

DLResearch x  Polkadot

POLKADOT IS LEVELLING UP

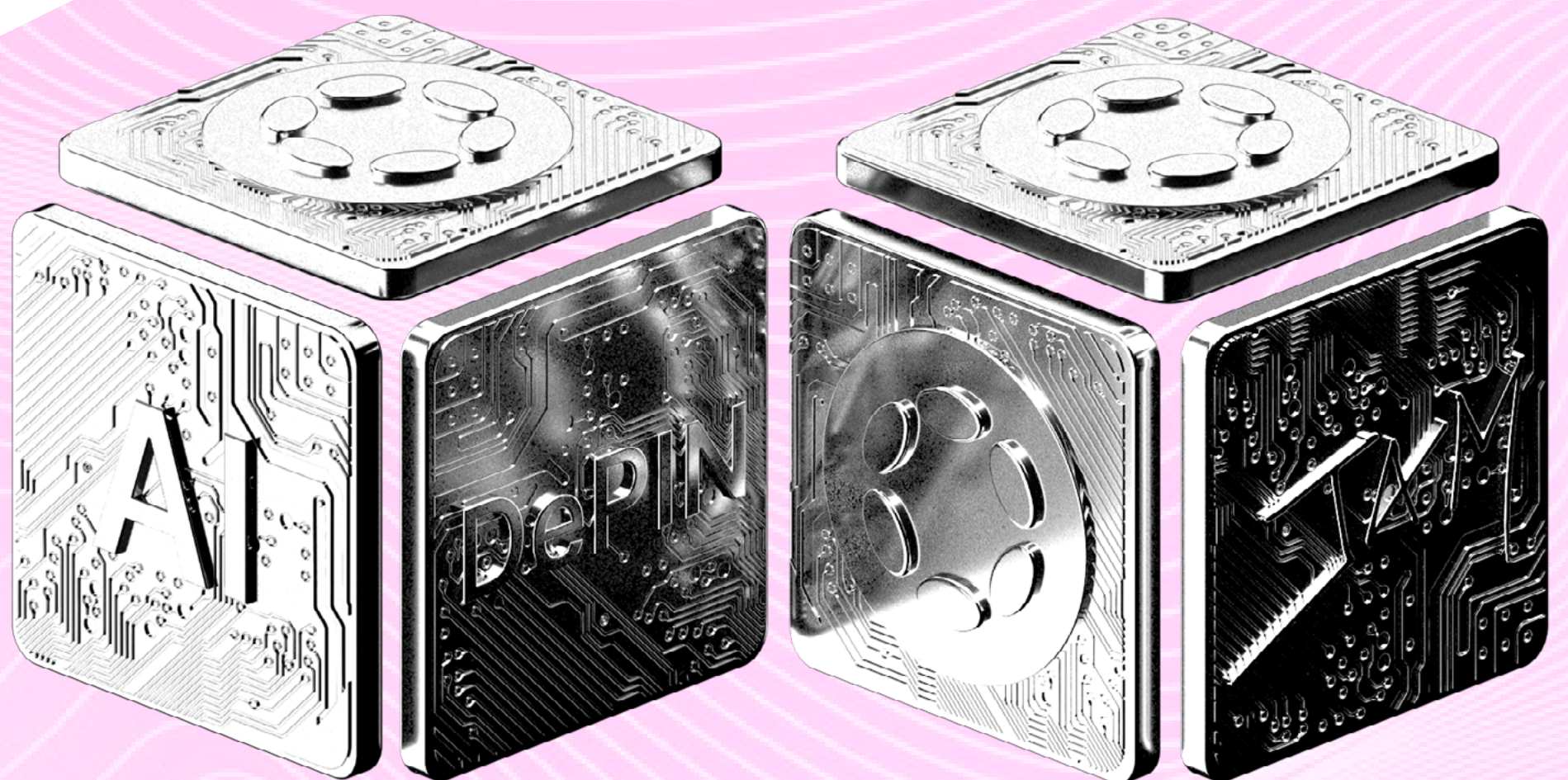
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Polkadot is Levelling Up

A brainchild of Ethereum co-founder Gavin Wood, the Polkadot network has been at the forefront of blockchain innovation since its mainnet launch in May 2020.

Today the network is in the midst of key advancements that will significantly expand its technological horizons, including the Join-Accumulate Machine (JAM) upgrade, which is expected to address longstanding challenges related to scalability and interoperability on the network.

JAM should also underpin efforts to innovate on Polkadot, as developers increasingly embrace decentralised physical infrastructure (DePIN) and make new forays into AI-driven applications.

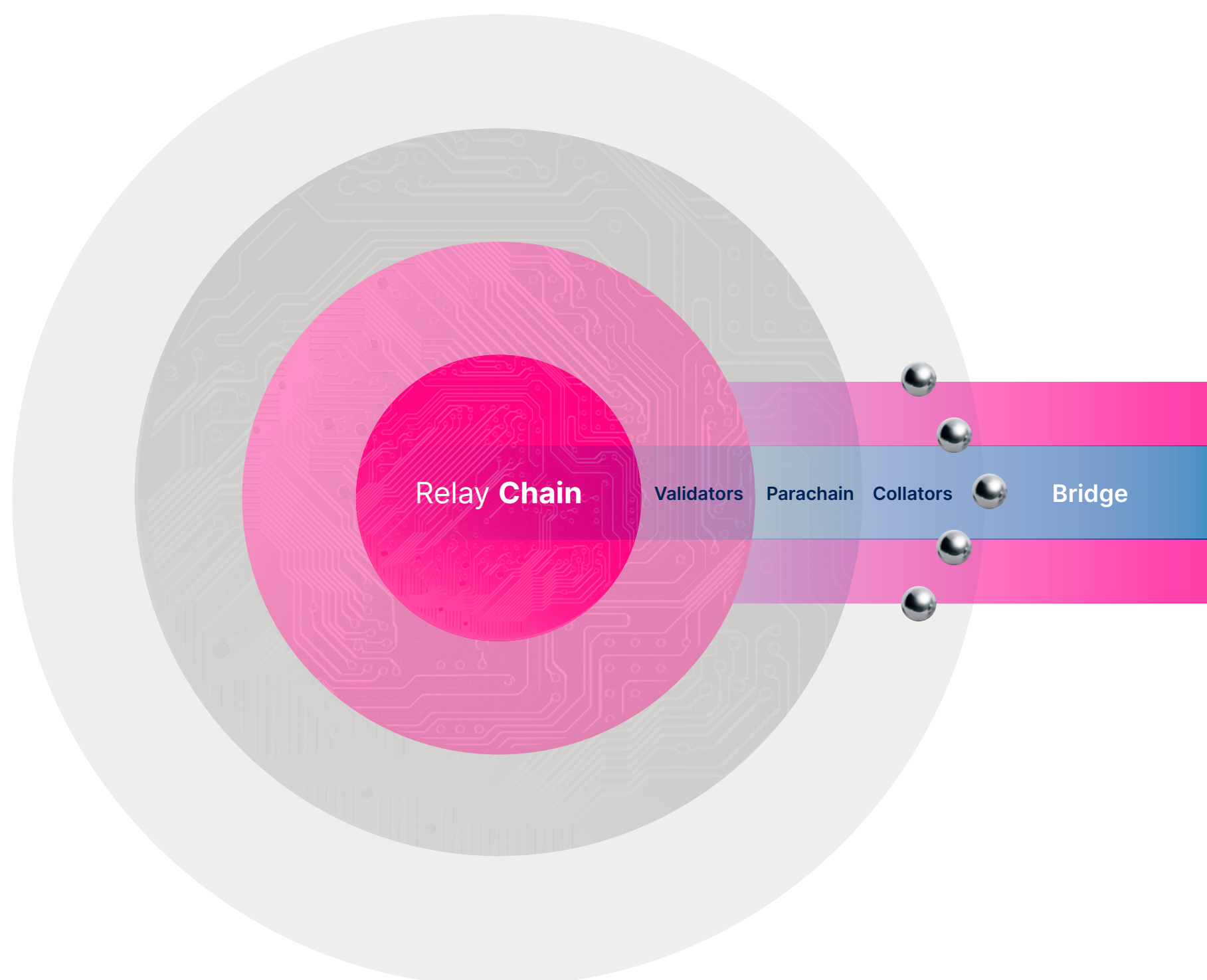


What is Polkadot?

A purely sharded network by design, Polkadot operates as a multi-chain network that splits consensus, execution, and data availability between several Layer 1 networks, called parachains, and a central chain, called the Relay Chain.

Parachains handle specific tasks independently, but they are all connected and coordinated by the Relay Chain. The network's top parachains include Moonbeam, HydraDX, Bifrost, Nodle, KILT, and OriginTrail.

Parachains operate by their own set of rules and logic, handling the execution of smart contracts or transactions.



Source: wiki.polkadot.network

The Relay Chain is responsible for achieving consensus among the parachains and ensuring security and smooth network validation, using a consensus mechanism known as Nominated Proof-of-Stake (NPoS).

NPoS is a variant of the proof-of-stake (PoS) consensus mechanism. PoS uses validators who stake their tokens as collateral to verify and add transactions to the blockchain. In contrast, NPoS adds a democratic element by allowing token holders to nominate validators and participate in the validation process.

THERE ARE THREE CRITICAL ROLES WITHIN THE POLKADOT ECOSYSTEM:

Validators

The full nodes of the Relay Chain participating in the consensus process. Each parachain appoints a validator subgroup to accept blocks and conduct validity checks to ensure the consensus rules are followed.

Nominators

The network participant that delegates their DOT, Polkadot's native token, to a validator to participate in consensus.

Collators

A validator's consensus assistant, the collator constructs the parachain blocks.

An established leader in application-specific blockchain networks, Polkadot is now seeking to improve its use of core computational resources and become more of a 'general services' blockchain. The JAM upgrade is designed to help accomplish this goal.

With the JAM upgrade, the network addresses the inherent challenges of scalability and interoperability by increasing network performance, providing more access for developers, and enhancing user experience with more cost-efficient parachains.

The JAM Upgrade

Unveiled in June 2023 and detailed at the TOKEN2049 conference in Dubai in April 2024, the JAM upgrade includes plans to redesign the protocol's relay chain, transforming the Polkadot network into cloud-like service infrastructure.

JOIN-ACCUMULATIVE MACHINE

A SEMI-COHERENT SCALABLE TRUSTLES VM
DRAFT 0.1.1 - April 18, 2024

Dr. GAVIN WOOD
FOUNDER POLKADOT & ETHEREUM
GAVIN@PARITY.IO



Source: graypaper.com

The upgrade will address several long-standing challenges related to interoperability and scalability. For example: At present, anyone can create a parachain since the network is permissionless, but Polkadot connects only the best and most efficient parachains to its Relay Chain.

In November 2021, Polkadot introduced slot auctions to regulate the number of operational parachains at any time. Winning one of these highly competitive auctions can be expensive, requiring a significant amount of DOT.

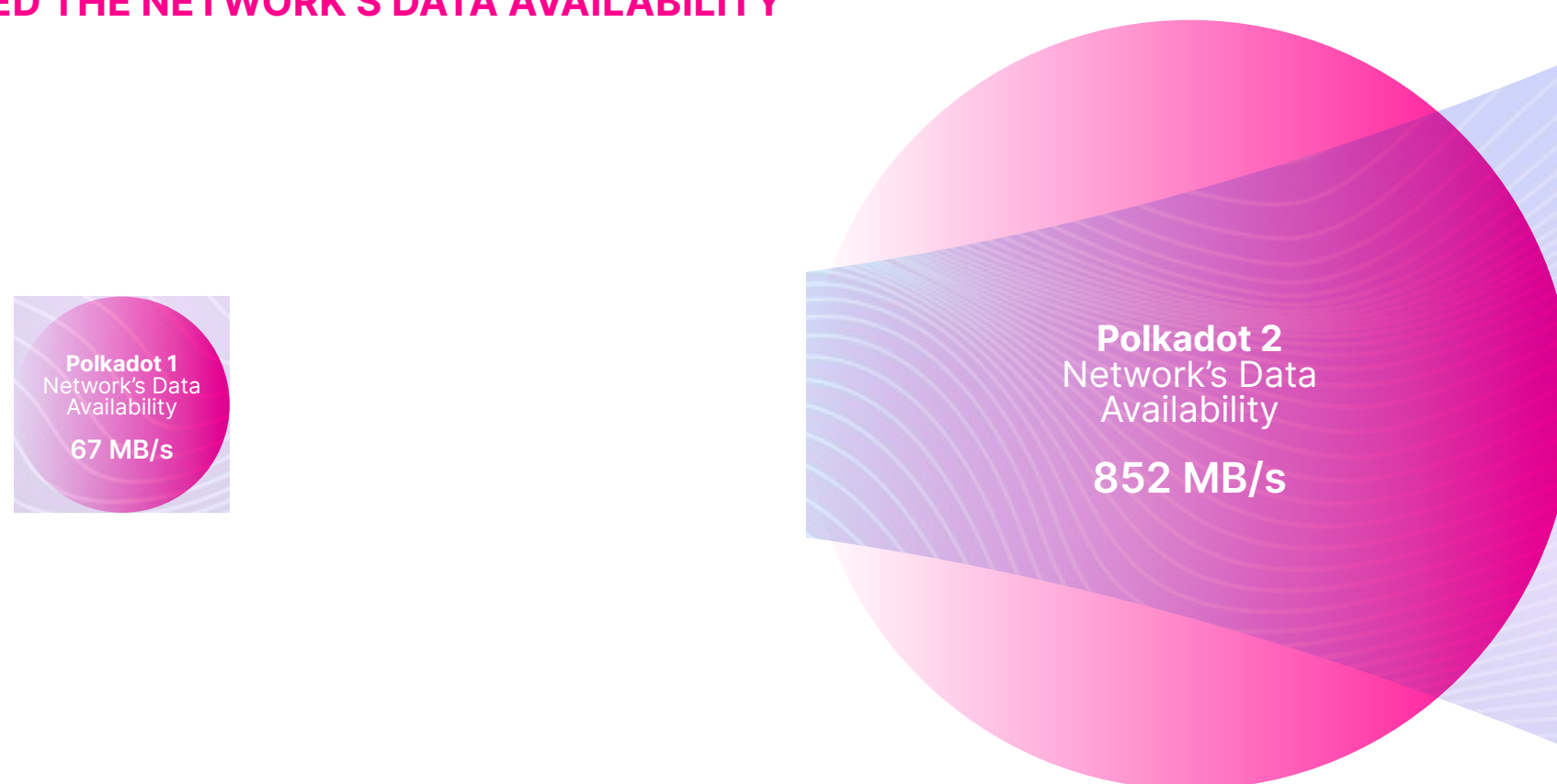
Additionally, the process of building a parachain is both complex and time-consuming. Parachains use a tool called substrate pallets to build their internal structure, and because these pallets are not standardised, each parachain must be customised.

The JAM upgrade aims to solve these problems by replacing the network's Relay Chain with a more modular and minimalist design. JAM's main goal is to streamline data integration and maintenance while maintaining the network's security and cohesion, meaning a faster, easier, and safe experience for users. The new hybrid system, which combines features of Ethereum smart contracts and Polkadot's architecture, is called the Polkadot Virtual Machine (PolkaVM).

Because JAM is built as a distributed computer, decentralised applications (dApps) built on the PolkaVM will be transactionless. This means that data is processed in stages, validated for accuracy, and securely added to the chain without typical transaction approval.

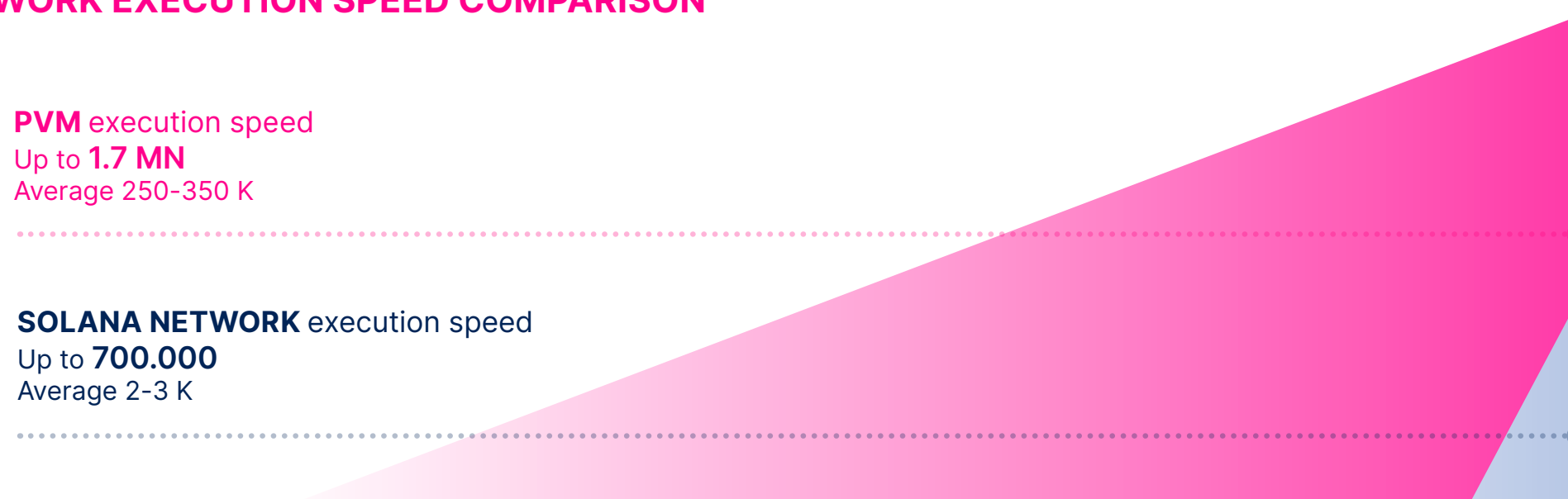
Things run faster with the JAM upgrade: 1023 validators totalling 341 cores — akin to off-chain virtual CPUs — significantly increase the network's data availability from 67 Mb/s to 852 Mb/s, compared to earlier iterations. This increase makes JAM capable of handling 85 times the computation load.

GRAPH 1. INCREASED THE NETWORK'S DATA AVAILABILITY



PolkaVM's execution speed can theoretically settle from between 250,000 and 350,000 transactions per second (TPS), to upwards of 1.7m. In contrast, the Solana network can theoretically process up to 700,000 TPS but settles between 2000 and 3000 TPS on average.

GRAPH 2. NETWORK EXECUTION SPEED COMPARISON



JAM is still in its nascent stages and is expected to be complete within the next five years. Plans are also underway to build a supercomputer with more than 12,000 cores — dubbed the 'Polkadot Palace' — to test JAM before it goes live. When it goes live, the upgrade will further underscore ongoing innovation on the Polkadot network, with DePIN and AI-supported projects in particular set to benefit.



Polkadot and AI

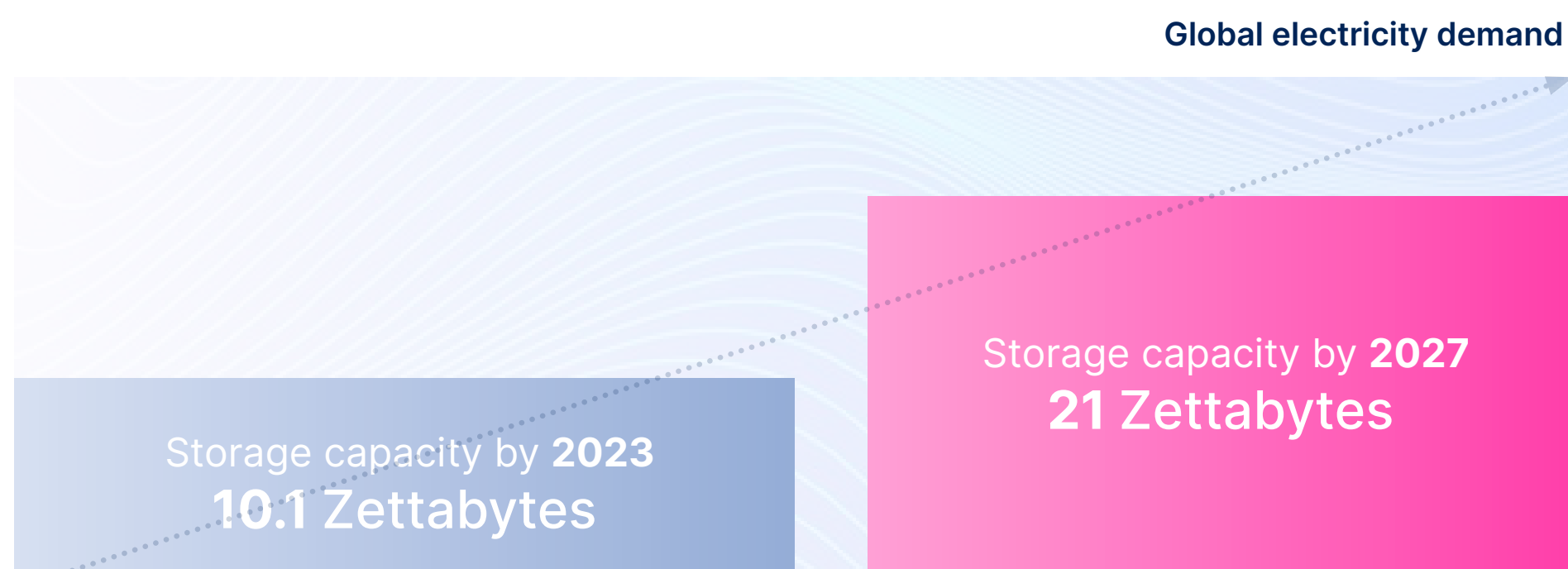
Polkadot's unique approach to network infrastructure could help crypto developers make new forays into AI-supported projects, by tackling one of AI's most pressing issues: its intense energy demands.

AI's deep learning algorithms and large language models require substantial computational resources and energy, and processing power and data storage may soon be in short supply. The International Energy Agency expects AI adoption to double global electricity demand by 2026, and Data Centre's 2024 Global Outlook report predicts storage capacity will double from 10.1 zettabytes in 2023, to 21 zettabytes in 2027.

However, Polkadot's foundational infrastructure could offer a scalability solution for novel AI projects. Its sharded, multi-chain network allows for parallel transaction processing, which reduces the energy needed for AI tasks by distributing workloads across a decentralised network.

A number of AI applications — including OriginTrail and Phala — have begun building on Polkadot's infrastructure, as developers seek to redefine what is possible at the intersection of blockchain and AI technology.

GRAPH 3. POWER SUPPLY AND DATA STORAGE SHORTAGE



OriginTrail

One popular parachain in the AI space is OriginTrail. As detailed in its March 2024 Whitepaper 3.0, the project envisions a ‘verifiable internet for all’ by leveraging the complementarities of crypto, internet, and AI technologies.

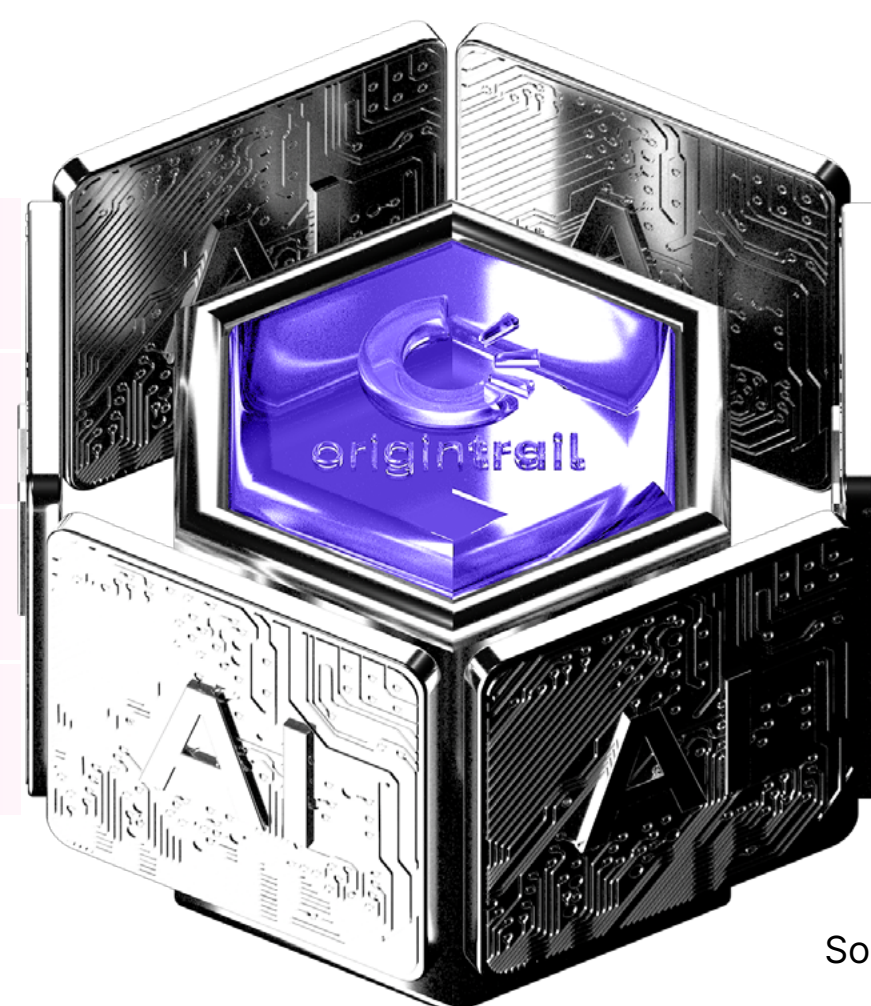
OriginTrail uses a special system called decentralised knowledge graphs (DKGs) to manage and share important information across a network. It can be thought of as a library system that organises information belonging to different users, while allowing them to easily connect and share information with each other.

With DKGs, businesses and individuals can create and add their intellectual property and information to their systems. This forms the basis of OriginTrail’s AI technology, which aims to provide AI responses based on verifiable information instead of conjecture.

The project began rolling out its latest iteration of the DKG in Q4 2023 on NeuroWeb, a permissionless EVM blockchain secured by validators of the Polkadot network.

NeuroWeb bills itself as the only blockchain focused on creating a ‘truly open and decentralised’ AI future using knowledge mining — the process of extracting meaningful information from vast amounts of data using AI and machine learning techniques.

- CREATE** TRUSTED KNOWLEDGE
- CONNECT** YOUR KNOWLEDGE WITH AI SYSTEMS
- SEARCH** SEMANTIC AND VERIFIABLE KNOWLEDGE
- OWN** YOUR KNOWLEDGE



Source: origintrail.io

OriginTrail's efforts have attracted some high-profile partnerships. The project is **collaborating** with ontological knowledge blockchain ONTOCHAIN to work on the European Union's data protection initiative, Next Generation Internet. Here, DKG-based tools were developed and integrated into ONTOCHAIN's tech stack, enabling the creation and exchange of ontological knowledge.

Further, in March 2024, the British Standards Institution, the UK's national standards body, **partnered** with OriginTrail to implement DKGs into the AidTrust medicine supply chain project. Polkadot **showcased** this work at a 2022 World Economic Forum-adjacent conference, hosted by Wood.

The project is also exploring the implementation of decentralised Retrieval Augmented Generation in developing the Polkadot network AI education tool, **PolkaBot.ai**.

Currently in beta, PolkaBot provides users with trusted information about various aspects of Polkadot, including its ecosystem, treasury proposals, and DOT tokenomics, using AI.

Phala

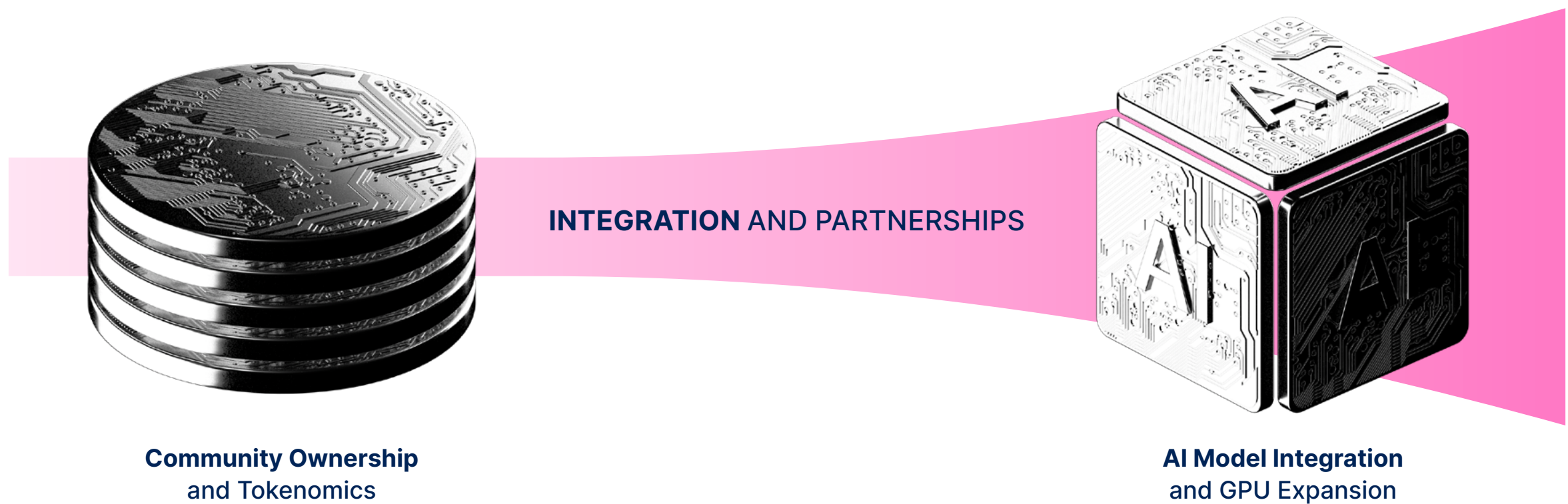
The decentralised cloud computing protocol Phala Network has lofty goals that rival giants like Amazon Web Services (AWS) and Google Cloud. Founded in 2018 by former Google software engineer Hang Yin and former Tencent product manager Marvin Tong, Phala left the Ethereum ecosystem and joined Polkadot's Canary network Kusama in 2021.

Now building as a parachain in the Polkadot ecosystem, Phala acts as an execution layer for Web3 AI services, offering a multi-proof system for building with an assortment of toolkits.

Developers can use Phala's infrastructure to integrate AI capabilities, and an AI co-processor assists with technical aspects like verifying data and executing smart contracts.

The network uses additional systems outside the main blockchain to handle large amounts of data. This setup improves the blockchain's performance by keeping the data secure and providing extra computing power for AI applications. It also ensures that sensitive information is protected with encryption and kept safe outside the main blockchain.

On April 8, 2024, Phala pivoted from using the 'Phat Contract' to the 'AI Agent Contract'.



Source: phala.network

AI Agent Contracts are designed to improve blockchain functionality by helping integrate AI technology, spreading out who can own and earn money from these technologies, and allowing more kinds of AI applications to be developed. The idea is to create a marketplace where AI services can be bought and sold freely by anyone.

Phala plans to expand its graphics processing unit capabilities further to integrate large language models with Web3. It also anticipates publishing the Phala Whitepaper 2.0, although a timeline for the whitepaper has not been made public.

DePIN meets Polkadot

Perhaps more promising is the advent of DePIN, which could represent a major step forward for crypto use cases.

One of the core concepts of DeFi is, of course, a decentralised network. This refers to the absence of a central authority or intermediary controlling a system. A decentralised network distributes power and control to its user base, ideally giving them equal rights in the network's operational procedures.

DePIN, meanwhile, is a decentralised network of connected physical objects and devices, such as phones and computers. DePIN distributes resources for various sectors, including data storage, cloud computing, and power grids.

In web 2.0 service provision, dominant players such as AWS and Google Cloud typically seek to monopolise these services, maintaining centralised control over their networks and killing smaller competitors.

As a grassroots countermovement, DePIN distributes ownership and control across a network of users. DePIN projects also generally employ strategies similar to DeFi projects, which often provide incentives such as tokens, in exchange for services, such as contributing resources or maintaining infrastructure. This helps develop a durable and cooperative ecosystem.

The Helium Network, for example, has operated as a decentralised wireless network since 2013. The network is powered by hotspots owned and operated by users, who receive a financial incentive – the Helium token – in exchange for their hotspot coverage.

DePIN projects face challenges with scalability and interoperability. For a DePIN project to expand, it must have sufficient infrastructure to facilitate smooth communication, and accurate data exchange to meet increasing demand.

Polkadot user numbers hit an all-time high in April 2024, at 650,000, which will help address this issue. The JAM upgrade will further bolster scalability because an improved user experience means more users. Several Polkadot-based projects are already moving to innovate with DePIN, brightening the outlook for near-term DePIN development.

Peaq

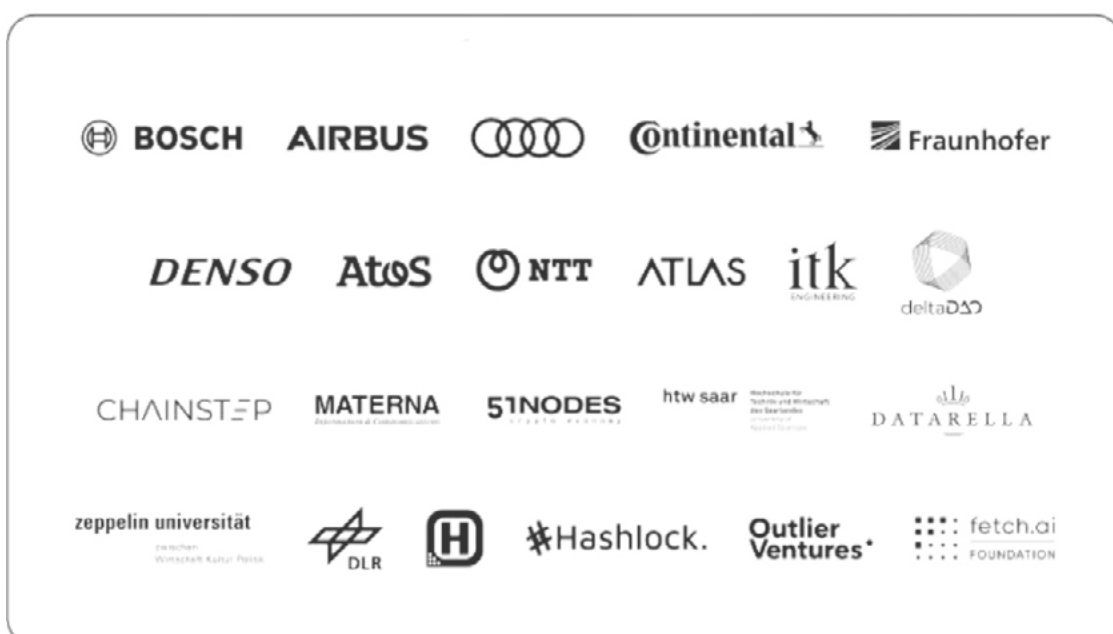
Peaq is a Polkadot parachain tailored for DePIN applications. Built with the Rust coding language and EVM smart contracts and pallets, Peaq provides a range of modular DePIN offerings that interact with the Polkadot ecosystem, including self-sovereign machine IDs, data verifiers, data storage, and autonomous AI agents.

Peaq ECOSYSTEM MARCH 2024

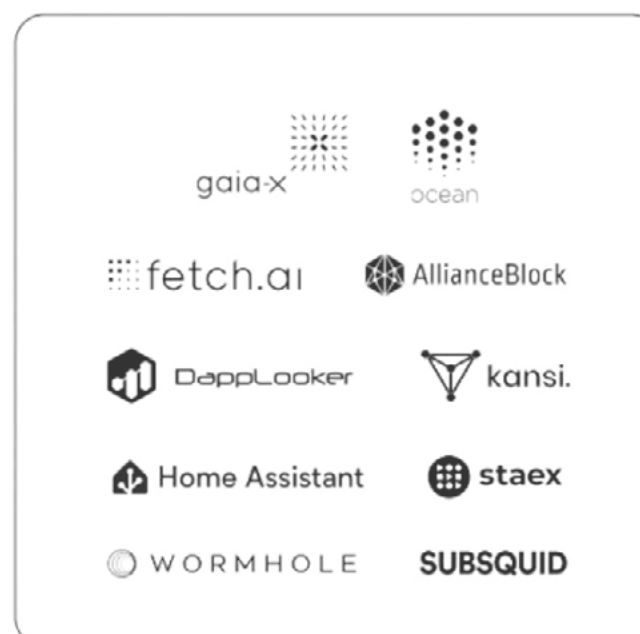
DePINs & dApps



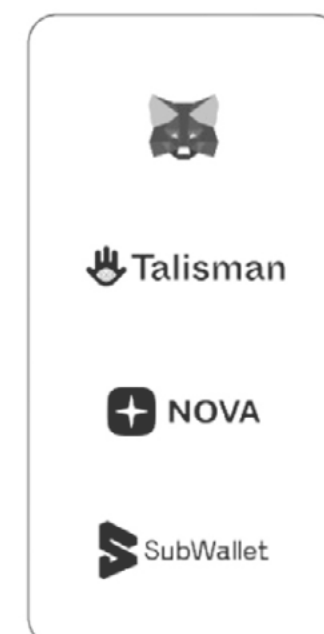
Enterprises & SMEs



Integrations



Wallets



IDs



Source: Peaq

Using key performance indicators designed to scale with increased usage, the Peaq network currently supports approximately 10,000 TPS, and can theoretically scale up to 500,000 TPS. The network achieves block finality in six seconds, according to Polkadot data, and the JAM upgrade will theoretically reduce this time to approximately 0.25 seconds.

46 DePIN applications are already operating on the network. Offerings include satellite crop monitoring, AI-powered drone internet, water quality monitoring, ridesharing, and decentralised real-time maps.

Peaq welcomed two additions to its ecosystem in late April 2024. On April 25, drive-to-earn platform MapMetrics **announced** that it would be moving from the Solana network to Peaq, favouring Peaq's DePIN-focused infrastructure.

The **following day**, Peaq revealed the successful integration of AI-powered street-mapping DePIN project NATIX into the Peaq ID system. NATIX can now assign Peaq IDs to mobile devices within its staging environment to effectively manage flows for real-time geospatial data collection.

Peaq also offers several Machine DeFi platforms for trading and asset management, including liquidity mining and yield farming, decentralised insurance, and crowdfunding initiatives.

A pioneering concept coined by Peaq, Machine DeFi is defined as **decentralised finance for machines in the Economy of Things**. Machine DeFi platforms help bring new machines to the Peaq network via financing mechanisms such as crowdfunding and community-voted subsidies.

Peaq is now preparing for a full-scale launch after completing a \$15m **Series A funding round** led by Generative Ventures and Borderless Capital.

Nodle

Nodle became Polkadot's 11th parachain after winning its auction in March 2022. The network self-funded another successful auction in September 2023, extending its lease until August 2025.

Using a concept called 'proof of connectivity', Nodle is a decentralised wireless network that uses smartphones to create its infrastructure. With it, developers and users participate by using their phones to provide bandwidth and wireless radio in exchange for NODL tokens.

One of Polkadot's busiest protocols, Nodle connects businesses and smart cities to its user base by leveraging Bluetooth Low Energy (BLE). The network is populated by 5m daily active smartphones and 30m internet of things (IoT) devices spanning 185 countries and more than 175,000 sq km.

MONTHLY H3 ACTIVE
TILES

11.733.127

MONTHLY COUNTRIES
COVERED

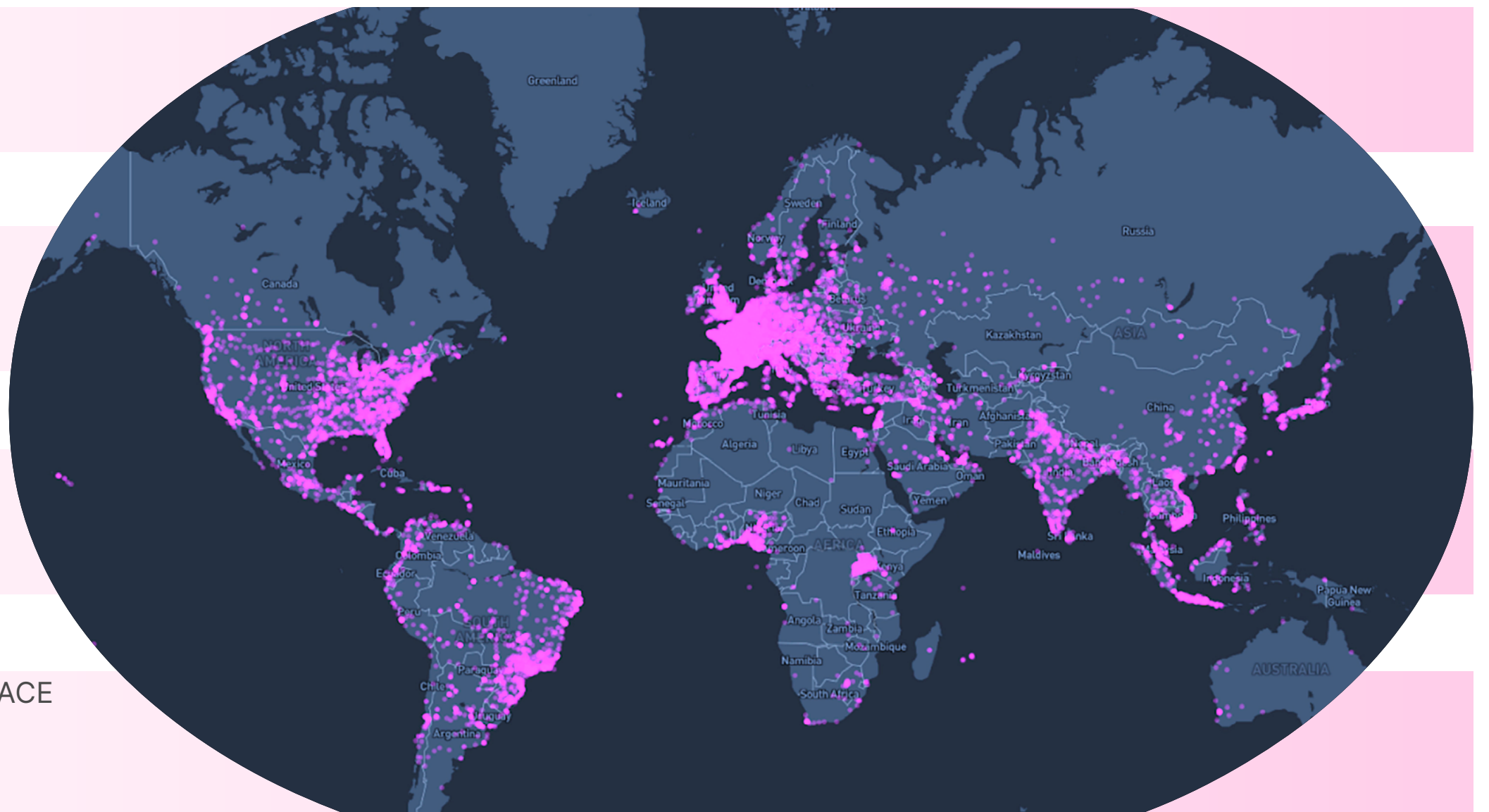
185

AVERAGE NODES PER
ACTIVE TILE

1.69

MONTHLY TOTAL SURFACE
AREA KM²

176.554



Source: [Nodle Explorer](#)

NODLE OFFERS SEVERAL PRODUCTS AND SERVICES, INCLUDING:

[Nodle App](#)

Turns user phones into nodes through the use of BLE technology;

[Nodle Hotspot](#)

Reduces e-waste by transforming old Android phones into hotspots that earn providers NODL tokens;

[Click App](#)

Authenticates and signs user media such as photos and videos for sharable authenticity;

[ConnectX](#)

Connects a low-cost global network of phones using BLE to enable interaction with IoT devices;

[ConsentSign](#)

Authenticates media content on blockchain to provide untampered and trustworthy document verification; and

[NodleSK](#)

Monetises smartphones through the app to generate ad-less revenue without collecting user data.

Nodle brings real-world consumer use cases to the Polkadot network, rewarding users of its iOS and Android applications.

The Road Ahead

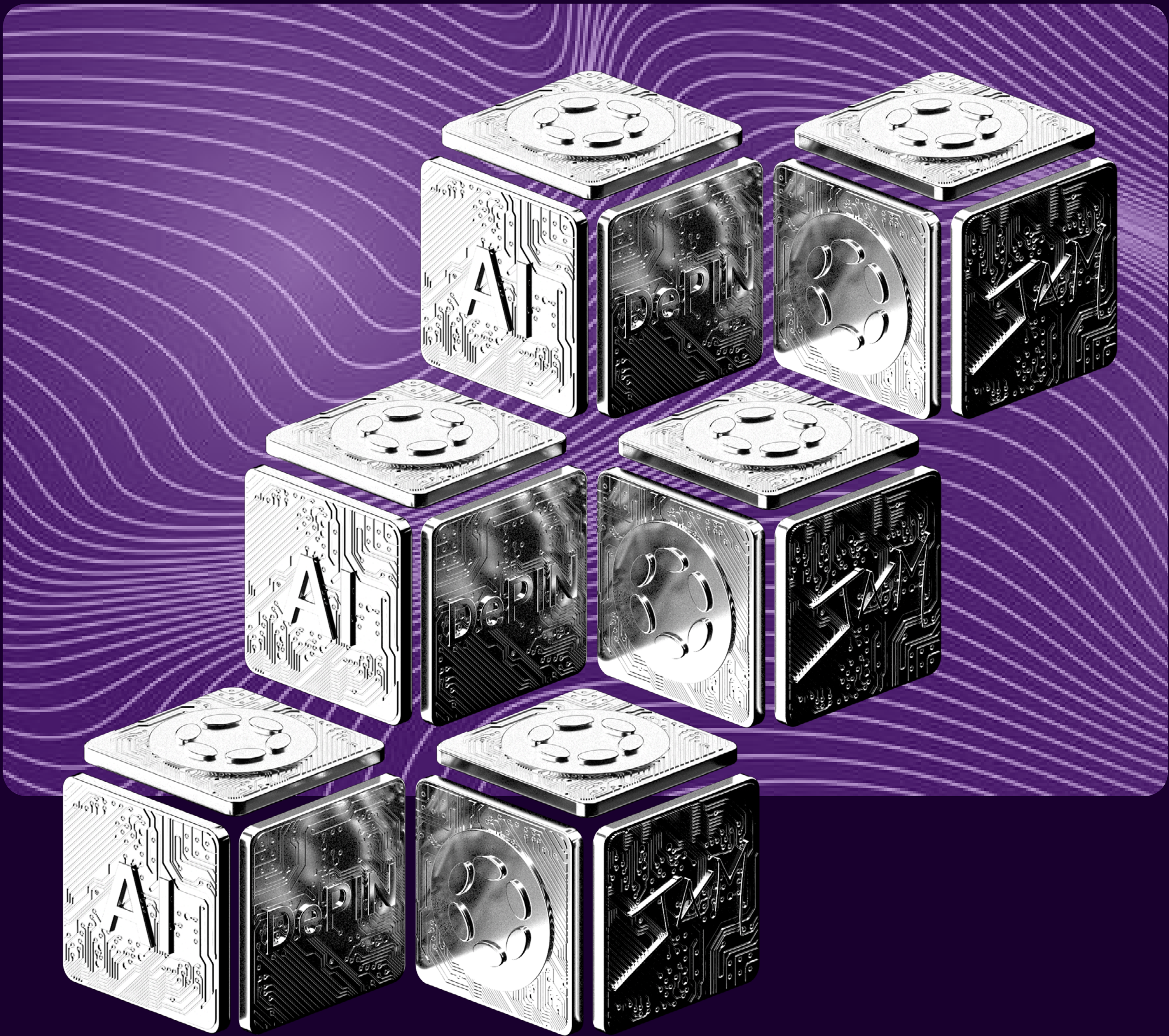
DePIN and AI-supported projects already active on Polkadot give a hint of things to come, proving that the network remains a major innovator and force to contend with. Polkadot's journey from 2016 whitepaper to blockchain superstructure will continue, and the JAM upgrade will be the next big game changer.

Parachains will continue to play an integral role in the network after the upgrade, as they will be one of the first services to run on JAM. Indeed, the upgrade will feature a parachain service that supports existing Substrate-based parachains, enabling developers to keep using Substrate for blockchain development.

DOT will also continue to be the network's flagship offering and the only way to interact with JAM. No new token will be issued.

For those interested in learning more about the [JAM upgrade](#), the recently updated [Polkadot Wiki](#) provides comprehensive resources covering the network's architecture, governance, and economics. All the dots are connected, and they lead to an interconnected web3 world powered by Polkadot.





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