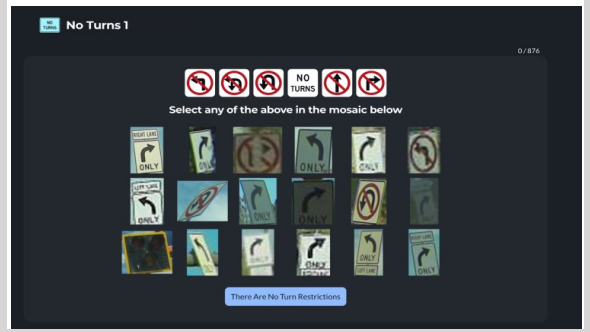
Hivemapper's map AI trainer UI

Demand

- Customers pay Hivemapper for map images & data, burning $HONEY in the process

- Customers can buy existing maps, or set bounties on new areas via bursts

- ~$250k worth of $HONEY burned
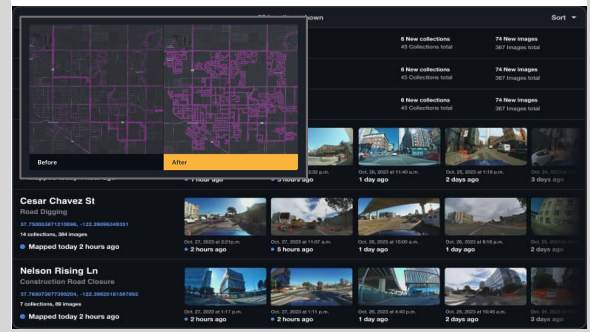
Hivemapper's map customer UI

EV

DePINs are beginning to scratch the surface of what <u>mobile sensors</u> are capable of.

Mobile phones are **incredibly powerful sensing machines…** but mobile-data-as-a-business faces several challenges.

Mobile Sensor DePINs

silencio	Noise pollution
NATIX	Navigation & mapping
MapMetrics	Navigation
Helium Mobile	Mobile coverage
sweatcoin	Pedometer

iPhone 14 Sensors

- Microphone
- Camera
- WiFi
- Bluetooth
- Ultra-wideband
- NFC
- Face ID & Touch ID
- Accelerometer
- Gyroscope
- Magnometer
- Barometer
- LIDAR scanner
- Ambient light sensor
- Temperature
- Hall sensor
- Speaker sensing
- Infrared camera

Business Challenges

- <u>Always-on</u> data collection comes with user privacy & device power-draw concerns
- <u>Opt-in</u> data collection typically has poor retention
- <u>'Data mining'</u> attracts users that skew datasets in unexpected ways
- <u>Airdrop farmers</u> make it hard to differentiate organic vs inorganic traction
- <u>Defensibility</u> vulnerable to race-to-the-bottom on token rewards

<u>AI x Crypto</u> creates an alternative exit path for DePIN sensor/data networks.

Networks can **monetize valuable datasets** via intelligence mining or compute-over-data markets, rather than competing upstream.

Upstream Expansion

Networks with large proprietary datasets can train/finetune ML models & use them to directly provide upstream services.

WEATHER XM
WEATHER ON DEMAND

Frodobots

Collect climate data from global network of rooftop weather stations.

Collect sidewalk robot driving data from real-world robot racing game.

↓

Train the world's best local weather prediction model.

Train the world's best self-driving sidewalk robot.

↓

Build an insurer with best-in-class underwriting margins.

Build a food delivery company with best-in-class delivery margins.

Illustrative upstream expansions

Intelligence Mining

- Networks with large proprietary datasets can compete in onchain mining games such as Bittensor's Yuma Consensus.

- Datasets that are both valuable & differentiated earn outsized mining rewards for a period of time, and are gradually competed away as the network's 'hashpower' catches up.

biττensor

Frodobots
Robotics training subnet

WEATHER XM
WEATHER ON DEMAND
Weather prediction subnet

silencio
Noise cancellation subnet

DIMO
Vehicle health prediction subnet

PlanetWatch
Air quality prediction subnet

MapMetrics
Driver navigation subnet

Examples of potential DePIN mining subnets on Bittensor

Data Markets

- Networks with large proprietary datasets can monetize them via decentralized data markets.

- These markets allow third parties to run computations over a private dataset (e.g., AI inferences) in a verifiable manner without accessing the underlying data.

ocean

Brainstem
Healthcare wearables data

Acentrik
Automative manufacturing data

datalatte
Consumer survey data

Future Mobility Data Marketplace
Mobility data

Aerospace manufacturing data

OVAL
ADAS development data

Ocean Protocol compute-over-data partnerships

◄ **More capital intensive & higher-margin** ——— **Less capital intensive & lower-margin** ►

Horizontal <u>services marketplaces</u> use crypto-incentives to source the world's top talent.

Whether human- or agent-based, **great services marketplaces:** 1) attract & retain the best talent, and 2) match supply & demand effectively.

Humans

Key insight: top freelance talent prefers **longer-term** engagements than on Upwork/Fiverr (months vs days).

Braintrust

Why crypto: $BTRST gives ownership & control over to freelancers & clients, creating long-term alignment; tokenholders govern platform fees, dispute resolution, & other network governance issues.

365k freelancers → 7k jobs → >$200m GSV → >$7m protocol revenue

Braintrust clients

NASA TaskRabbit Walmart nextdoor Deloitte. wayfair Nestle PORSCHE Boston Consulting EY
coursera intel. PACIFIC LIFE Guardian Five9 TELADOC ReMatter dfkhain IBM LUCRA
McKinsey & Company NIKE airbnb Goldman Sachs Google Expedia

Average project is $90k GSV over 7.5 months.

Braintrust cumulative gross service value (blue) & gross contract value (yellow) in $

AI Agents

Key insight: top autonomous agents will be used **>1 billion times per day**; scaling to that point requires combining onchain reputations with offchain verified compute.

Autonolas

Why crypto: AI developers mint code as NFTs and earn $OLAS donations when agent services are called on by users, creating an onchain reputation for useful agents.

25 agents → 250 services registered → 250k services rendered → 13 ETH donations

Dune

Autonolas autonomous service transactions weekly (purple) & cumulative (orange)

Vertical <u>services marketplaces</u> are disrupting web2's gig economy vampires.

Uber/Doordash et al were built on **extracting economics from local economies in perpetuity**; web3 flips the script by returning ownership & control back to local operators.
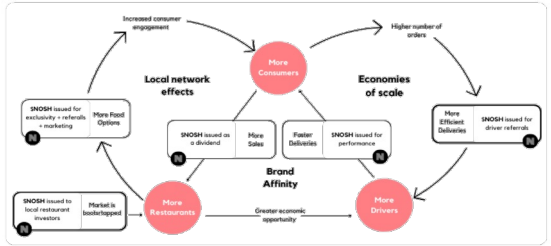
Food Delivery
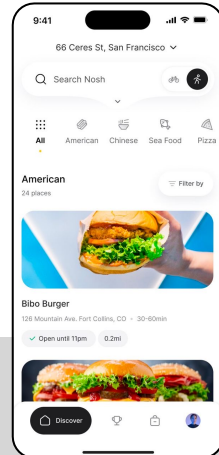
nosh

<u>Key insight</u>: local restaurants & local drivers love working together (low-churn), but hate paying Doordash a 25%+ cut (high-churn).

<u>Why crypto</u>: Nosh's co-operative model gives local restaurants ownership over the ridesharing network, incentivizing them to recruit dependable drivers.

Launch in Fort Collins, CO (2021) → $10m GMV (2023) → $NOSH token launch (2024)

Nosh's DePIN flywheel & app

Ridesharing

Teleport

<u>Key insight</u>: both drivers & riders are fed up with Uber, but have no mechanisms for local/grassroots 'guerilla coordination'.

<u>Why crypto</u>: Teleport estimates the minimum density needed to bootstrap a new city, then incentivizes drivers & riders to sign up pre-launch.

$9m seed raise (Oct'22) → iOS invite-only launch (Oct'23) → 700 signups at Solana breakpoint (Nov'23)

Teleport rider/driver simulations & app

Onchain <u>security services</u> will feel like the most obvious winners of '24-'25.

In the last crypto cycle, **Certik laid the blueprint** for what a $10B+ onchain security services marketplace could look like.

Centralized Security

Certik built the <u>leading crypto security auditing business</u> from '20-'22, reaching 60% market share & >$365B of crypto market cap assessed.

In 2022, growth investors Tiger, Softbank & Insight invested $150m into Certik at a $2b valuation.
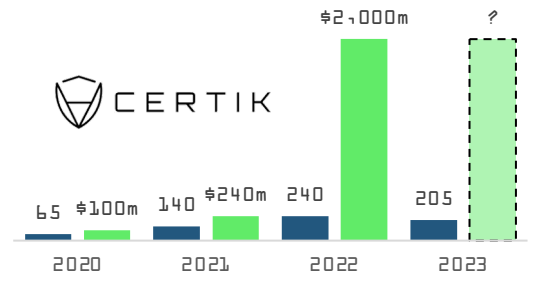
Certik number of employees (in blue) & post-money valuation (in green)

Decentralized Security

Decentralized <u>blockchain security networks</u> incentivize developers & autonomous agents to provide onchain security services including:
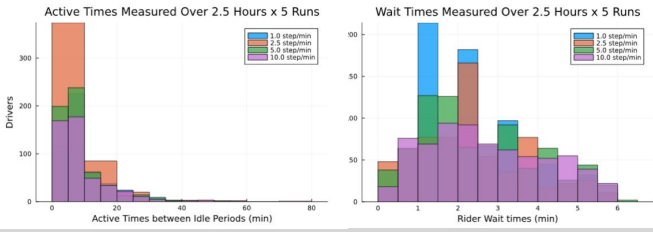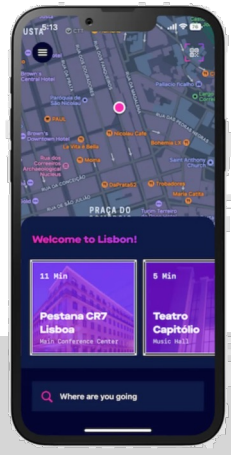
- token/contract audits
- live monitoring & pen testing
- bug bounty hunting
- txn-level circuit breakers
- parametric insurance

Agent-based security networks can be <u>faster</u>, <u>cheaper</u>, & <u>more consistent</u> than human auditors alone.

$HAPI ($20m FDV) $AEGIS ($15m FDV) $OTACON ($3m FDV)

TAM Comparison

By democratizing access to security audits, agent-based networks can expand the market <u>by a factor of 5-10x</u>.

	Certik in '20-'22	AI audits in '24-'26
Peak-to-trough crypto market cap	$200B → $2T	$1T → ???
% projects getting security audits	10%	50-75%
% leader market share	60%	60-75%
Projects audited	10k+	100k+
Capital raised	$230m	fair launch
Valuation	**$2B**	**$10B+**

Comparing centralized auditors vs decentralized security networks across crypto market cycles

Vertical <u>ad networks</u> return ownership & control of data back to users.

Great ads networks combine: 1) **viral** user acquisition, with 2) **proprietary**, **contextual** data streams, in 3) **large** end-markets.

Fitness

sweatcoin

+ <u>Virality</u>: Sweatcoin had >13m waitlist signups for a fitness & step tracker app (though >40% of users never claimed the airdrop)
+ <u>Balanced growth</u>: MAUs grew +30% in '23, with token price up +20% despite significant dilution
− <u>Weak context</u>: Sweatcoin ads only leverage step & location data, which makes for weak conversion
− <u>Lack of DeFi integration</u>: <5k onchain $SWEAT holders represents <0.1% of Sweatcoin app MAUs

Sweatcoin app MAUs ('23)

Automotive
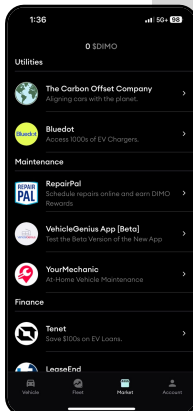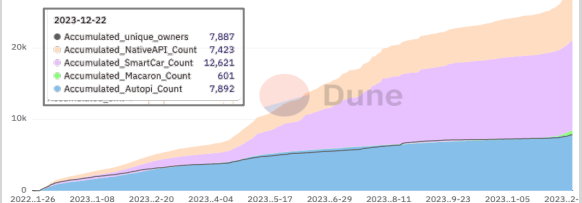
DIMO

+ <u>Virality</u>: Dimo's connected vehicle ecosystem grew onboarded >10x vehicles in 2023 (2.5k to 25k)
+ <u>Valuable context</u>: comprehensive real-time automotive data decoded directly from vehicles (OBD readers & OEM integrations)
+ <u>Large end-markets</u>: average American spends $4-6k/yr across auto insurance, financing, repair, gas & registration costs
− <u>Early conversion</u>: only <100 'big-ticket' & <1000 'small-ticket' sales to date[1]

Dimo onboarded vehicles ('23)

Pets

petastic

+ <u>Scale</u>: Petastic has >600k pre-registered pets via shelter & rescue partnerships
+ <u>Valuable context</u>: onchain Pet Passport tracks breed, birthday, location, vaccination records, food history, & other key pet data
+ <u>Large end-markets</u>: average American pet parent spends >$600/yr across food, insurance, medical, & toys
− <u>Pre-launch</u>: public beta launching in Q1 2024

Petastic registered pets ('23)

EV

Decentralizing the <u>energy supply chain</u> may prove to be DePINs toughest challenge yet.

Regulatory overhead in the energy sector makes experiments slow/difficult/expensive… but the **toughest challenges attract the most resilient entrepreneurs.**

Financing
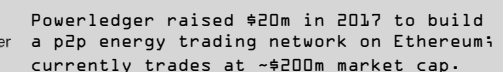
GlowGreen

- Onchain permanent capital vehicle to incentivizes green energy production

- Solar farms mine $GLW by contributing 100% of electricity revenues to the Glow treasury. Miners compete over fixed $GLW emissions, where hashpower = carbon credits produced

- This creates a self-reinforcing incentive to generate carbon credits in places where solar could not otherwise exist

Daylight ✳

- Homeowners earn cashback rewards for electrifying homes & neighborhoods with:
  - Solar panels
  - HVAC
  - insulation
  - smart meters
  - thermostats
  - EV chargers

Virtual Power Plants

Entheos

- Enables solar & wind operators to monetize their latent battery capacity

- <u>Go-to-market</u>: proprietary battery management system extends battery life >2x by tapping individual cells

STARPOWER

- Democratizes virtual power plant participation for homes & SMBs

- <u>Go-to-market</u>: scaling a global VPP with smart plugs that mine $STAR tokens & connect other energy devices

Fuse raised $78m in 2022 to build a full-stack, regulated UK energy company using VPPs & crypto rails — launching in 2024.

Certificates & Trading

energy web

- Real-time, 24/7 energy usage tracking software for enterprises

- Stakers run nodes that ingest enterprise data & validate green energy certificates

- $EWT listed in 2020 and currently $70m market cap

Pilots

SoftBank | VW | Shell
elia | vodafone

Jasmine

- Enables anyone to trade EACs (energy attribute certs)

- Jasmine Bridge connects with offchain registries

- $JLT tokens create unified onchain liquidity for semi-fungible certificates

- Currently ~$25k of onchain liquidity

Powerledger raised $20m in 2017 to build a p2p energy trading network on Ethereum; currently trades at ~$200m market cap.
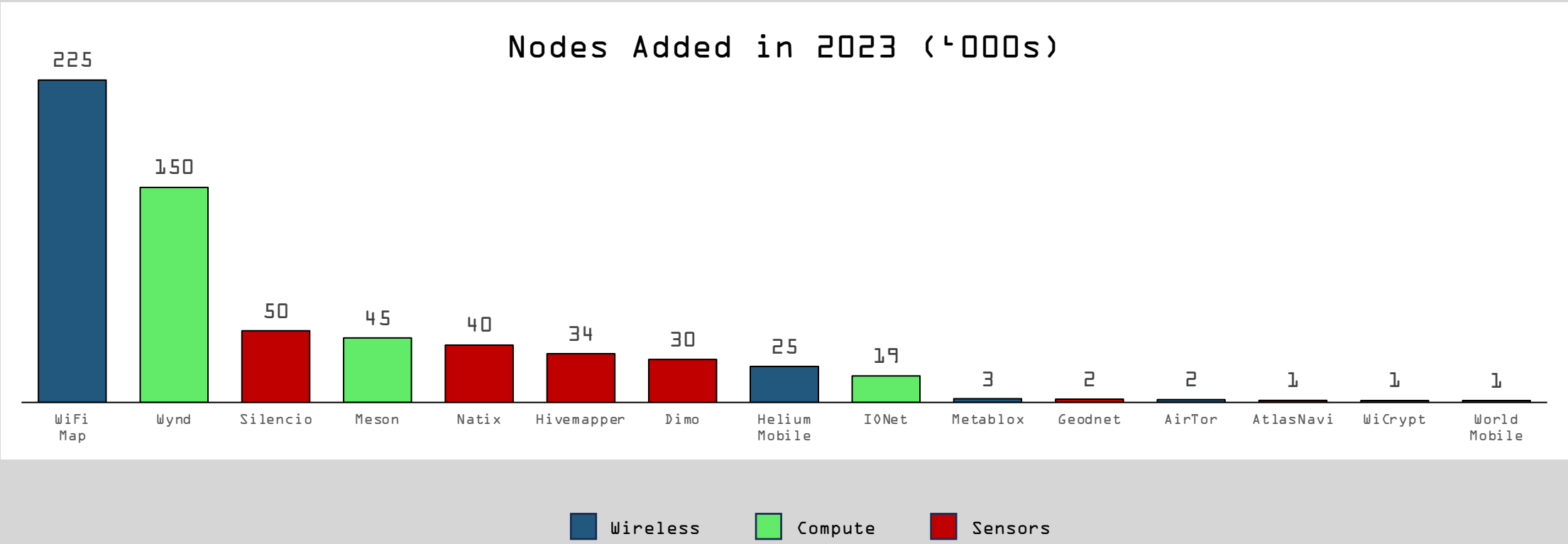
Supply-Side

DePINs use crypto-incentives to coordinate the capital, equipment, and labor needed to scale global critical infrastructure.

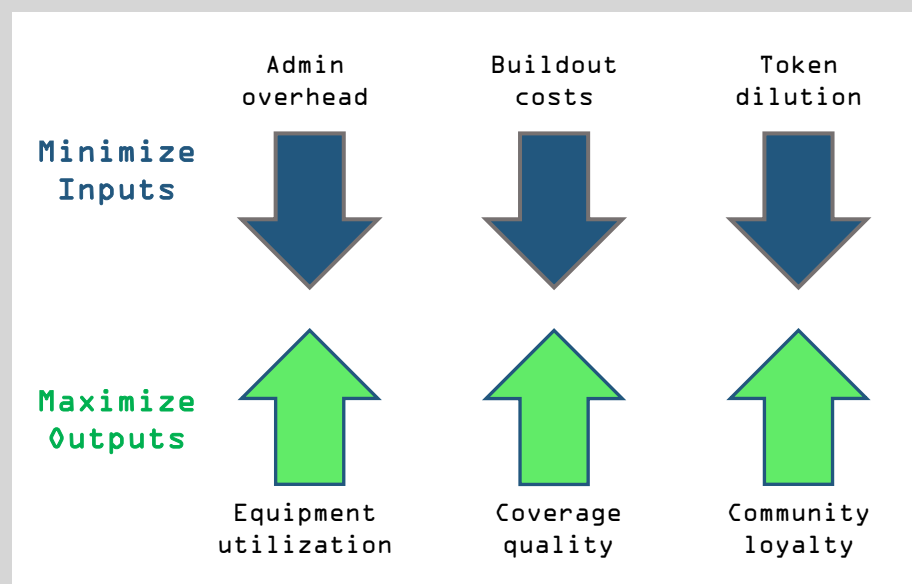# DePINs added 600k+ nodes in 2023 across wireless, compute, & sensor networks.

In addition to those shown on this page, **dozens of emerging DePINs added 100-500 nodes this year** and are scaling rapidly into 2024.
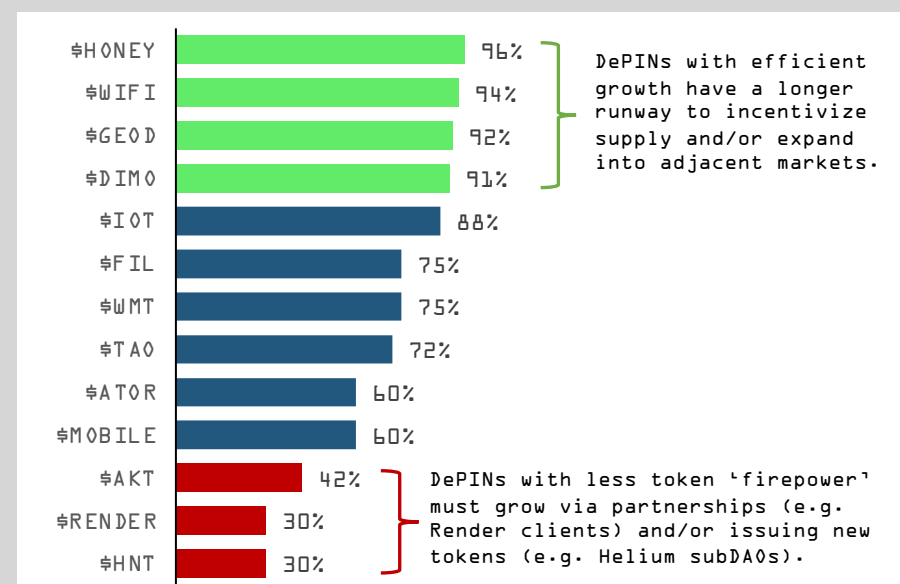
Nodes Added in 2023 ('000s)

WiFi Map	Wynd	Silencio	Meson	Natix	Hivemapper	Dimo	Helium Mobile	IONet	Metablox	Geodnet	AirTor	AtlasNavi	WiCrypt	World Mobile
225	150	50	45	40	34	30	25	19	3	2	2	1	1	1

Legend: ■ Wireless ■ Compute ■ Sensors

DePINs are becoming <u>massively more efficient</u> at scaling supply.

The newer generation of DePINs are putting a **stronger focus on capital efficiency**—sometimes at the expense of decentralization.

DePIN Scaling Goals

Minimize Inputs

Admin overhead | Buildout costs | Token dilution

Maximize Outputs

Equipment utilization | Coverage quality | Community loyalty

Locked Tokens as % of Total Supply

Token	%
$HONEY	96%
$WIFI	94%
$GEOD	92%
$DIMO	91%
$IOT	88%
$FIL	75%
$WMT	75%
$TAO	72%
$ATOR	60%
$MOBILE	60%
$AKT	42%
$RENDER	30%
$HNT	30%

DePINs with efficient growth have a longer runway to incentivize supply and/or expand into adjacent markets.

DePINs with less token 'firepower' must grow via partnerships (e.g. Render clients) and/or issuing new tokens (e.g. Helium subDAOs).

We've seen 3 approaches to token issuance: based on <u>time</u>, <u>supply-KPIs</u>, & <u>demand</u>.

Most DePINs **combine the three strategies**, using different issuance schedules for different buckets of tokens at different times.

Time-based

helium
Halvings every 2 years

➕ Strong incentive to deploy on day-1

🚫 Speculative excess followed by crash

🚫 Enables manufacturer extractable value (MEV)

Supply KPI-based

hivemapper
Based on % of global roads mapped

➕ Balances token prices & supply growth

🚫 Less certainty over token issuance curve

🚫 Incentivizes fake or low-quality supply

Demand-based

althea
Based on $ fiat revenues generated

➕ No wasted token dilution

🚫 No outside incentive to deploy on day-1

🚫 Miners must underwrite their own revenues

Growth ⟷ Efficiency

What's worked well for __hardware__ DePINs: __Targeted bursts/boosts__ for mining rewards.

DePINs with higher capital requirements benefit from using offchain data & decisions to **incentivize high-value deployments.**

	Wireless	Positioning	Mapping
	helium	GEODNET	hivemapper
Who influences rewards:	Service providers & 3rd party data oracles	Geodnet Foundation & customers	Hivemapper Inc & customers

Wireless

<u>HIP-74</u>: oracles influence $MOBILE incentives via coverage simulations.

<u>HIP-84</u>: enables service providers to boost rewards in certain hexes by burning $MOBILE.

Positioning

<u>SuperHex Staking</u>: enables miners to earn 4-14x boosted rewards for deploying in Foundation-approved hexes.

Mapping

<u>Bursts</u>: enables drivers to earn boosted rewards for mapping an area of high-value to Hivemapper customers.
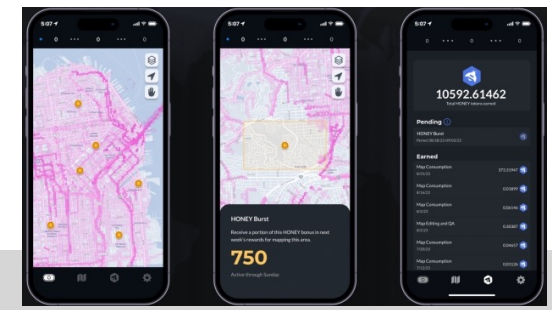
What's worked well for __software__ DePINs: __Points__ that "might" turn into tokens.

Leading software-based DePINs are scaling to tens or even hundreds of thousands of active users BEFORE actually launching a token.

Bandwidth	Data	Mapping

grass >150k users in first year

silencio >50k users in first year

NATIX Network >40k users in first year

What users see:
- Download browser extension to earn points.
- Download mobile app and record audio clips to earn points.
- Download mobile app and record dashcam videos to earn points.

Monetization:
- Scraping website data via residential IPs.
- Selling noise pollution data.
- Selling traffic & mapping data.

What's worked well for DePIN <u>investors</u>: differentiating <u>market cap</u> vs FDV.

The very best networks will largely **trade on circulating market cap**, while lower-quality networks will be upside-capped by FDV.

In Theory

DePINs should be valued based on circulating market cap, <u>assuming future token issuance is used to productively drive onchain revenue</u>.

This excludes DePINs with:

🚫 <u>Small markets</u>: where increasing supply might not lead to increased demand on a reasonable time frame

🚫 <u>Lossy verification</u>: where tokens are rewarded to miners onboarding fake or fraudulent supply

🚫 <u>Unaligned incentives</u>: where insiders use tokens to enrich themselves vs grow the network

🚫 <u>Hidden liabilities</u>: where tokens are needed for "backpay" for regulatory infractions or hacks

In Practice

- Crypto VCs historically earned token allocations based on max token supply (fully-diluted valuation). Unlike in web2 VC, these allocations are not diluted by future fundraises—which is detrimental to founders & later-stage investors.

> **miles jennings** ✔ 🔵 @milesjennings · Dec 19, 2023   ···
>
> If you're a founder in web3, you should never agree to fixed token allocations for investors.
>
> Market standard is for token allocations to be dilutable, which is critical for maintaining flexibility for future fundraisings.
>
> Fixed token allocations are predatory.
>
> 💬 13   🔁 18   ♡ 150   ıl 29K   🔖 ⬆

- Many crypto "VCs" will sell tokens as soon as they can generate a 5-10x return. <u>If these VCs are on a the cap table, token price will be capped by FDV rather than market cap</u>; otherwise, FDV is largely irrelevant as a valuation metric.

Looking Ahead: 2024

In 2024, we will see DePINs begin to experiment more deeply with novel crypto primitives including ZK, memecoins, onchain AI, & onchain gaming.

DePIN x AI

ZK-verifiable GPU clouds are 1-2 years away from **enabling an onchain inferencing economy** that centralized providers won't be able to service.

Centralized AI

- Google offers its top AI model for free (up to 60 queries per minute) in order to capture training data in the wild

- As compute becomes more powerful, training data becomes the limiting factor for more-powerful AI

- By amassing massive datasets, the biggest AI firms & protocols will build a deep scale & data moats

Decentralized AI

Ritual	$32m	Robot Ventures, ARCHETYPE, ACCOMPLICE, EV
SPECTRAL	$30m	POLYCHAIN CAPITAL, PARAFI CAPITAL, FRANKLIN TEMPLETON, galaxy, SOCIAL CAPITAL, Gradient Ventures, OP CRYPTO, SAMSUNG NEXT, GENERAL CATALYST
UPSHOT	$25m	POLYCHAIN CAPITAL, Framework, MECHANISM CAPITAL, CoinFund, SLOW VENTURES, DELPHI DIGITAL
Modulus	$6m	1k(x), variant
Giza	$3m	CoinFund, TA VENTURES, arrington CAPITAL

DePINs building verifiable inference by total capital raised

ZK Proof Costs[1]

- Inferencing LLMs is expensive: hosted providers would prefer to run smaller, cheaper models if they can get away with it. This is problematic for smart contract developers looking to embed AI into onchain logic

- Verifying whether a certain model was inferenced is possible via ZK, but makes transactions 75x more expensive today

- Lowering these overhead costs is the key to unlocking onchain AI:
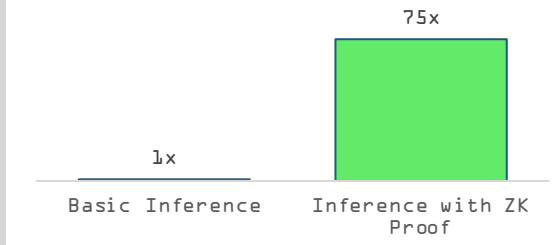
ZK-verified inferencing is ~75x more expensive than regular (trusted) inferencing

DePIN x Memecoins

Like it or not, **memecoins are becoming genuine catalysts** for the mass adoption of DePIN.

Solana & $BONK

$BONK developers airdropped 30m tokens to every Solana Saga phone (worth >$600 at peak) on 12/14.

Within days:
- Solana Sagas sell out (>25k units) & trade for $5k on eBay (vs $600 retail)
- Dozens of dapps are built into the $BONK app store, mainly games & DeFi
- Multiple other Solana protocols announce airdrops for Saga owners

Helium & $MOBILE

- HIP-51 created subDAO tokens whose value is decoupled from data transfer: miners & users get $MOBILE, demand-side burns $HNT

- $MOBILE holders can in theory redeem for a pro-rata slice of treasury $HNT (green below); but not in practice since $MOBILE trades at a >100x multiple of redemption value

- $MOBILE can be seen as a DePIN memecoin with wide circulation & strong memetics
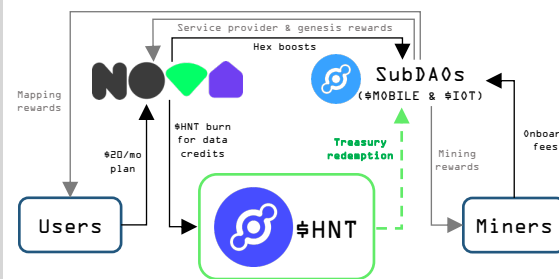
HIP-51 structure chart: fiat flows in black, crypto flows in gray, redemptions in green.

Memecoins vs DePIN

- The top 8 memecoins are worth more than twice as much as the top 8 DePINs by circulating market cap

- DePIN can capture memecoin attention and redirect it towards building productive critical infrastructure
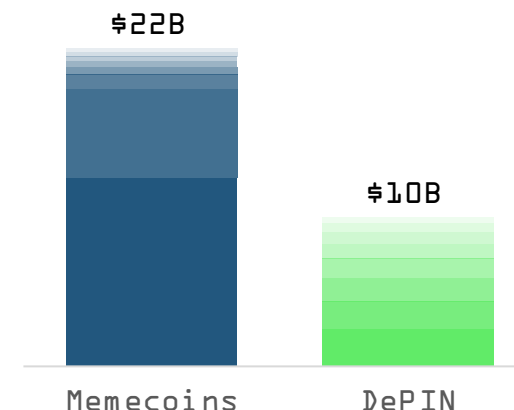
Top 8 memecoins vs DePINs by market cap

DePIN x ZK

Web3 vampire-attacks on web2 will be the next gold rush as developers create user-aligned clones of the most popular web2 apps on top of newly-performant ZK infra built by projects such as: **Sovrn** DECO ⚡ZXPASS *jomo* ℛ reclaim
(in stealth)

What is ZK TLS?

- ZK TLS uses advanced cryptography (ZK, MPC, & TLS) to create verifiable identity primitives

How it works:

- User downloads a client, i.e. app or browser extension and logs into any web2 account or app (e.g., Uber)
- The https request is sent by an MPC wallet co-owned by end-users and a decentralized network of 'notaries'
- If the request meets certain criteria (e.g., driver rating >4 stars), a ZK proof is generated locally, without data leaving the users' computer
- The ZK verifiable credential can be minted onchain or sent privately via web2 rails
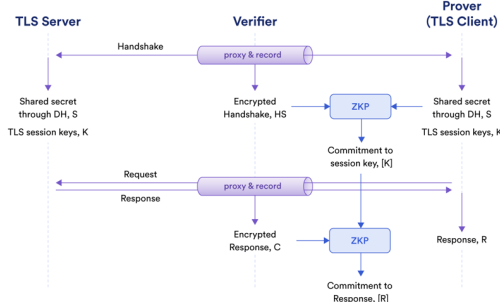
Chainlink DECO research: provenance & authenticity

Web2 Vampire Attacks

- In traditional vampire attacks, protocols issue token incentives to attempt to steal away their competitors' sticky power users
- Historically, only *onchain* data can be used in vampire attacks. ZK TLS enables, for the first time ever, verifiable *offchain* data to power vampire attacks
- The result: DePINs can now bootstrap themselves with *reputation*, in addition to capital & labor: an entirely new primitive
- Crypto users know: once the genie is out of the bottle, vampire attacks permanently change an industry's competitive dynamics
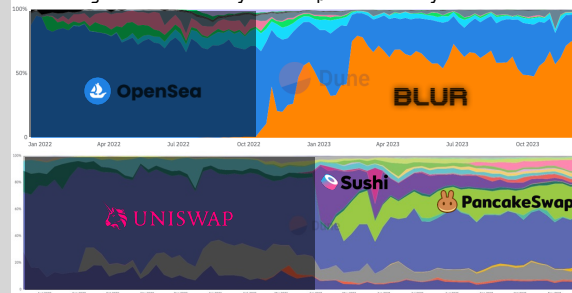
Market share before & after vampire attacks in DEXs ('20-'21) & NFT marketplaces ('22-'23)

Use Cases

Qiber
Ridesharing for top 1% drivers
(criteria: >1k rides & >4.9 stars)

Berizon
Cell service for users who are tired of overpaying every month
(criteria: >10GB/mo average data usage)

Upwoke
Freelancer coops for social justice warriors
(criteria: >$1k/yr donated to liberal causes)

Yinder
Dating app with no surprises
(women pay fiat subscriptions; men earn token rewards for verified age/height/income)

Resolution
Self-help app for e/acc's
(users fund an onchain pool of "goal money"; if goal isn't achieved, funds get donated)

Potential web2 vampire attack startups; logos generated by Midjourney

DePIN x Gaming

As more DePIN activity moves onchain, the **design space of real-world infra x onchain gaming** is going to grow faster than anyone expects.

Frodobots
Gaming x AI x Robotics

- Real-life racing video game: users remotely-control sidewalk robots in cities around the world (e.g., Wuhan, Madrid, Singapore)
- Mission: bootstrap the world's largest open source robotics dataset for training ML models

WiFi Map
Crypto x WiFi x Gaming

- Global WiFi mapping community with 2m+ monthly contributors
- Launching onchain speed tests in 2024, creating a new geo-primitive for dApp developers (proof-of-physical-proximity)
- Expanding beyond WiFi to other public utility networks such as restrooms, water fountains, parks
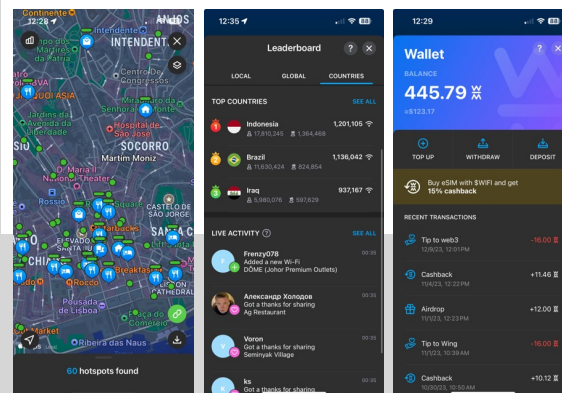
NATIX
Crypto x Mapping x Gaming

- Mobile phone-based dashcam mapping app with >40k users
- Launched gamified missions, enabling users to earn boosted points for reaching certain in-app milestones
- Daily active engaged users more than doubled since launch
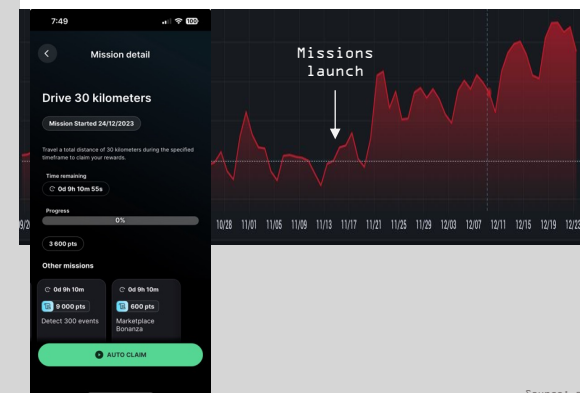
DePIN x Privacy

ATOR will fork the Tor network in 2024, aiming to create a scalable, performant ecosystem for privacy-centric developers to build on.

Onion Routing

- Tor ("The Onion Router") is a decentralized private routing protocol launched in 2002.

- Messages on Tor get 3 concentric layers of encryption: routers can only read the addresses of the other nodes in the chain; not the underlying message.
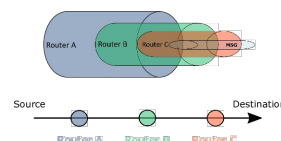
- Tor is used by almost 5m users globally wherever privacy is a critical concern.
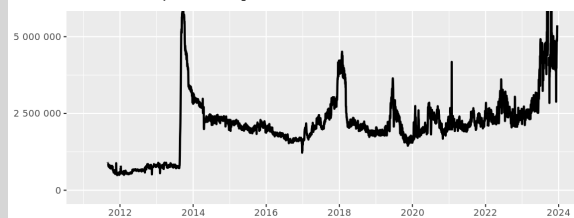
TOR global users ('11-'23)

TOR Network

- Tor relays grew ~5x from 2011 to 2015, then stagnated due to lack of incentives for node operators. With fewer nodes, network performance degraded and became unusable for 'everyday' users.

- Everything changed in Feb'23, when ATOR began incentivizing relays with token rewards & added >2k nodes in ten months.

- In Nov'23, the Tor Foundation banned ATOR nodes (~25% of all relays) citing "high-risk, for-profit cryptocurrency scheme"
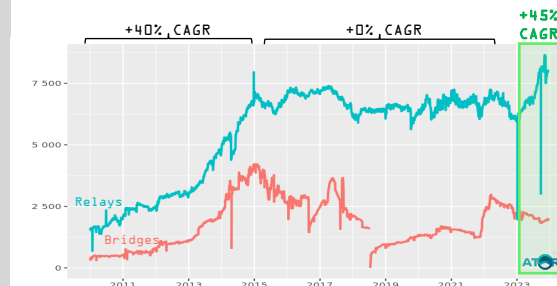
Tor active relays & bridges ('10-'23)

ATOR Network

- $ATOR will fork Tor in 2024 by launching hardware relays and incentivizing node operators with token rewards.

- As more nodes join the network, developers can build performant privacy-centric apps (onion services) on top of ATOR.

- $ATOR mining could become the killer DePIN consumer use case: buy a WiFi router, secure all your home internet traffic through it, and earn tokens for doing so

Akash protocol revenues ($/day)

Other Leading Privacy DePINs

0 Knowledge Network

hopr

SESSION

AeroNyx

NYM

Appendix: DePIN Resources

Onchain Analytics

DePIN Ninja
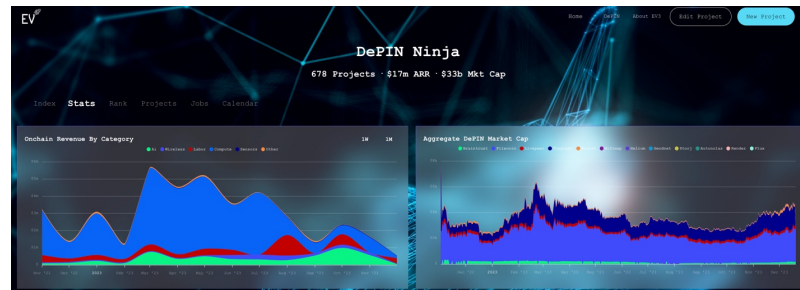
DePIN Project Screener

Messari Screener
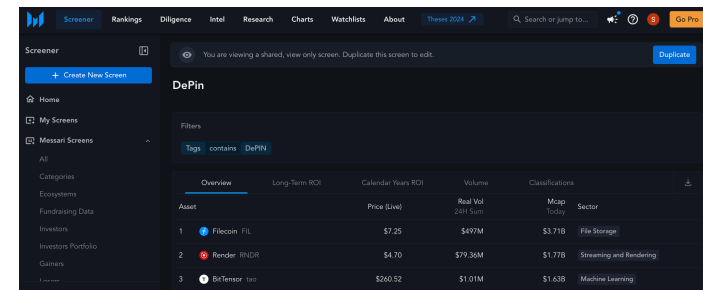
Research

State of DePIN

Proof of Coverage

Newsletter & Events

DePIN Snacks

DePIN Summit

<u>Appendix</u>: Disclaimers (1/2)

<u>Appendix</u>: Disclaimers (2/2)