Annual Report 2023
Polkadot in Numbers

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1. Introduction

As the **Data Team** at Parity Technologies, we're driven by the conviction that data is the cornerstone of meaningful advancements. It's through understanding data that we can unlock the full potential of the Polkadot ecosystem and demonstrate its value to the world. Our mission is to decode Polkadot's block data and ecosystem data, transforming them into valuable community insights.

Our journey began with the creation of a data warehouse ("**Dotlake**") to first serve Parity's internal data needs. We've now broadened our scope, sharing our initiatives and learnings with the wider community. We plan to progressively make our datasets available to the public in 2024, alongside dashboards, metrics, code, and best practices we employed to ingest and decode Substrate data (Select * from Polkadot, Pieces of a decentralized data lake, etc.).

The heart of our solution is Dotlake, a scalable and cost-efficient data platform built on Google Cloud Platform (GCP). It's designed to store all blocks, events, extrinsics, and more for all the chains in the Polkadot ecosystem. We've utilized a range of existing technologies, keeping the architecture simple with low operational overhead. This includes tools like Terraform, the Substrate Sidecar, Rust & Python programming languages, and various GCP services like Cloud Storage, BigQuery, Cloud Run & Jobs, and Workflows & Functions.

Our approach allows us to process data from block number N to M, storing the raw results as JSON in Google Cloud Storage. This method not only provides a convenient abstraction, but also avoids the pitfalls of custom block parsing strategies in the ever-evolving Substrate Framework. The key to our platform's efficiency is our Block Compressor, which optimizes and reduces the data size significantly, making it more manageable for analytical purposes.

Dotlake currently consists of 70+ Polkadot & Kusama chains with their full history and is continuously expanding. The focus of this report is the Polkadot relay chain and its parachains.
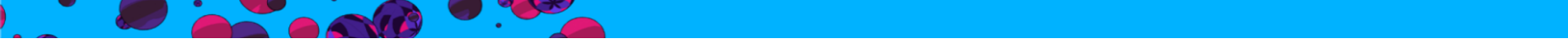
Since Q2-2023 we have been working diligently with Dune Analytics' team to integrate Polkadot Ecosystem data into their platform, which will further democratize access to Polkadot insights.

Dotlake: Batch
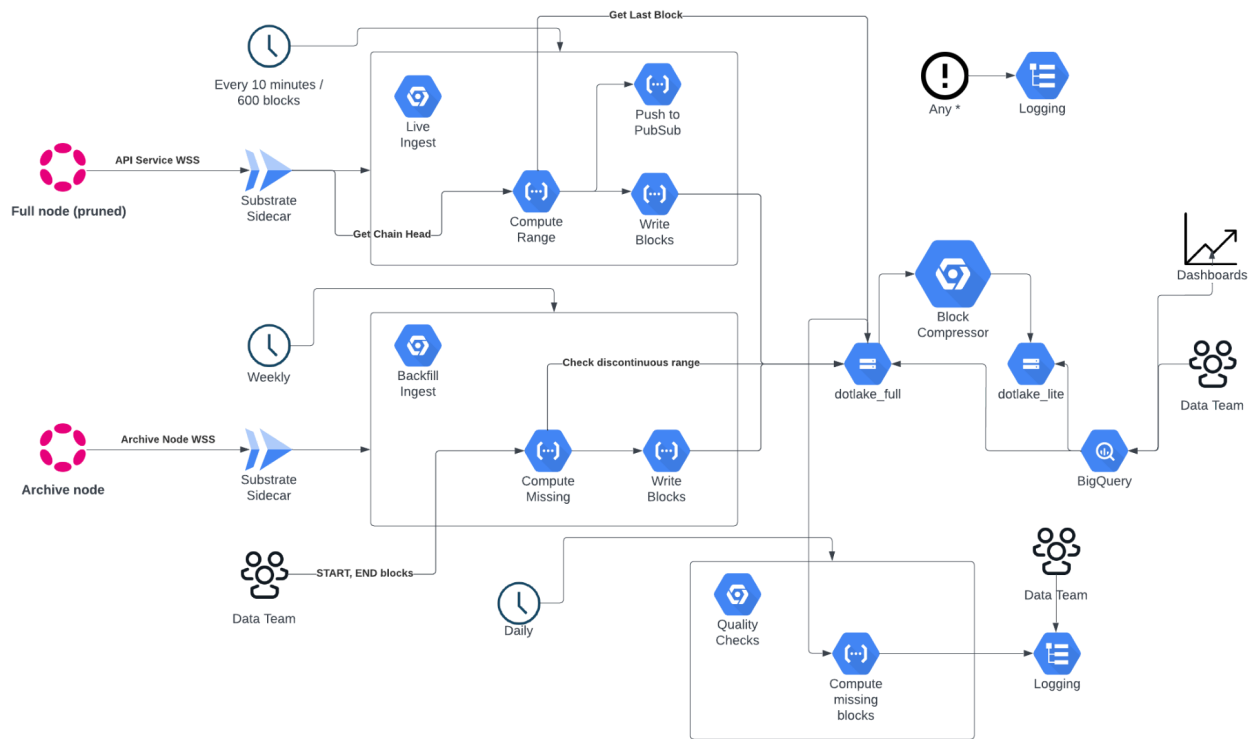
Dotlake: Real-time
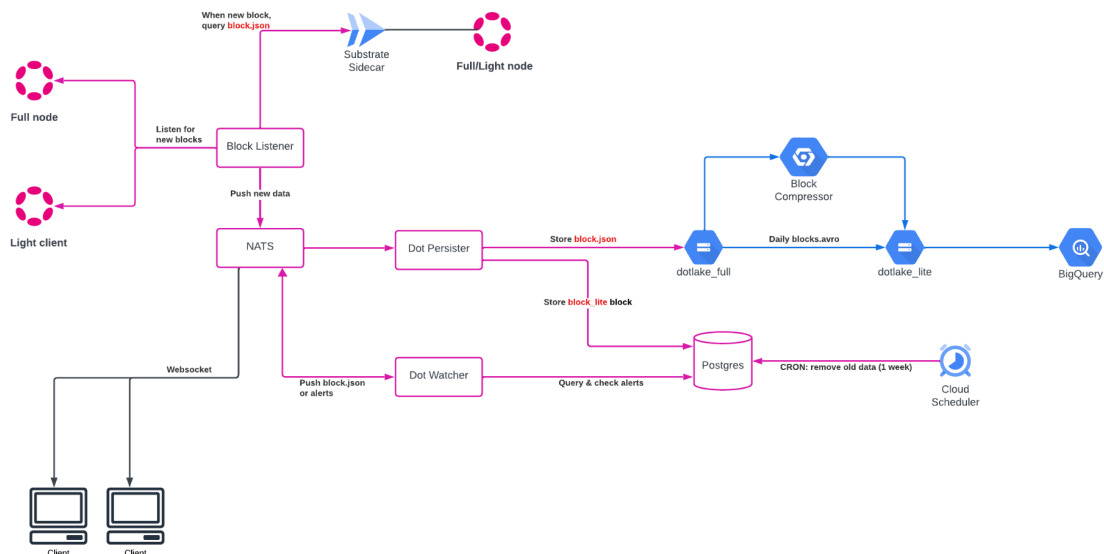
This report is an attempt to share some of the insights we have, by combining dashboards and metrics accompanied by lightweight wiki descriptions about each report area covered in order to educate our readers on key aspects of Polkadot.

If you're new to Polkadot, its design and architecture, we recommend starting with section 2 "What is Polkadot", but if you're a veteran and have technical understanding, we suggest moving directly to the first graphs, in section 3 "Shared security of the network".

All charts are produced in monthly increments or YTD with a cut-off date as of 1st December 2023, unless otherwise explicitly stated.

Your feedback on this report as well as data and metrics you would like us to integrate in future iterations, would be very valuable. Please don't hesitate to reach out - data-team@parity.io.

1.1. TL;DR

- **Polkadot XCM v3 merge** - January 2023
  - XCM V3 has been officially released on Polkadot, bringing enhanced features such as sophisticated programmability, improved bridging with external networks, cross-chain asset locking, refined fee payment systems, and support for Non-Fungible Tokens (NFTs)
- **OpenGov** launched on Polkadot 15th June 2023
  - OpenGov, Polkadot's revamped governance system, streamlines decision-making by focusing on referenda and removing separate bodies like the Council and Technical Committee, introducing features like multiple 'Origins' and 'Tracks' for categorizing proposals, and enabling more direct community control with flexible voting, agile delegations, and enhanced involvement in proposal submission and management.
  - In 2023, the Treasury registered a 1.825M DOT positive inflow
- **Polkadot 1.0** - completion of Polkadot Whitepaper and handover to community
  - The release of Polkadot 1.0 in July 2023, delivered on its original vision with features like heterogeneous sharding and cross-chain communication, while introducing Long Term Support for stability, and transitioning all runtime code to community management, marking a significant step in decentralization and future community-driven development.
- **Native USDC Launch on Polkadot Asset Hub system parachain**
  - September 2023 was notable for the launch of Native USDC on Polkadot Asset Hub which enhanced stablecoin functionality for the Polkadot Ecosystem with over 4.5m USDC available in circulation by Mid-December.
- **The Great DOT Unlock**
  - Beginning in October 2021, the almost 100 Million DOT tokens were locked for nearly 2 years from the initial five parachain auctions were unlocked. On October 24th at 01:59 UTC, those tokens were unlocked, resulting in a rise of over 5% of the total staked amount.
- **50 parachains on Polkadot**
  - The number of **parachains** has continuously grown throughout the year reaching **50 L1 blockchains secured by Polkadot** in Q4

- **Leading in decentralization metrics - the Nakamoto Coefficient for Polkadot is 93**
  - As of November 2023, the Nakamoto Coefficient for Polkadot is **93**, indicating a high level of decentralization, as it would require collusion among these many validators to control over a third of the network's stake.
- **Asynchronous Backing** live on Rococo testnet - October 2023
  - The Asynchronous Backing upgrade in Polkadot enhances network performance and scalability by enabling validators to process multiple parachain blocks concurrently, thus increasing throughput and efficiency, decentralizing block production, and accelerating block times. This substantial modification to Polkadot's consensus mechanism, currently under testing on Rococo and soon to be deployed on Kusama, is expected to significantly scale the network to support around 1,000 validators by the end of 2024.
- Web3 Foundation unveiled **The Decentralized Futures Program**
  - providing 20 million USD and 5 million DOT to kickstart teams and initiatives driving Polkadot's success.
- **Ecosystem activity**:
  - the Polkadot Relay and Parachains sent over **100M fee paying transactions** and averaged monthly ~9.124M
  - The number of **unique addresses** grew at a steady pace in 2023 with a 44% increase from `3.162M in January to ~4.54M in November
  - **Spike in XCM activity** in Q4 - QoQ 60% increase observed in XCM parachain activity
  - **Developer activity** in Polkadot has been consistently stellar, with over 800 unique developers committing to codebases each week in 2023

2. What is Polkadot

2.1. The blockspace ecosystem for boundless innovation
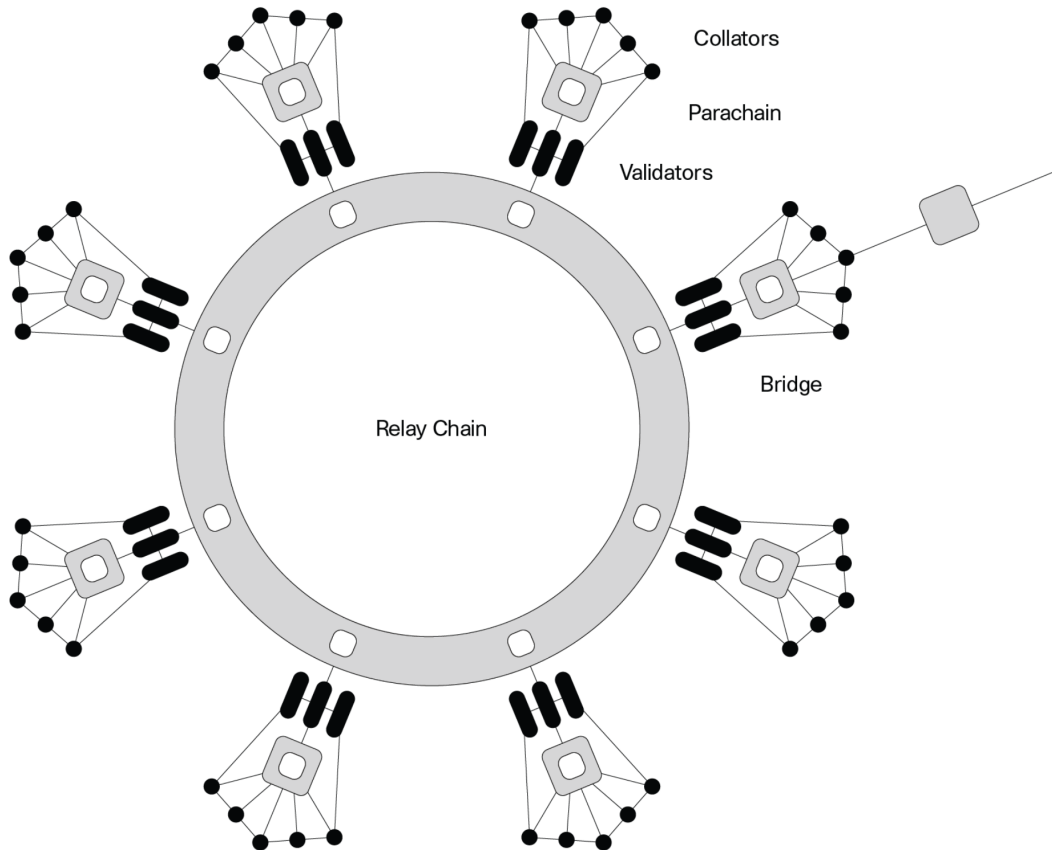
Polkadot is a heterogeneous multichain platform characterized by shared security and interoperability. It is designed to enable multiple blockchains to transfer messages, including value, in a trust-free fashion. Key components of its architecture include the Relay Chain, Parachains, and Bridges.

Relay Chain: The central chain of Polkadot, responsible for the network's shared security, consensus, and cross-chain interoperability. It is deliberately minimal in functionality (e.g., does not support smart contracts) and focuses on coordinating the system, including parachains.

Parachains - dedicated and on-demand: Polkadot facilitates a sharded network where transactions are processed in parallel. Parachains are application-specific layer-1 individual blockchains that connect to the Relay Chain, have their own tokens, and can be optimized for specific use cases. L1 chains attached to Polkadot benefit from its shared security model, including the Nominated-Proof-of-Stake (NPoS) mechanism, which provides out-of-the-box

security without the need for individual chains to bootstrap their own. Parachains can have a dedicated slot procured by on-chain auction (current model), or operate on a more flexible on-demand basis, procuring Bulk or Instantaneous Coretime, trading blockspace, and utilising only specific amount of blockspace needed for individual block production (new model).

Cross-Consensus Messaging Format (XCM) - facilitates trust-free message passing between parachains, enhancing interoperability.

Bridges: These enable connections between Polkadot and external blockchains (like Ethereum), allowing for the transfer of data and tokens.

The **technology stack** of Polkadot includes:

- **Polkadot Runtime:** The core state transition logic, upgradable without a hard fork.

- **Polkadot Host:** The environment executing the runtime, involving components like networking (Libp2p), state storage, consensus engines (GRANDPA and BABE), Wasm interpreter, and low-level blockchain primitives.

- **WebAssembly (Wasm):** Used as the compilation target for the runtime, ensuring platform-agnostic and efficient execution.

Key features include:

- **Forkless Upgrades:** Enabled by storing the runtime on-chain and using Wasm, Polkadot can upgrade without hard forks.

- **Consensus Mechanisms:** It employs Nominated Proof-of-Stake (NPoS), hybrid consensus (combining BABE for block production and GRANDPA for finality), and BEEFY for bridging with non-Polkadot networks.

Stakeholders in the Polkadot ecosystem include **Validators** (block producers on the Relay Chain), **Nominators** (stake bonders supporting validators), and **Collators** (maintaining parachains and providing proofs to validators).

2.2. Ubiquitous computing engine
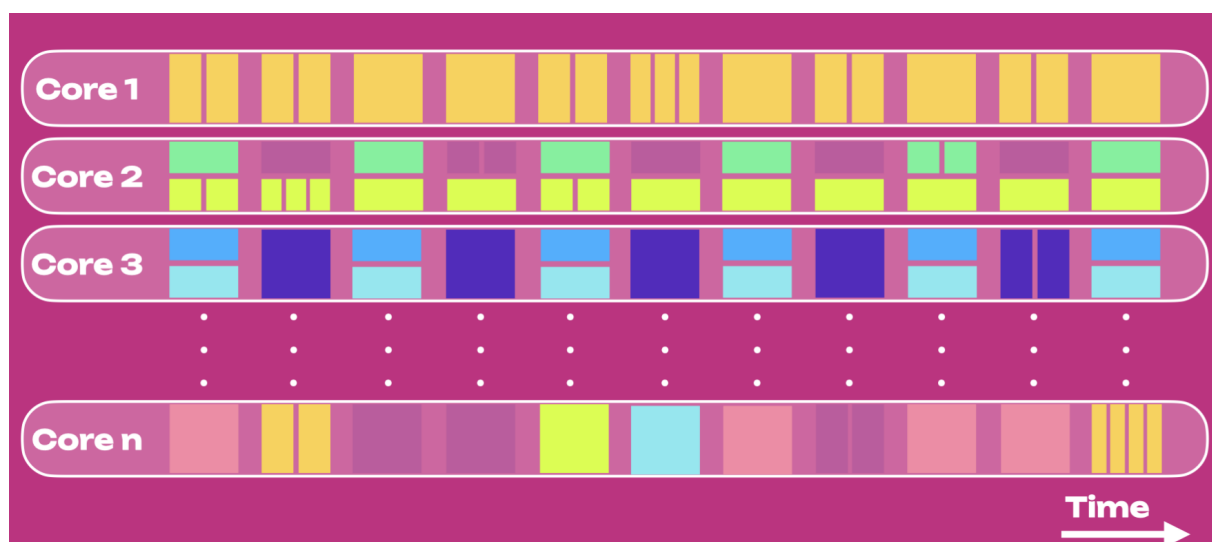
Based on [Gavin Wood's talk at Polkadot Decoded 2023](#), the direction of Polkadot 1.0 illuminates a shift towards more abstract and generalized blockchain functionality, moving beyond the original concepts in its whitepaper.

Polkadot as a Computational Resource

Polkadot is a platform for building applications using underlying resources called [Blockspace](#). It provides a resilient general-purpose continuation computation and operates like a multicore computer with chains called parachains operating in parallel. It is not just a platform for hosting chains but for people to use those applications.
As of end of November 2023, there are 50 independent cores in Polkadot.

Polkadot is transitioning from a chain-centric ecosystem, where each parachain owned a dedicated execution core, to an application-centric model, where cores are shared resources. The previous model used [slot auctions](#) for securing parachain slots, but with the shift towards a coretime marketplace, applications can now purchase or reserve coretime on demand, significantly lowering entry barriers for developers.

The new model introduces agile core usage and coretime allocation, ensuring efficient utilization of Polkadot's computation and blockspace according to application needs, without waste. "Accords" are set to improve cross-chain communication and security of XCM messages. Furthermore, Polkadot plans to increase its scalability by offloading on-chain logic to system parachains, thus freeing up more bandwidth for parachain protocols and accords.

The coretime marketplace represents a departure from traditional slot auctions, treating coretime as a tradeable tokenized commodity. Applications can opt for bulk or instantaneous coretime rental, with options to standardize the rental through a broker system or purchase immediate use at a spot price.

Polkadot's shift towards application-centricity focuses on leveraging the collaborative potential of different chains to build applications that operate across chains, addressing real-world problems. The relay-chain will concentrate on its primary tasks of security and message passing, while system parachains will assume secondary tasks, creating a more streamlined and efficient ecosystem.

Polkadot is perfecting its implementation through RFCs to continue being a decentralized, secure, ubiquitous computing engine to power the next generation of Web3 applications.

# 3. Shared Security of the Network

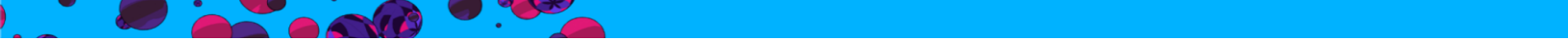## 3.1. Polkadot's Security Architecture

Relay Chain is the core of Polkadot, crucial for its security, consensus, and cross-chain communication. It doesn't directly support smart contracts or user applications, focusing instead on coordinating the entire system. Validators on the Polkadot network are staked in DOT on the Relay Chain, which features a limited range of transaction types primarily for governance, parachain auctions, and NPoS participation. Its functionality is intentionally minimal, delegating specialized core protocol features to various system chains and specific tasks to parachains that offer diverse implementations and features. This design ensures efficient overall coordination and flexibility within the Polkadot ecosystem.

Nominated Proof of Stake (NPoS) on Polkadot is an election algorithm designed to achieve three primary goals: maximizing the total amount staked, maximizing the stake behind the minimally staked validator, and minimizing stake variance across validators. It employs algorithms like Sequential Phragmén, Phragmms, and Star Balancing for computing solutions. The Sequential Phragmén method elects validators based on their self-stake and stakes from nominators, balancing weights between validators after each election. This complex optimization is performed off-chain by Polkadot to maintain consistent block times. As shown below, 51.25% of the total 1.383B DOT in issuance was staked as of November 30 2023.

Polkadot: Staking Rate
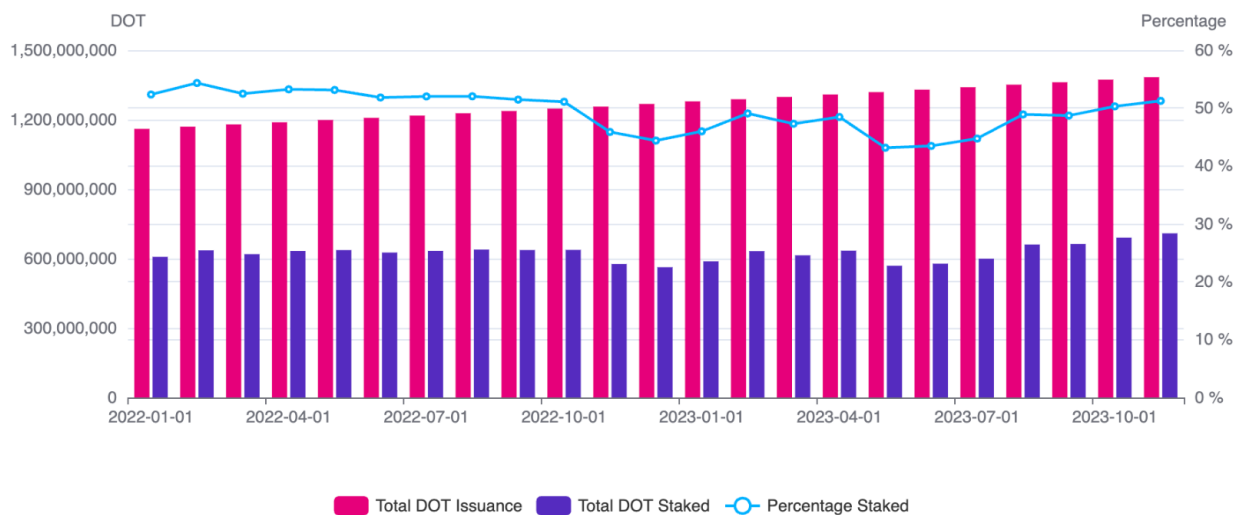
Source: DotLake

NPoS functions in the background, requiring little user intervention, although understanding its mechanics is beneficial for nominators. In Polkadot's system, voter weight is proportional to token holdings, mirroring a corporate shareholder election more than a traditional politikcal one. The Weighted Phragmén algorithm, an extension of the basic method, sequentially elects candidates while building a weighted mapping of each nominator's selection for validators, ensuring fair stake distribution. Post-election, a redistribution process attempts to minimize variance in voter stakes among elected candidates, ideally allowing each nominator to support a single validator per era.

In Polkadot, proportional representation ensures decentralization by preventing any minority group from having excessive influence. Traditional systems focus on avoiding underrepresentation of groups, but Polkadot goes further by also avoiding overrepresentation. This approach enhances the security of the network, as a more evenly distributed representation makes it harder for any single group to dominate or manipulate the system. Polkadot's use of the seqPhragmen election rule is unique in this respect, offering an added layer of security through balanced representation.

3.2.   Decentralization - Nakamoto Coefficient

In the world of blockchain and cryptocurrencies, decentralization is a key feature for security and fairness. One common approach to quantify network's decentralization is through the Nakamoto **Coefficient** metric. In simplified terms, it represents a minimum number of validators controlling more than 33% of stake in PoS networks.

Polkadot's Approach to Decentralization

Polkadot employs a distinctive method to ensure network decentralization, primarily focusing on its validator selection process. Unlike other blockchain networks where a validator's stake amount can significantly influence consensus power, Polkadot operates differently. All active validators in Polkadot's GRANDPA consensus protocol have equal voting power regardless of their stake. This design choice is crucial in maintaining a balanced and decentralized network.

The Phragmen Election Algorithm

Polkadot's network utilizes the Nominated-Proof-of-Stake (NPoS) mechanism and Phragmen election algorithm to select validators. This algorithm optimizes the validator set by maximizing the total value staked, boosting the stake behind the least staked validator in the set, and minimizing the variance in stake distribution. With **297** active validators at any time, and approximately **700** others waiting, the validator set is dynamic and changes every era (about 24 hours). This constant flux in validator composition enhances network security and decentralization. Below you can see a monthly

snapshot of this process where the number of active validators and waiting validators are listed for the last block of a given month - the number of active validators is constant while there can be small fluctuations in the number of waiting validators.

Polkadot: Nominators & Validators
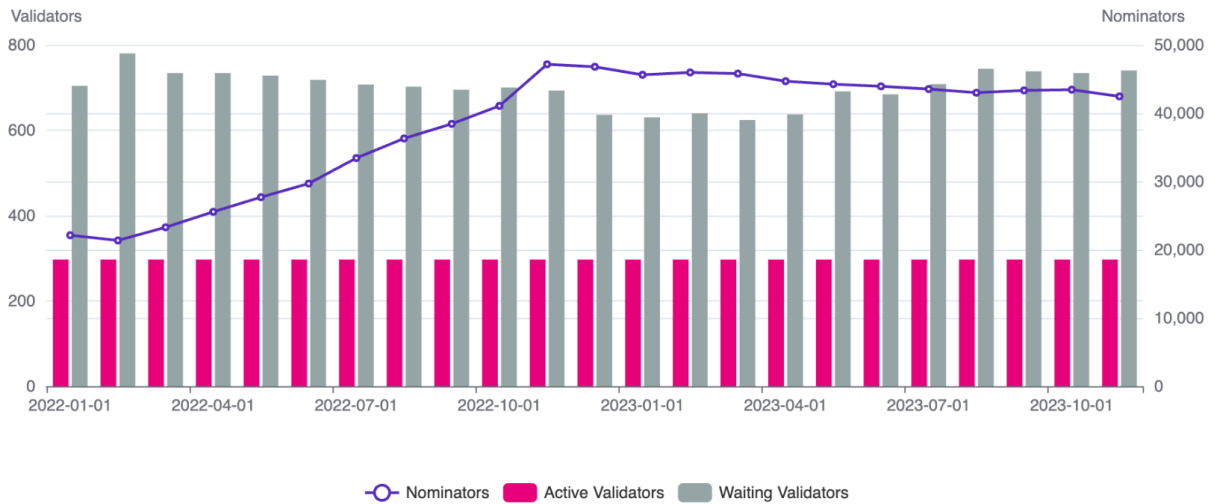
Understanding Polkadot's Nakamoto Coefficient

The Nakamoto Coefficient in blockchain networks typically refers to the minimum number of entities required to control a significant portion of the network, often leading to consensus failures. For PoS blockchains, this threshold is tied to the control of over 33% of the total stake. However, Polkadot's equal voting power among validators changes this dynamic.

At the time of writing, in Polkadot's case, the Nakamoto Coefficient is equal to 93, meaning top **93** validators held one third of total stake, which means that 93 entities would need to collude to control the network. This high number is a testament to Polkadot's robust decentralization.

Polkadot: Nakamoto Coefficient
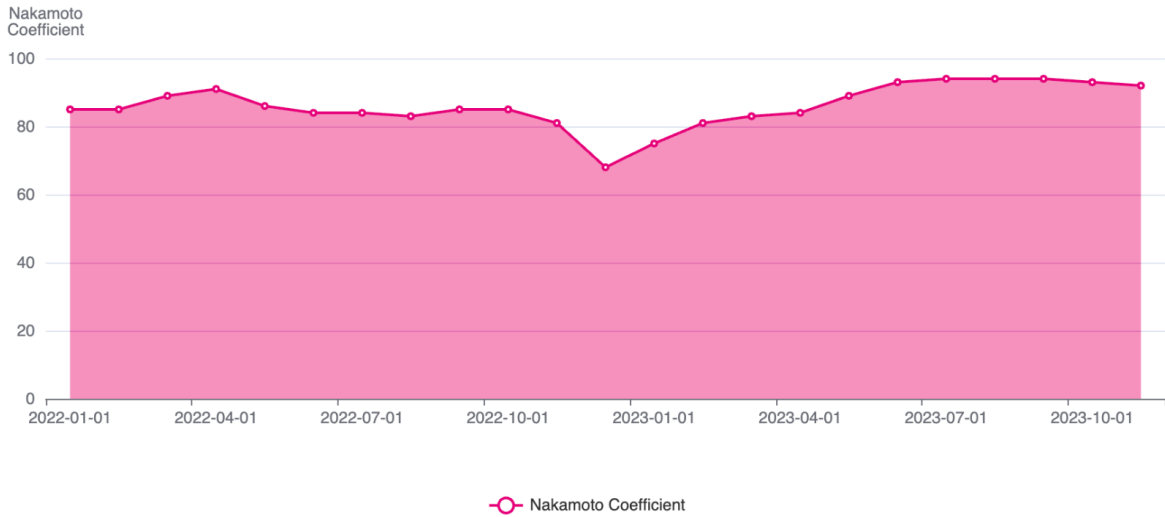
Furthermore, the minimal difference in stake percentages between the highest (**0.47%**) and lowest (**0.29%**) staked active validators on November 30th 2023 further underscores this balance.

Polkadot: Minimum and Maximum Validator Stakes

3.3. Polkadot Tokenomics

Polkadot's tokenomics revolve around its native token, DOT, which serves multiple purposes including economics, slashing, governance, and parachain allocation. In terms of economics, DOTs are minted or burned to reward nodes running the consensus protocol, fund the treasury, and control the inflation rate. Polkadot's proof-of-stake system involves validators, who stake DOTs to produce blocks and reach consensus, and nominators, who support validators with their stakes and share in rewards and penalties.

The inflation model in Polkadot is non-linear, and driven by the Nominated Proof of Stake (NPoS) payments, where the inflation rate is a function of the staking rate and aims to balance security and liquidity by adjusting incentives for staking DOTs. The inflation rate comprises various factors, including inflation from minting for NPoS and the treasury, deflation from slashing, and transaction fee burns.

Validators and nominators earn rewards through a point system based on their participation in validity checking and block production. These rewards are proportional to the points earned in each era, which are then divided amongst validators and nominators. The payment distribution within each validator slot is based on a proportional stake, with a fixed commission fee for the validator and the remainder shared among all parties in the slot.

Polkadot's tokenomics are designed to incentivize network participation and security while balancing the needs of governance, staking, and parachain development. This approach creates a dynamic ecosystem where token holders are actively involved in network maintenance and decision-making.

4. Governance

4.1. Gov 1 - the first iteration of Polkadot Governance

Polkadot initially implemented an innovative decentralized governance system that featured a tri-cameral structure: a technocratic committee for upgrade timelines, an elected executive body that initiated legislation to manage parameters, administration, and spending, and a general voting system that favored long-term stakeholders. Somewhat inspired by parliamentary democracy, this system functioned effectively for 2–3 years, efficiently managing treasury funds and implementing upgrades and critical fixes.

However, there were challenges. The centralization and lack of anonymity in the executive council (the Council) posed risks to the protocol and its members, who could be pressured into biased decisions. The Technical Committee faced similar issues of centralization and vulnerability. In a society where decentralization is increasingly vital for safety and security, these aspects were concerning.

Another limitation was the singular, all-encompassing referendum model, curtailing the decision throughput by restricting the number of proposals that could be considered simultaneously and leading to prolonged voting periods. This system favored in-depth consideration of a few proposals over a broader range of many, inadvertently curtailing the potential of collective decision-making.

The governance model also had inherent exclusivity due to high barriers to entry, impacting diversity and inclusivity, and ultimately affecting turnout and legitimacy.

Although the original model was considered advanced in the Web3 space, by acknowledging that this first version was a starting point, improvements and iterations were always anticipated. As a result, a new model was designed and launched, set to advance Polkadot's governance, addressing these issues and evolving the ecosystem's decision-making process even further.

4.2. Introducing OpenGov:

OpenGov, the advanced governance system for Polkadot, aims to address the shortcomings of the previous model. It retains core principles like the 50% stake rule for decision-making and Conviction Voting, which gives more weight to long-term stakeholders. However, it simplifies governance by removing separate bodies like the Council and Technical Committee, and does away with alternating proposal timetables and public queues. The focus is on referenda as the primary decision-making tool, allowing numerous simultaneous referenda for more agile and inclusive governance.

This system enables anyone to initiate or vote on referenda anytime, potentially leading to numerous concurrent votes. To manage this, Polkadot OpenGov introduces unique features for referendum management, including various 'Origins' and 'Tracks' to categorize referenda based on their complexity and potential impact. More significant decisions require stricter safeguards and longer consideration periods, while less critical ones have simpler processes.

Key differences to Governance V1

- **Simplification and Decentralization:** OpenGov eliminates the Council and Technical Committee, creating a simpler structure with only the Public (token holders) and the Technical Fellowship involved. This approach ensures a more decentralized governance model.
- **Multiple Origins and Tracks:** In OpenGov, referenda are executed from multiple origins, each with a different track. This allows for categorizing proposals based on their importance and urgency, enabling simultaneous execution within and between origin tracks.
- **Public Proposal Submission:** Unlike Governance V1, where proposals could be submitted by the Council or the Public, in OpenGov, all proposals are submitted by the public, enhancing the democratic nature of the system.
- **Origin-Specific Approval and Support Curves:** OpenGov uses origin-specific approval and support curves, determining the amount of approval and support needed over time. This system replaces the Adaptive Quorum Biasing used in V1, leading to a more equalitarian and time-responsive approval process.
- **Flexible Voting and Enactment Periods:** OpenGov allows multiple referenda to be voted on simultaneously, with customizable periods for voting and enactment based on the origin's importance and urgency.
- **Cancellation and Blacklisting:** OpenGov introduces a special operation for canceling ongoing referenda, allowing immediate rejection of proposals, with a provision for slashing the deposit if the proposal is malicious or spam. This cancellation operation comes with its own Origin and Track, designed for urgent execution.
- I**mproved Voting Options:** Voters in OpenGov can choose to abstain or split votes, in addition to the traditional aye or nay options, offering more engagement in the voting process.
- **Agile Multirole Delegations:** Voters can delegate votes to different accounts depending on origins, allowing more tailored and expertise-based delegations.
- **Polkadot Fellowship and Whitelisting:** Polkadot Fellowship, a more decentralized entity than the Technical Committee, can whitelist proposals, enabling them to have shorter lead-in, confirmation, and enactment periods. This process ensures a quicker response for urgent and critical proposals.

OpenGov was launched on Kusama, Polkadot's "canary" network, in November 2022. After six months of operating on the canary-network Kusama, it went live on the Polkadot on **June 15, 2023**.

This new governance model significantly enhances Polkadot's decentralization by enabling the community to have more direct control over decision-making processes.

4.3.   Polkadot 1.0 - completion of Polkadot Whitepaper and handover to community

In July 2023, the first runtime was released under the Polkadot Technical Fellowship as an independent collective - v1.0. This version fully realized the groundbreaking vision outlined in the [2016 Polkadot whitepaper](#), which proposed a scalable, heterogeneous multi-chain network. Key features include heterogeneous sharding, advanced staking, on-chain governance, cross-chain communication, and forkless upgrades.

The journey to Polkadot 1.0 involved significant advancements in blockspace management, transaction efficiency, and scalability, addressing the blockchain trilemma and enhancing the developer experience.

Polkadot 1.0 also introduced "Long Term Support" (LTS) releases, ensuring critical security fixes for parachains without the need to upgrade to newer versions with breaking changes. The LTS releases are maintained for 6 months, providing enterprises and users with prioritized stability and a secure parachain codebase.

With the 1.0 release, all runtime code has been transitioned to a repository managed by the Technical Fellowship, which marked a full handover to the community, fostering greater decentralization, transparency and collaboration.

Future development will focus on community-driven discussions and consensus, potentially introducing new allocation mechanisms and 'accords' between blockchains. Polkadot's continuous innovation emphasizes interoperability, scalability, and upgradeability.

The Polkadot Treasury
Consistent across both Governance V1 and OpenGov implementations has been the role of the Polkadot [Treasury](#). The balance controlled by the Treasury as of November 30th 2023 was ~44m DOT or ~ 3.19% of total DOT issuance.
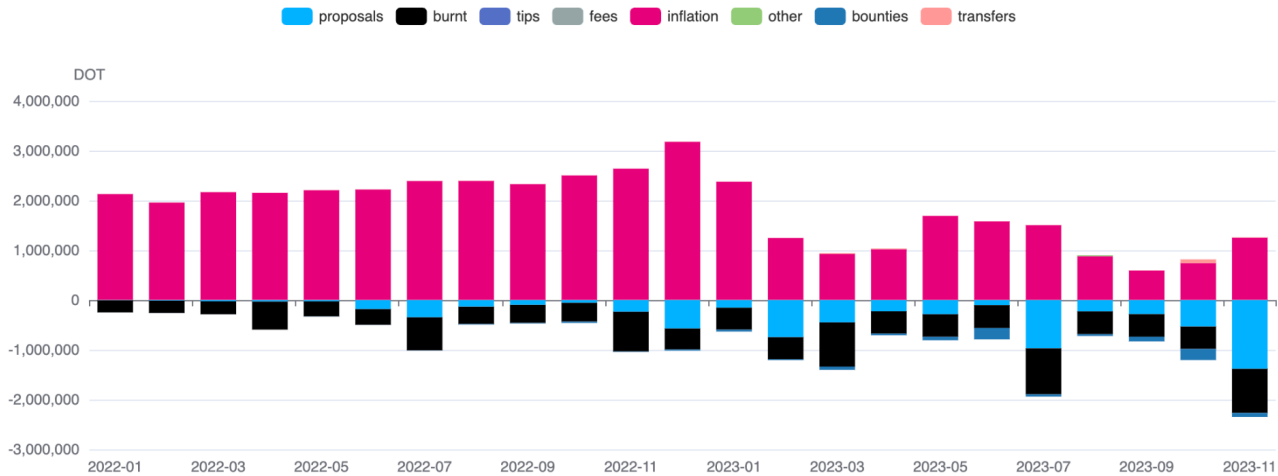
Polkadot: Treasury Balance

Inflows to and Outflows from the Treasury account come in several different forms. In terms of DOT flowing from the Treasury to the Polkadot Ecosystem, Bounties (including Child Bounties) and Proposals are the most prolific funding mechanisms. For 2023 ~5.356M DOT left the Treasury in the form of proposals while 949K DOT was paid out via bounties.

The majority of DOT that flows to the Treasury is its share of network inflation which arises from the deviation between the actual staking rate and the ideal staking rate. Other sources of Treasury income come from network transaction fees and miscellaneous transfers to the Treasury from other wallets. In 2023, the Treasury registered a 1.825M positive inflow, meaning that inflows exceeded outflows.

Polkadot Treasury Flows

Number of Referenda by Outcome (Gov1 vs Open Gov): Open Gov was implemented in mid-June (deployed on Polkadot runtime / approved to be included by the community), marking the transition from Gov 1, used in the first half of the year. Given concurrent referenda allowed in the OpenGov system, this led to a 570% increase in the number of referenda conducted up to November 30th. Despite the change, the approval rate of referenda remained relatively stable.

Number of Referenda by Outcome (Gov1)

Rejected: 32%

Approved: 68%

Approved   Rejected
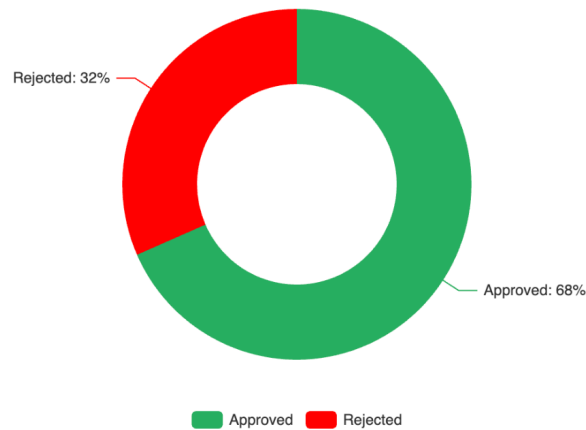
Source: DotLake

Number of Referenda by Outcome (OpenGov)

Cancelled: 1%
TimedOut: 8%

Rejected: 28%

Approved: 63%

Cancelled   TimedOut   Rejected   Approved
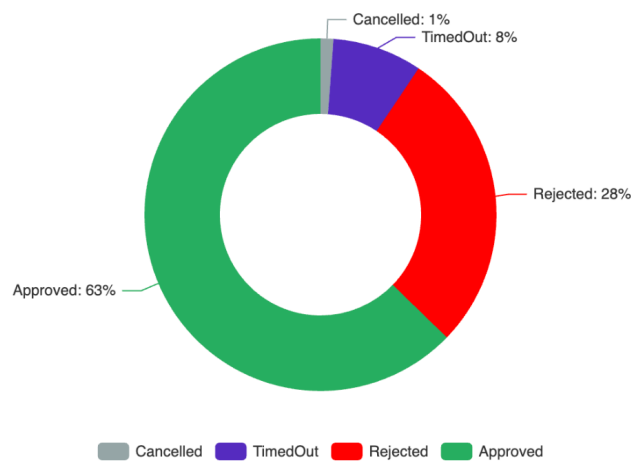
Source: DotLake

Number of Treasury Proposals (Gov1 vs Open Gov): Here we can see the immediate increase in treasury proposals after the launch of Open Gov and over 90 proposals in November alone.

Number of Submitted Treasury Proposals (Gov1 vs OpenGov)
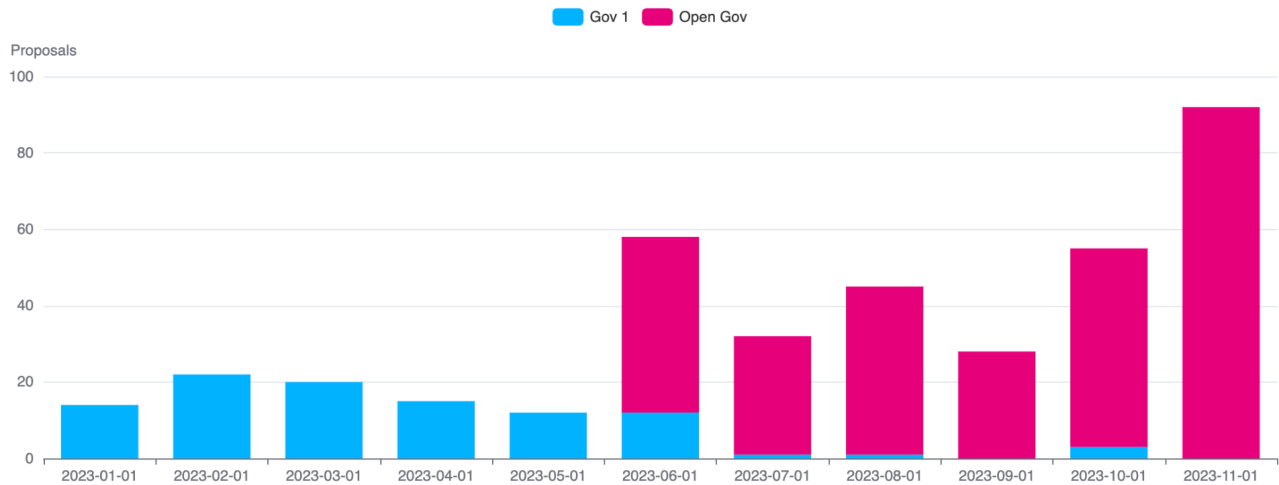
Average Number of Votes (Gov1 vs Open Gov): Open Gov sees a significant increase in the average number of votes per referendum (~25 million), greatly exceeding the Gov 1 average (~1.3 million), suggesting a heightened level of engagement from DOT holders in governance activities

Average Number of Votes (Gov1 vs OpenGov)

Gov Type and Average Votes

Number of Referenda by Origin (Open Gov): We can see below that the most popular origins are those where funds from the treasury can be requested. The top 5 origins with the most referendums all allow for such requests.

Number of Referenda by Origin
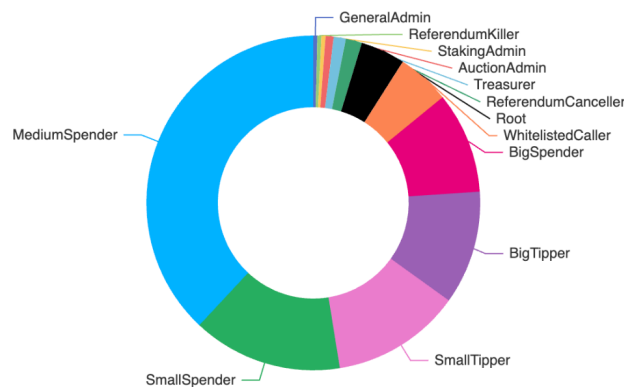
Number of Votes by Duration of Lock (Open Gov): Showing a detailed view of voter distribution based on the lock duration, the most popular choice is voting with 1x conviction. The conviction entails a 28-day lock period for tokens, following voting with no conviction, where tokens aren't locked but the voting power is diminished to 10% of its initial value

Number of Votes by Duration of Lock
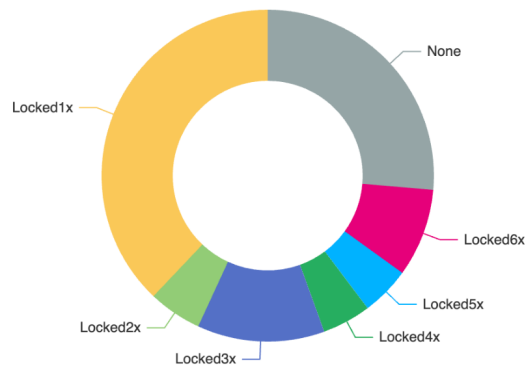
Monthly Number of Voters (Open Gov): The count of individual voters starts off low in June considering Open Gov was launched mid-month, resulting in fewer referenda and a period of adjustment to this new system. The number of voters rises in July, drops in August, and then steadily increases each month up until November. We can also see a rising trend in delegated voters. In November, for the first time, the count of delegated voters exceeded that of direct voters
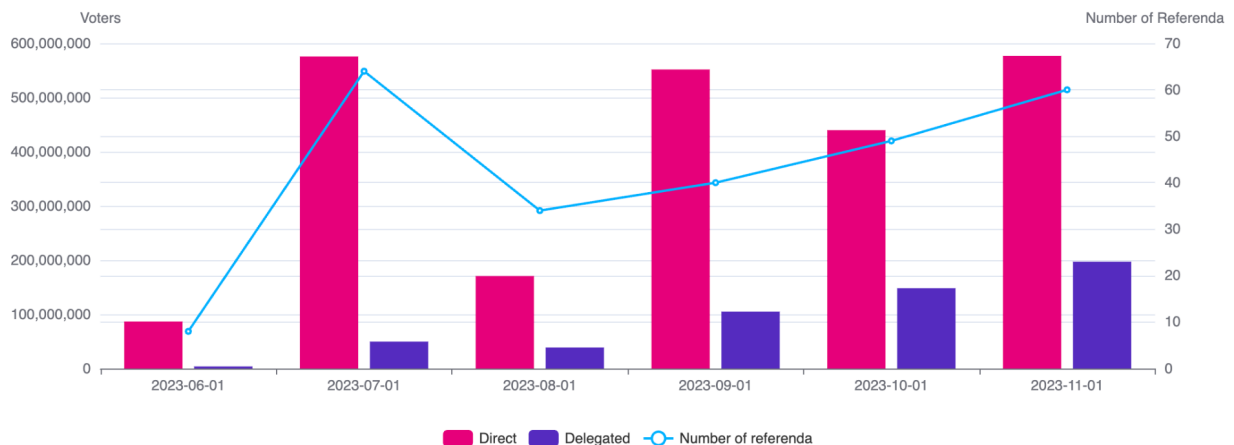
Number of Monthly Voters

Monthly Voting Power by Type (Open Gov): There is a more clear upward trend in tokens voted with conviction, suggesting that some voters are willing to lock their tokens for longer in order to increase their voting power. Notably, in November, the number of tokens voted with conviction was double that of those voted without conviction.

## Monthly Capital by Type (no conviction)

Monthly Voting Power by Type (w/ conviction)
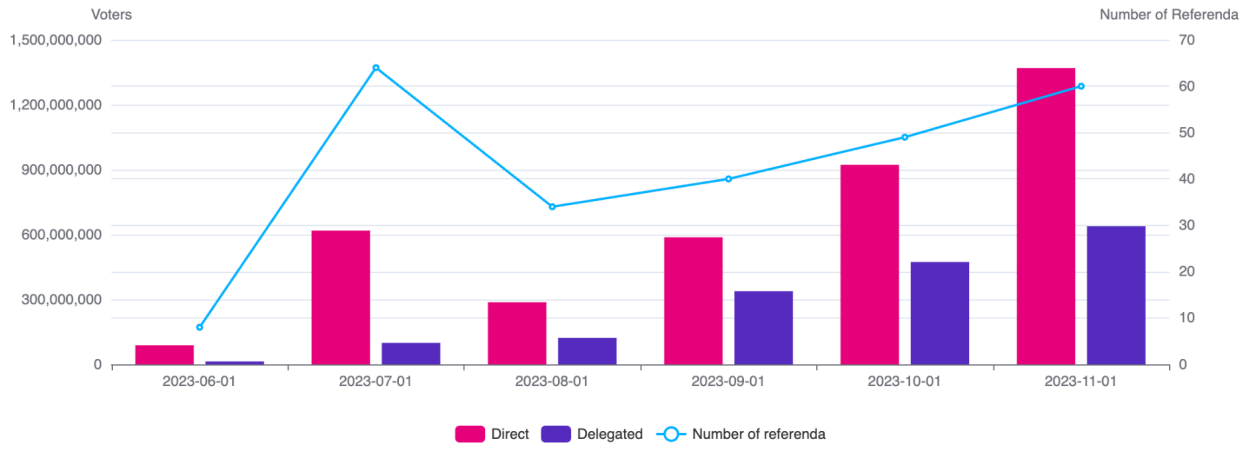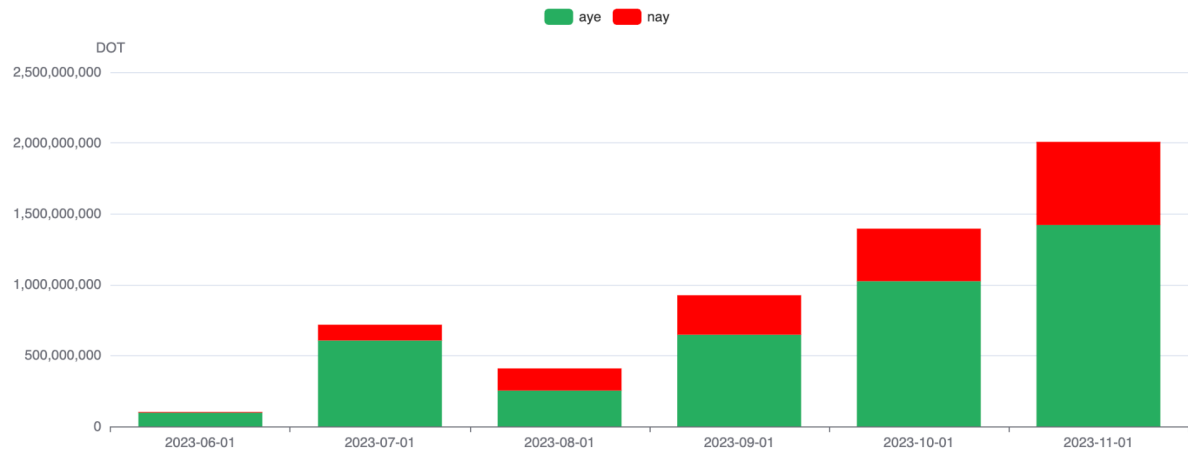

Source: DotLake

Monthly Voting Power by Direction (Open Gov): Regarding vote direction, both graphs depict a similar trend, with a higher number of votes favouring 'aye' over 'nay'. While having more ayes than nays does not determine the outcome due to conviction and number of tokens voted, it is notable to remark on the increase in positive voting patterns on proposals throughout the previous months.

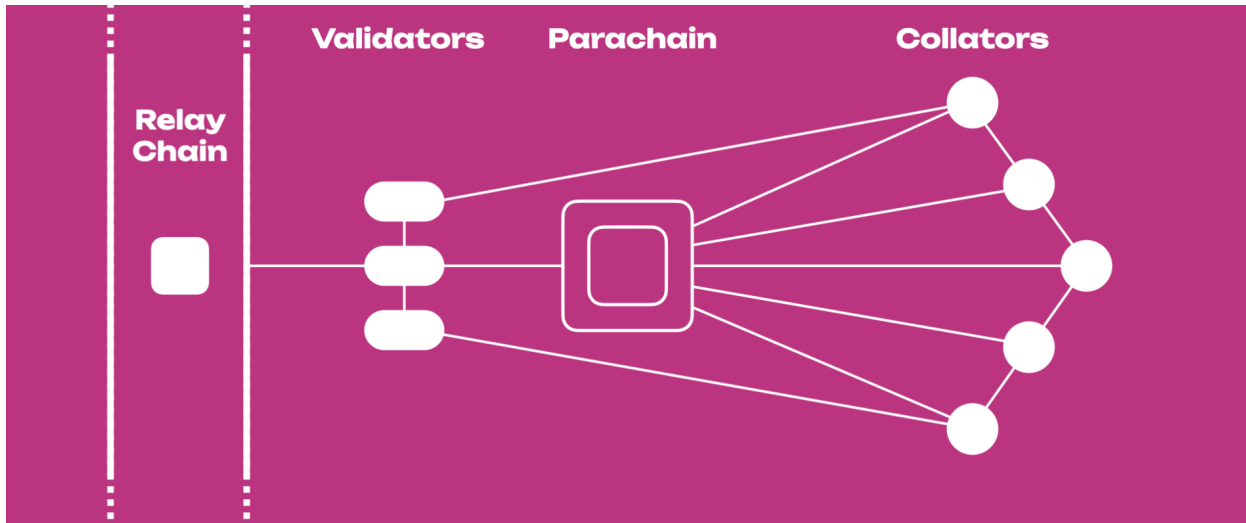## Monthly Tokens Voted by Direction (no conviction)
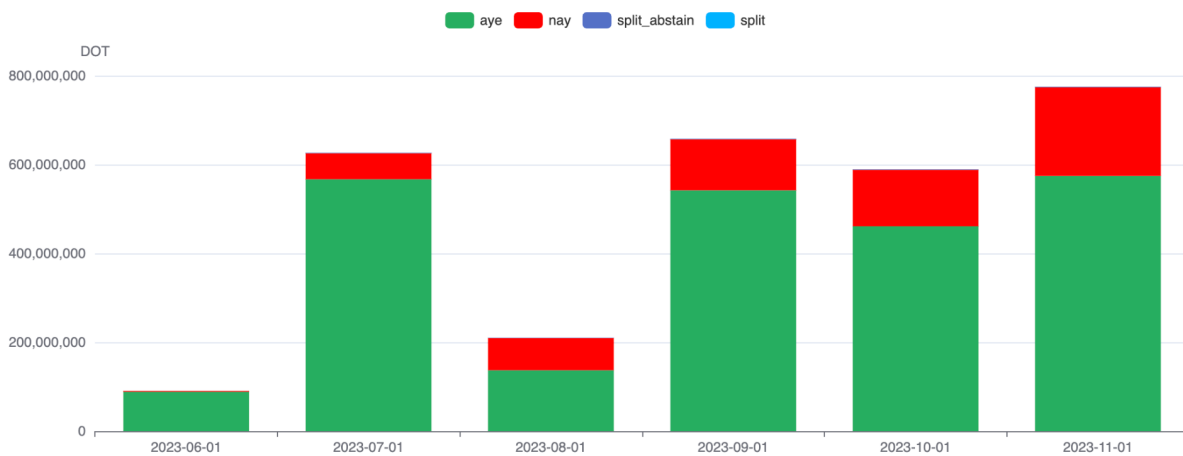
Source: DotLake

Monthly Tokens Voted by Direction (with conviction)

Source: DotLake

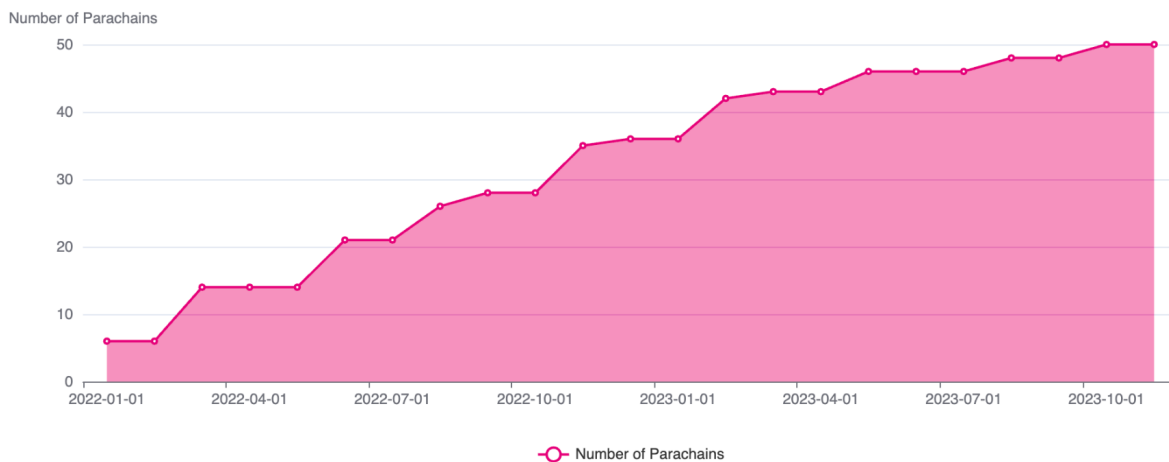# 5. Ecosystem - Parachains and System Chains

5.1. Parachains

Polkadot parachains are specialized blockchains that integrate with the Polkadot network, each designed for specific use cases. They offer solutions to the scalability and flexibility challenges in blockchain technology by allowing multiple blockchains to operate independently yet securely, leveraging the shared security provided by the Polkadot Relay Chain. This shared security is a significant value proposition for chains becoming parachains, as it allows them to tap into the economic security of the Relay Chain without the need to maintain their own validator set, which is a crucial distinction from independent chains connected by bridges.

Parachains can have their own economies and native tokens, but they are not required to. They function using schemes like Proof-of-Stake to select validators, although they rely on the Relay Chain for validation and finalization. Transaction fees and other economic models can be implemented at the discretion of each parachain.

Overall, the true potential of parachains is vast, with use cases ranging from encrypted consortium chains and high-frequency chains to privacy chains and smart contract chains. They represent a significant component of Polkadot's architecture, designed to enhance the scalability, interoperability, and flexibility of the network.

The below graph shows the evolution of the number of parachains secured by the Polkadot Relay Chain from the beginning of 2022 (6) to the end of November 2023 (50).

Polkadot: Number of Parachains

Number of Parachains

Source: DotLake

5.2.   System Parachains

System chains, also known as "System Parachains," are specialized parachains that host key network functionalities. They are governed by the network rather than individual governance systems, ensuring that essential services and features are maintained efficiently and securely for the benefit of the entire Polkadot ecosystem.

Core Protocol Features: System parachains contain essential elements of the Polkadot protocol, but unlike standard parachains, they are not acquired through auctions. Instead, their execution cores are allocated by network governance. This setup allows Polkadot to utilize its parallel execution capability for hosting core protocol logic, improving scalability and efficiency.

Evolution of Terminology: Previously known as "Common Good Parachains," the term has evolved to "System Parachains" for clarity. This change reflects their role in the network and their management by on-chain governance mechanisms, rather than having separate native tokens or governance systems.

Existing System Parachains:

- **Asset Hub:** This parachain acts as an asset portal for tracking and managing the issuance of assets, including reserve-backed stablecoins and non-fungible tokens (NFTs). It offers efficient transaction processing with significantly lower fees compared to the Relay Chain.

- **Encointer:** A blockchain platform for self-sovereign ID and universal basic income, Encointer focuses on financial inclusivity and mitigates Sybil attacks using a Proof of Personhood system. It allows groups to create and manage their digital community tokens.

- **Collectives:** This parachain hosts on-chain collectives that contribute to network stewardship and decentralized governance, allowing networks to express legislative opinions within other networks.

- **Bridge Hubs:** Dedicated to creating bridges between networks, Bridge Hubs facilitate trust-minimized bridges to other networks, enhancing interoperability and network integration.

5.3.   Polkadot Relay & Parachains: A Few Numbers

We can achieve a 'birdseye' view of the ecosystem by looking at a few common metrics across the Polkadot Relay and Parachains.

Transactions

In 2023, the Polkadot Relay and Parachains sent over 100m fee paying transactions and averaged monthly ~9.124M. The number of fee-paying and signed extrinsics along with the number of `ethereum.executed' and `evm.executed` events were taken into to account to include both substrate native as well as EVM transactions.

Polkadot: Monthly Transactions by Parachain and Relay Chain
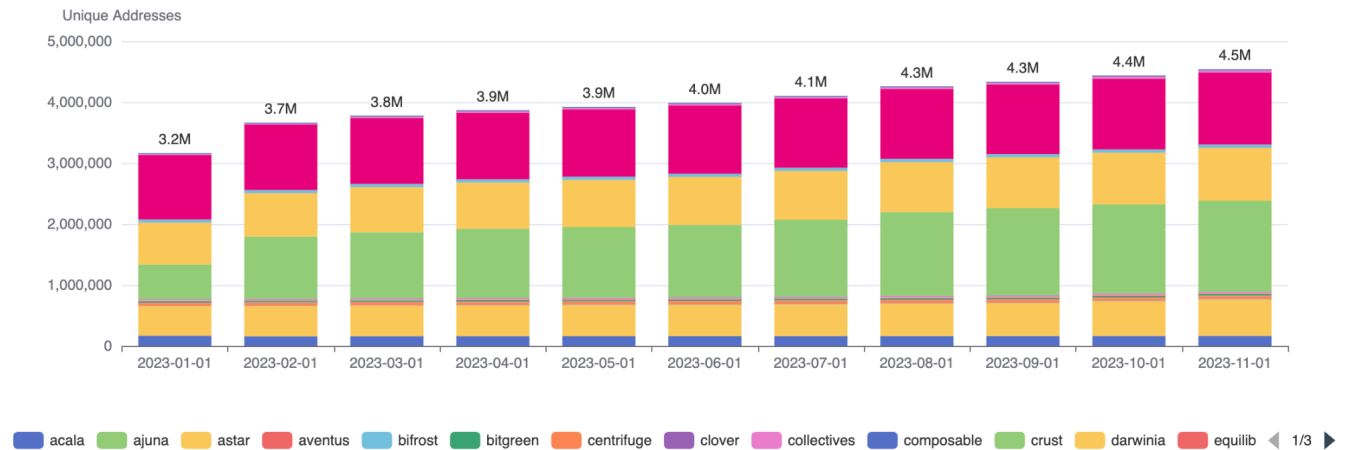

Source: DotLake
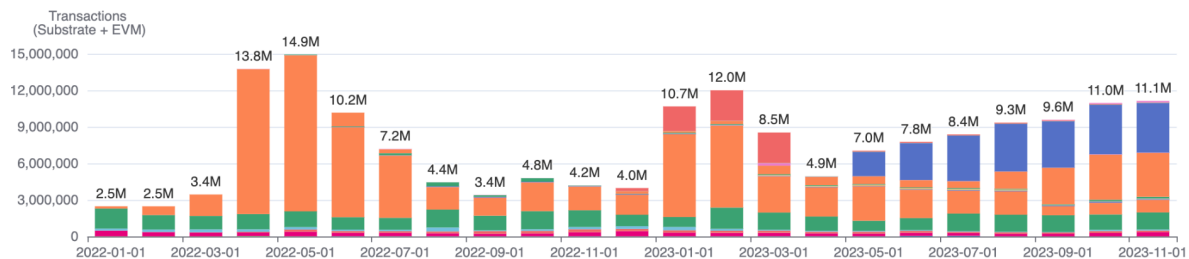
Unique Addresses

The below graph shows the number of ss58 wallet addresses on each chain that had a non-zero balance from the `system.accounts` storage function. The number of unique addresses grew at a steady pace in 2023 with a 44% increase from `3.162M in January to ~4.54M in November.
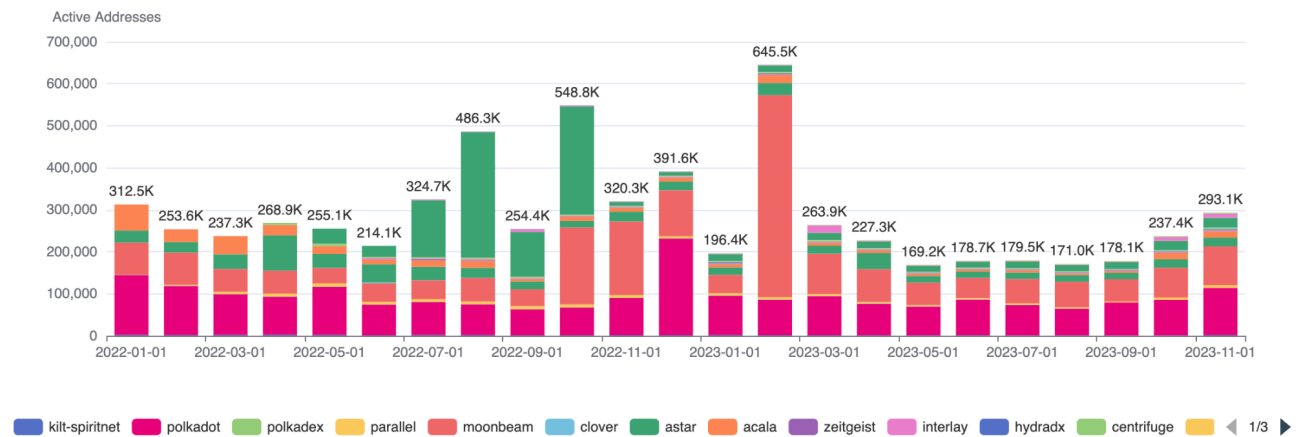
Polkadot: Unique Addresses

Source: DotLake

Active Addresses

Defining an active address as one that signs a successful extrinsic (substrate transaction) or is the sender of an `ethereum.executed`/`evm.executed` event (evm transaction) yields a monthly average of 249k active addresses in 2023.

Polkadot: Active Addresses

Source: DotLake

Interoperability: XCM

Looking at the transport methods for Cross-Consensus Message Format (XCM), we can see that Vertical Message Passing (VMP), where XCM messages are sent between the Relay and Parachains, is more popular than Horizontal Relay-routed Message Passing (HRMP), where parachains send XCM messages to other parachains using the Relay Chain.
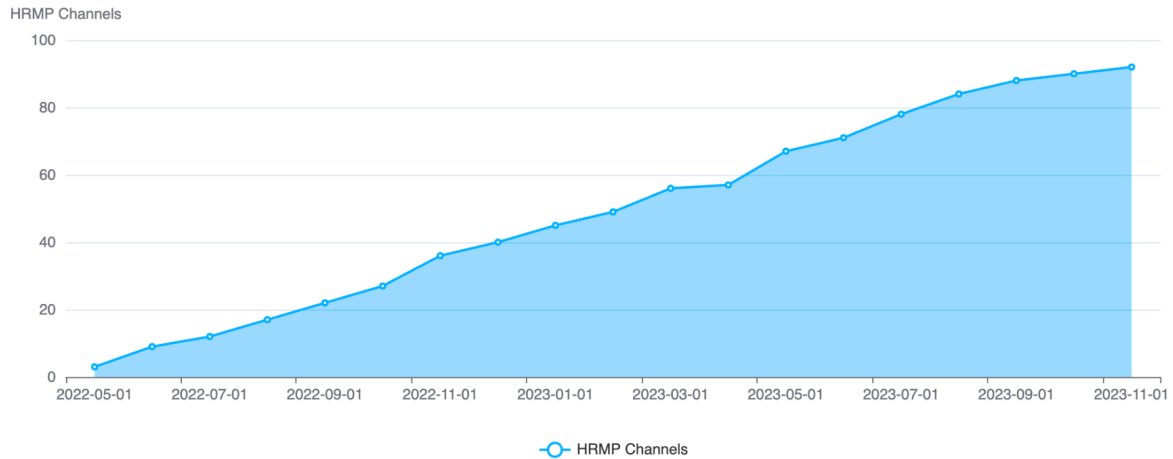
XCM: Monthly Messages Sent by Type
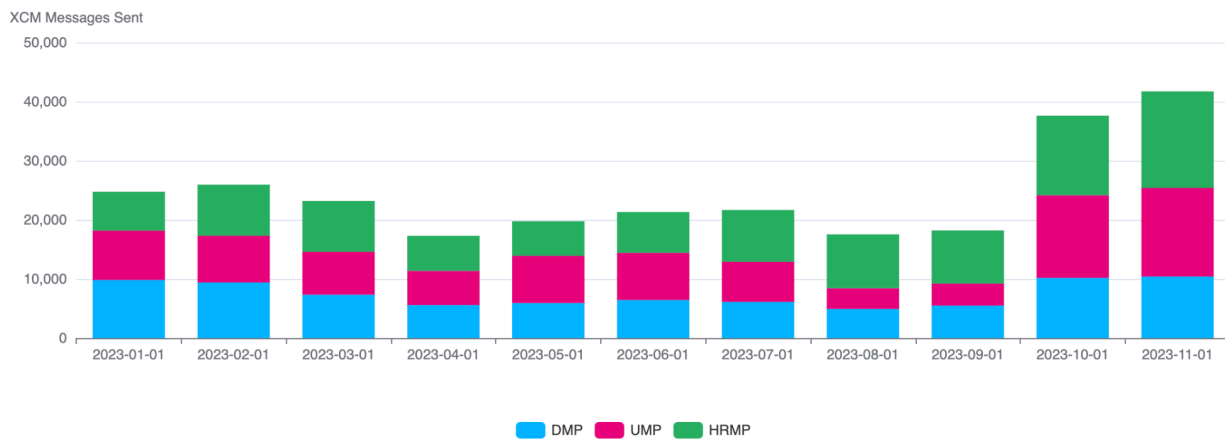
Source: DotLake

In order to understand the transport paths of XCM messages, the `xcmpqueue.XcmpMessageSent` event was used to identify HRMP messages sent, the `dmpqueue.ExecutedDownward` event to signal the receipt of Downward Message Passing (Relay Chain -> Parachain) and the `parachainsystem.UpwardMessageSent / ExecutedUpward` events to denote the sending of Upward Message Passing (Parachain -> Relay Chain).

VMP was the most prolific in 2023 with ~170k messages sent and UMP was slightly more popular (~88k messages sent) than DMP (~82k messages received). HRMP on the other hand saw 99k messages transported in 202 and on average ~25k XCM messages were sent a month across all the transport methods in 2023.

Taking a closer look at HRMP, we can see the number of distinct HRMP channels between parachains more than doubled in 2023 with 45 at the end of January and 92 at the end of November.
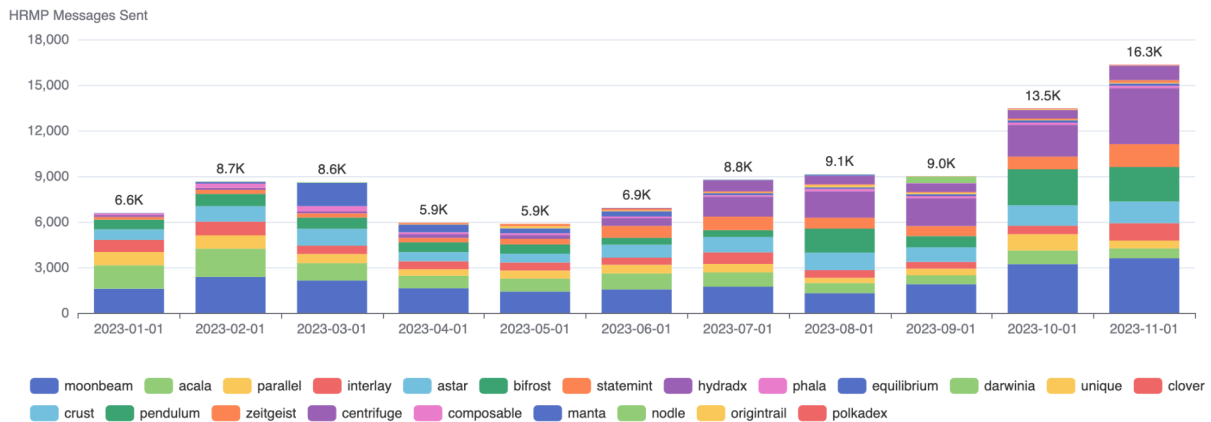
XCM: Number of Distinct HRMP Channels

Source: DotLake

In terms of HRMP messages sent, Moonbeam took the top spot in 2023 with over 22k total messages sent while Hydra DX, Bifrost, Acala and Astar were all in the 10-12k range for the year.

XCM: Monthly Parachain HRMP Messages

Source: DotLake

6. Polkadot-SDK & Developer Community

6.1. Developers

Polkadot's developer community is a prominent force in the blockchain space, standing out for its strength and active engagement. According to [Electric Capital](#), Polkadot is one of the leading development ecosystems in the blockchain world, continuously ranked second only to Ethereum. Polkadot reached 500 full-time developers (developers that contributed code 10+ days out of a month) in just 3.6 years, the fastest growth rate of any blockchain ecosystem. This recognition is a testament to the diligent contributions made within the ecosystem and the significant number of developers actively involved in it.

The [Polkadot Blockchain Academy](#) (PBA) offers a unique educational experience focused on blockchain technology, using Polkadot and Substrate as its foundations. The program, designed for both developers and Polkadot project founders, is led by experts from the Polkadot ecosystem, Parity Technologies, and the Web3 Foundation. The curriculum includes theoretical modules on economics, governance, game theory, cryptography, and practical applications in Polkadot-specific technologies. The Academy aims to equip participants with the knowledge and skills to build blockchains and contribute significantly to the Polkadot ecosystem. It welcomes both new and experienced individuals passionate about Web3 and blockchain technology.

As of September 2023, PBA has made its [course materials publicly available](#) after a year of development and refinement. This initiative is part of their continuous effort to enhance the curriculum and learning experience, aimed at equipping builders with essential skills for thriving in the Polkadot ecosystem.

The [Polkadot Developer Heroes Program](#) is a community-focused initiative for developers who are actively engaged in the Polkadot ecosystem. It is open to developers of all levels who contribute technically, participate in discussions, and create technical content related to Polkadot. The program offers various benefits, including dedicated educational space, exclusive content, mentoring sessions, networking activities, career opportunities, and more. It aims to connect, grow, and inspire the Polkadot developer community, providing a platform for knowledge sharing and professional development. It includes two categories: Rookies (beginners in Polkadot development) and Heroes (advocates for Polkadot technology). Activities include mentoring, contributing to the Polkadot stack, content creation, and speaking at events. Interested participants can sign up and nominate themselves for the program.

Commits

Commits across the Ecosystem were consistently higher than 4k per week in 2023 but were much higher in the first months of the year compared to the latter half. Commits do not always represent the true activity behind repositories and while we do see a decrease, we can complement the findings with additional GitHub metrics to highlight overall engagement from developers.
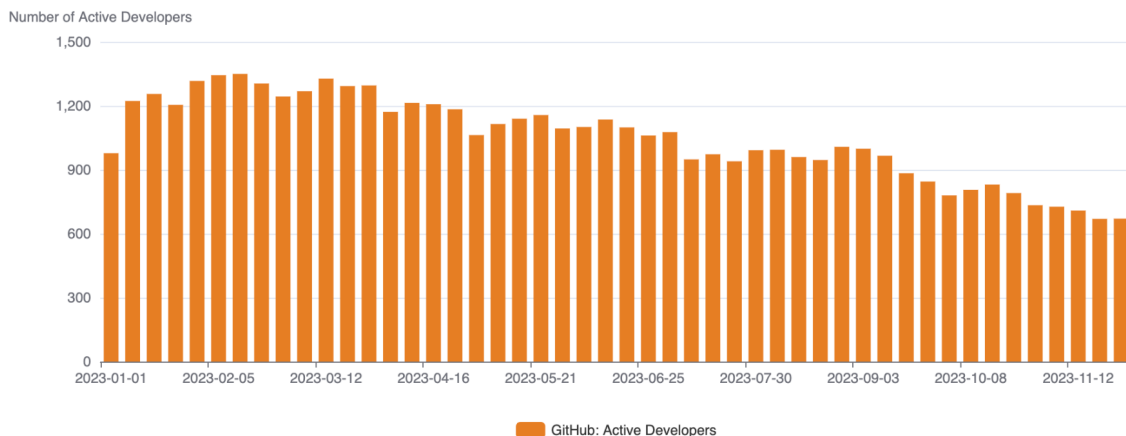
GitHub: Commits
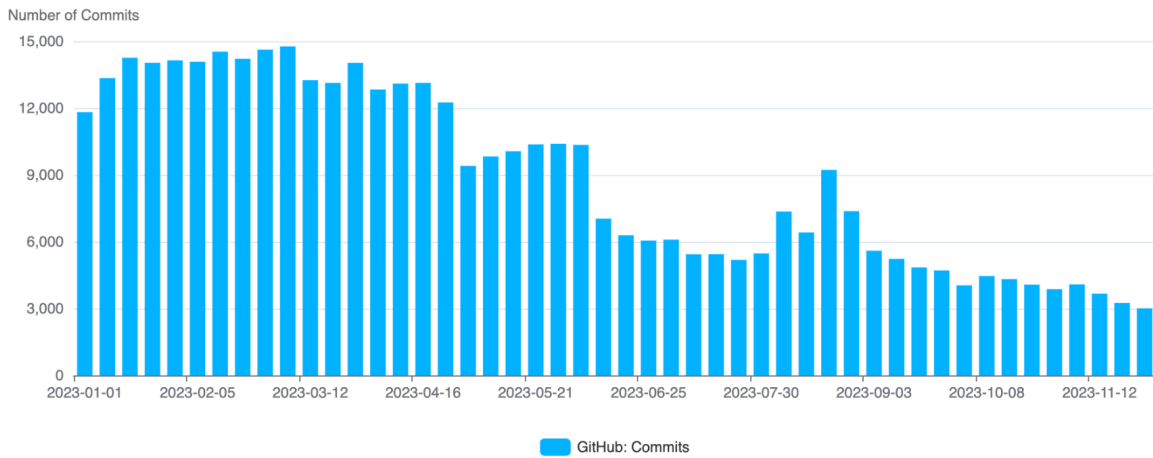
Number of Commits

Source: DotLake (GitHub)

Active Developers

Reviewing developers who committed to code per week reveals that there is a steady number of devs who are contributing. There were over 800 unique developers committing to codebases each week in 2023. The figures count the distinct author names of devs who made a commit to the master default branch, excluding bots as well as forked repos.

GitHub: Active Developers

Number of Active Developers

Source: DotLake (GitHub)

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Issues Opened and Closed

Counting the number of Issues Opened and Closed per month illustrate that activity is constant throughout the entire year. Despite decreases in commit numbers, issues remain high and are continually being opened and closed throughout the year. From all of the repos sourced, there were over 3k issues opened for 8 of the 11 months analyzed and over 2.5k issues closed.

GitHub: Issues Opened and Closed per Month

Source: DotLake (GitHub)

Github Merged Pull Requests

Furthermore, we can point to merged pull requests for all branches to show how activity is constant in the ecosystem. Nearly every month measured over 7k merged pull requests in 2023 from all repositories collected. By viewing commits, which authors are active, issues and merged prs, we are able to gain a deeper understanding of the vibrancy of the ecosystem and underscore the sustained development taking place.

GitHub: Merged Pull Requests

Source: DotLake (GitHub)

GitHub: Top 50 Repos by Unique Developers and Total Org Commits

Disclaimer:
The GitHub dashboards provided are designed to offer a directional view of developer and ecosystem activity, excluding forks and bots to the best of our knowledge. While we strive for accuracy, we acknowledge the potential for anomalies and are committed to continually refining and enhancing the data logic, even on case-by-case basis. Therefore, this data should be used as a guide and not as a definitive source. We encourage users to consider this context when interpreting dashboard metrics and look forward to implementing ongoing improvements.

Thanks yangWao for the heads up!
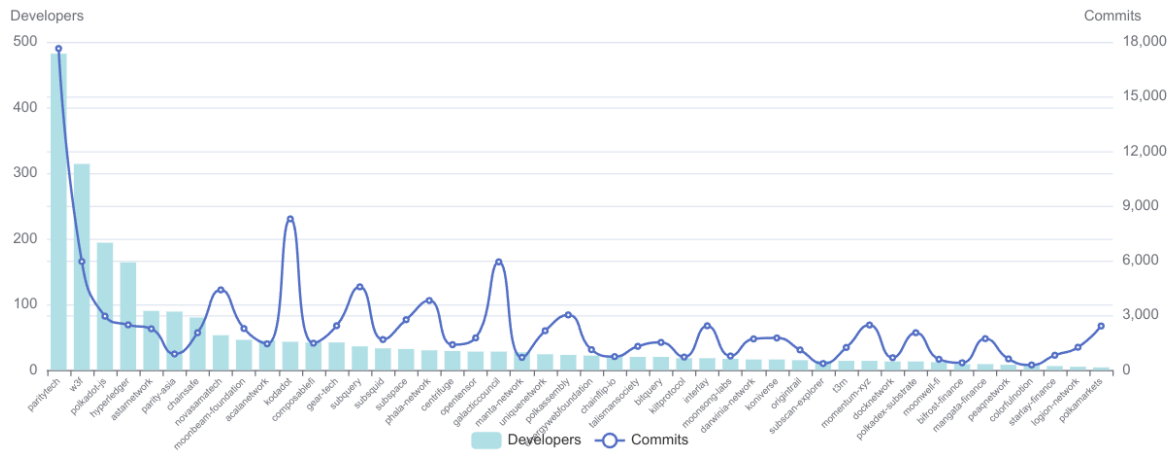
Source: DotLake (GitHub)

6.2.   Polkadot-SDK

The **Polkadot SDK** is a robust toolkit designed to streamline the development of Web3 applications within Polkadot or standalone blockchain ecosystems. It integrates **Polkadot**, **Substrate** and **Cumulus** into a unified framework, simplifying the creation of both independent blockchains and parachains. Substrate serves as the foundational framework, providing developers with customizable building blocks (called "pallets") for blockchain construction, while Cumulus facilitates the creation of parachains, which benefit from Polkadot's security and interoperability. Additionally, the Polkadot.js API allows for seamless interaction with the Polkadot network, critical for developing user interfaces and dApps that communicate with the blockchain.

The consolidation of Polkadot, Substrate, and Cumulus repositories into the Polkadot SDK repository simplifies issue tracking and documentation, enhancing collaboration and continuity across development teams. Existing issues and pull requests remain accessible, ensuring continuity. The amalgamation aims to simplify the development process by eliminating the need for "companion" pull requests across various repositories and fostering improved collaboration. The transformation underscores the SDK's role as an all-encompassing ecosystem for blockchain development.

For more detailed information, please visit - [Polkadot Wiki on starting building](#), [Polkadot build index](#) and [Polkadot open-source technology stack](#).

"The difference between competition and cooperation is technology. That's why we engineered Polkadot and Substrate to be both neutral and general." *Dr. Gavin Wood*

The general and neutral nature of Polkadot-SDK has drawn projects outside the Polkadot ecosystem to utilize its future-proof open-sourced technology. Some of them include:

Avail Project is a comprehensive solution for modern blockchain development, addressing issues with monolithic blockchains. It offers a modular approach, allowing for optimized, scalable, and efficient blockchain development. Avail provides a secure data and consensus layer, supporting a variety of blockchain applications including sovereign rollups and trust-minimized applications.

Avail chose **Polkadot and Substrate** for their Data Availability (DA) layer due to Polkadot's BABE and GRANDPA consensus mechanisms, which provide a balance between network liveness and security. This hybrid consensus approach enhances network resilience, enabling Avail to withstand various network challenges. Additionally, Polkadot's Nominated Proof of Stake (NPoS) and light client network offer a high level of decentralization and security. This, combined with Avail's modular approach and effective reward distribution, sets it apart from other DA solutions.
For a detailed analysis, you can read the full article on Avail's blog [here](#).

Madara **Starknet Sequencer** - Madara is a high-performance Starknet sequencer designed to support customizable and efficient application-specific blockchains, known as appchains. It utilizes the **Substrate framework** to enhance the capabilities of the Cairo VM, enabling the creation of secure, provable, and flexible programs. Madara offers scalable infrastructure, high throughput, and control over applications, with features like on-chain privacy support, interoperability across chains, and robust execution. It facilitates cost-effective, scalable, and customizable solutions in blockchain development, particularly for decentralized applications (dApps).
For a detailed understanding of Madara and its features, you can read the full article on StarkWare's website [here](#).

Cardano **Partner Chains** - Cardano announced introducing Partner Chains, interoperable layer 1 blockchain networks. For this, Cardano will use Substrate, the foundation of the Polkadot SDK, as a "proven open-source modular framework" — showcasing Substrate's potential to expand across Web3, and its ease of use for other chains and ecosystems.
For more information, you can read the full announcement on the IOHK blog [here](#).

NEAR / **Octopus Network** - Built on NEAR, the Octopus project allows app-chains or application-specific chains to create and provide a form of horizontal scalability and greater customizability, flexibility to any project on NEAR that wishes to have its own blockchain. These app chains are created through **Substrate (Parity Tech's blockchain SDK)** with the use of pallets and can be EVM compatible using Barnacle EVM as a template "".

6.3.   Substrate Stack Exchange

The Polkadot community fosters knowledge sharing between developers through the use of a **Polkadot & Substrate Stack Exchange** forum found here. The forum is a key resource for asking and answering questions related to Substrate and the broader Polkadot ecosystem. It is a place for developers to engage with the community and participate in valued discussions on a wide range of topics. From new developers to founders of parachain projects and Polkadot core engineers, it is a powerful community-driven resource that enables collaboration and serves as a pivotal knowledge hub for the ecosystem.

In 2023 there were almost 1,300 new joiners to the forum with thousands of questions asked and answered. Topics ranged from pallet-contracts, wasm, XCM, runtime, ink, polkadot.js to more general questions about governance, parachains, staking, on-chain data and other aspects of core Polkadot technology.

Stack Exchange: User Growth
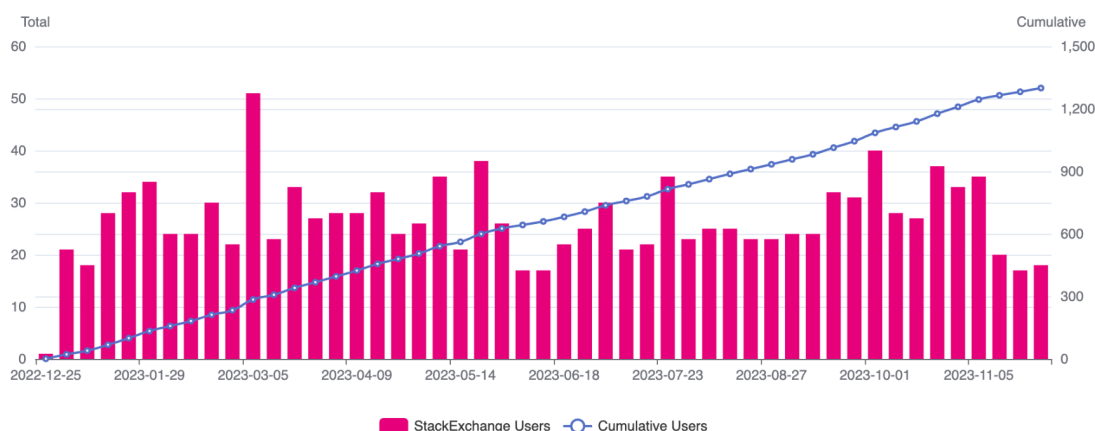
Source: DotLake (StackExchange)

Top 25 Tags: Over time we have witnessed specific topics raising interest on Stack Exchange as developers seek to engage with the latest developments. In 2023 polkadot-js was the most tagged topic, followed by the substrate-node-template, polkadot and ink.
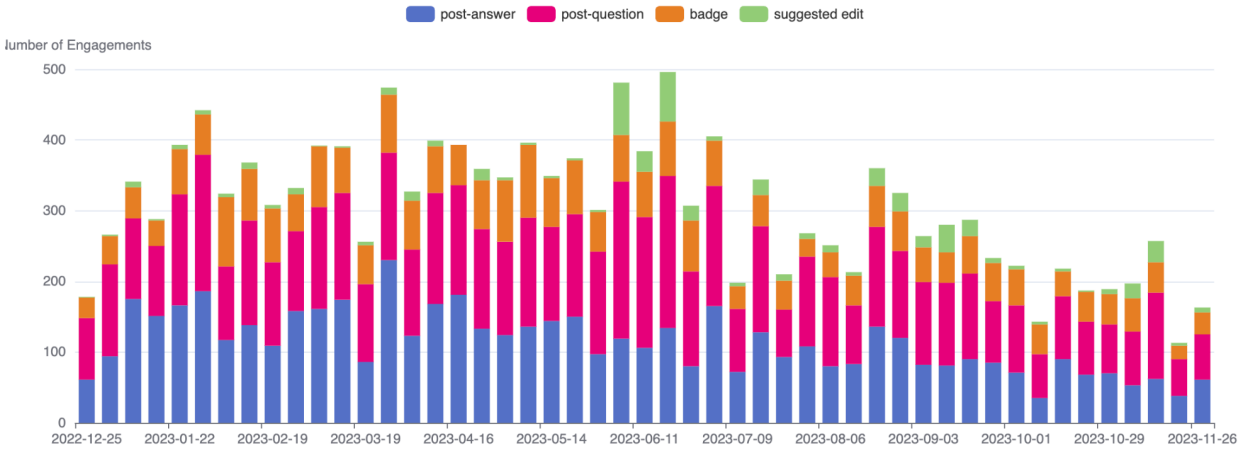
Stack Exchange: Top 25 Tags

User Activity: Throughout the year hundreds of questions were posted each month to the forum with weekly engagement steady. The largest weeks saw over 400+ questions and answers with a normal week ranging from 200-350.

Stack Exchange: User Activity

7. 2023 Highlights

Native USDC Launch on Polkadot Asset Hub

September was notable for the launch of Native USDC on Polkadot Asset Hub which enhanced stablecoin functionality for the Polkadot Ecosystem with over 4.5m USDC available in circulation by Mid-December.

Polkadot Asset Hub: Sum of USDC
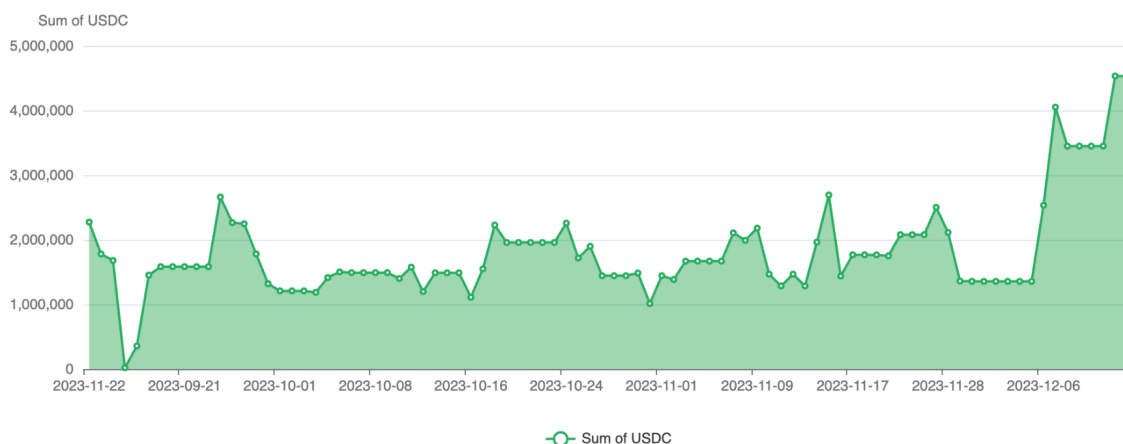
Source: DotLake

The Great Unlock

During the first initial Parachain Auctions, almost 100 Million DOT was locked in Acala, Moonbeam, Parallel, Astar and Clover. Beginning in October 2021, the tokens were locked for nearly 2 years and were released on October 24th, 2023. The highest amount was locked in Moonbeam with over 35 Million DOT followed by Acala, Parallel, Astar and Clover. The number of contributing accounts ranged between 5k for Clover to over 45k for Moonbeam.

Polkadot: Auction #1-5 Contributions
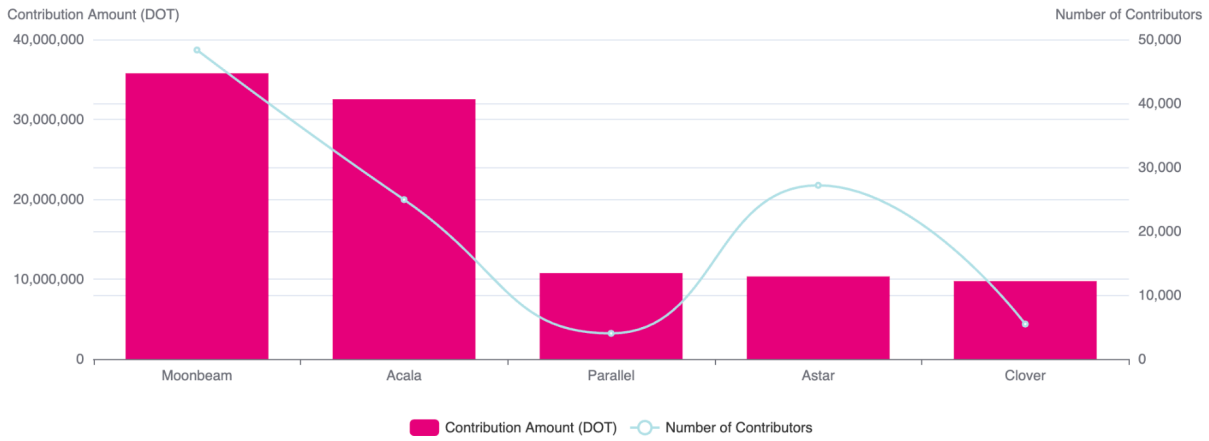
At the time of the unlock on October 24th the number of tokens staked was ca. 673 Million DOT which rose to ca. 709 Million by November 30th, a rise of over 5% of the total staked amount. We see a significant bump occurring right after the unlock towards the end of October and a continual rise to the end of November.
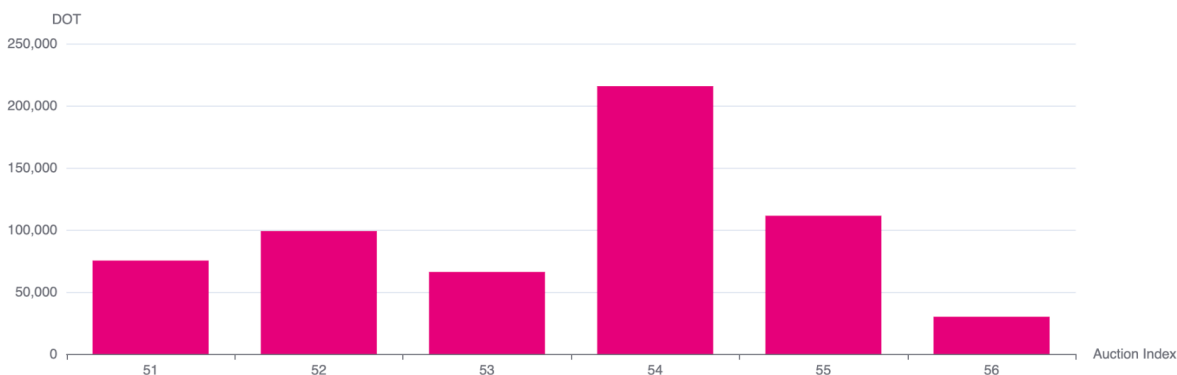
Polkadot: Sum of Staked Tokens
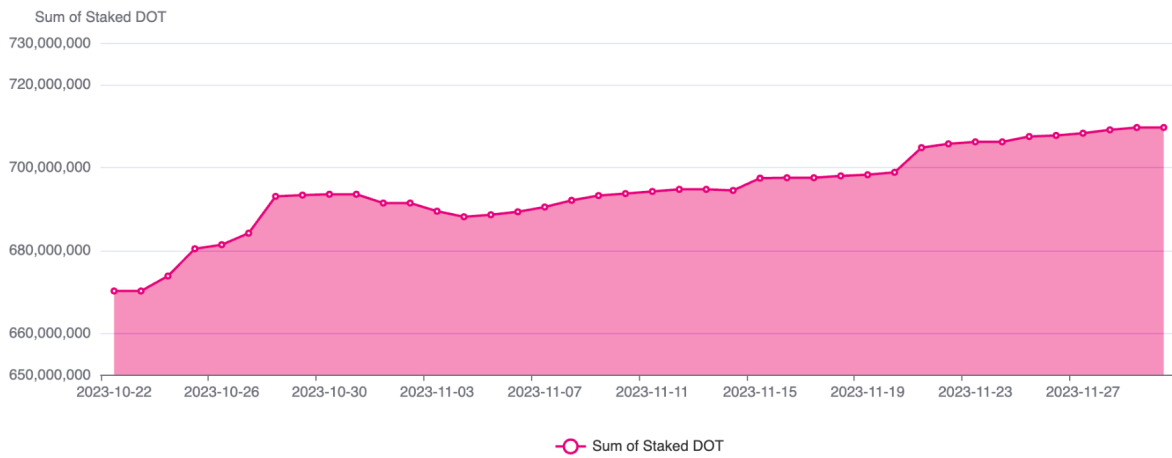
Polkadot: Q4 Auctions

Source: DotLake

Additional 2023 quarterly highlights

Q4 2023

- **New parachains and slot renewals**: Hydra DX, Logion, Parallel Finance, Clover, Polimec and parathread 3353
- **Asynchronous Backing**, a process that streamlines the parachain block generation and validation process, which could bring an eight-fold increase to Polkadot's scalability, is rolled out on the testnet **Rococo**.
- Web3 Foundation's **The Decentralized Futures Program** is providing 20 million USD and 5 million DOT to kickstart teams and initiatives driving Polkadot's success.
- **Agrotoken Launch**: Agrotoken is set to launch on Polkadot, enabling the tokenization of agricultural commodities (November 15, 2023).
- **Uniswap** LIVE on Moonbeam (October)
- **OriginTrail** is developing an AI-powered solution that is set to revolutionize the verification of company data news and insights
- **Astar Network** is invited to join the Busan Blockchain Alliance to integrate web3 into the second-largest city in Korea's public services and develop a blockchain city
- **Enjin** Migrates 200 Million NFTs from Ethereum to Polkadot-powered Enjin Blockchain
- **Deloitte** has selected the **Kilt** blockchain, part of the Polkadot ecosystem, to develop a digital shipping and logistics platform aimed at enhancing efficiency and transparency in the shipping industry

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- **Web3 Foundation** will deploy part of its treasury into real-world assets on Centrifuge, beginning with an investment in tokenized US treasuries.
- **Cardano** Blockchain Plans to Adopt Polkadot's Substrate Framework
- **NFL Alumni Association** is teaming with **Aventus** to help veteran players launch NFTs via Polkadot

Q3 2023

- **New Parachains**: peaq, Bit.Country, InvArch, Energy Web, and Nodle joined the ecosystem, each bringing unique contributions.
- Technical Upgrades: Polkadot's Fellowthip approved the development of a system chain for assigning Polkadot coretime, a proposed upgrade known as "**Agile Coretime**".
- **Polkadot Blockchain Academy wave 3** concluded at UC Berkeley, California, where a new entrepreneur-focused Founders Track was introduced. Waves 4 and 5 will visit Hong Kong and Singapore respectively, in January and May 2024.
- **USDC Integration**: Circle began launching native USDC in the Polkadot ecosystem.
- Enterprise adoption highlights included:
  - **Zodia Custody Partnership**: Announced institutional custody and staking services on Polkadot.
  - On/off ramp provider **Banxa** is helping onboard users into the Astar parachain with diverse payment options as it works towards a full-scale ecosystem integration with Polkadot.
  - **Zondax** announced a new Polkadot Ledger app that will support any parachain in the network, rather than needing a separate app for each parachain.
  - **OpenZeppelin**, a security and auditing specialist, has completed its first batch of work to ease the development of Polkadot's native ink! smart contracts. This includes the creation of easily implementable and extensible smart contract standards and translating Solidity contracts into ink!
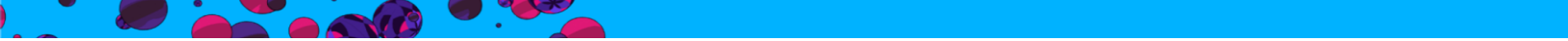
Q2 2023

- Arrival of **Polkadot OpenGov**, bringing further decentralization to Polkadot's governance by giving DOT holders control over the network's future direction.
- **XCM v3** was implemented, taking Polkadot's cross-consensus messaging standard up a level. Parachain teams immediately tested XCM's new capabilities.
- Fourth edition of **Polkadot Decoded**, the annual flagship conference celebrating the ecosystem's successes and pointing the way forward

- The winner of Parachain auction 42 was **Moonsama**, a project which accelerates the arrival of NFT-powered applications to the market by developing infrastructure and utility solutions.
- **Zeitgeist** announcing smart contract functionality in its prediction market protocol.
- **Polkadot Vault**, the ultra-secure air-gapped cold wallet formerly known as Parity Signer, underwent some significant updates including major UX improvements.
- Binance began its support of **USDT** deposits and withdrawals on Polkadot, and the total volume of USDT on the Polkadot Asset Hub had surged by 125% in a day
- Enterprise adoption highlights included:
  - **Mythical Games**, the number one gaming blockchain, announced its decision to leave Ethereum to launch its new "Mythos ecosystem" on Polkadot,
  - **Energy Web** revealed its plans to join Polkadot to help big names like Shell, Vodafone and Volkswagen on their path to decarbonization
  - Polkadot parachain **Frequency** brought self-sovereign blockchain-based identities to the 20 million users of its social media platform MeWe
  - **KILT** partnered with accounting giant **Deloitte** to issue reusable digital credentials for its KYC identity checks
  - KILT and Deloitte are working with **Polimec**, a new ecosystem team, to issue reusable KYC credentials, enabling access to global fundraising of digital assets
  - Astar unveiled details about **Astar 2.0**
  - A partnership between Sovereign Nature Initiative and **Moonsama** will bring data about lions in Kenya into virtual realms, benefiting real-world conservation efforts
  - The Substrate-built **peaq** announced it was bringing Teslas into the Polkadot ecosystem via the car-sharing start-up ELOOP
  - Evrloot revealed its new game Stardust Colonies would be built on **Ajuna Network** — demonstrating the growth of builder activity at the application layer

Q1 2023

- **New Parachain Slot Winners:** Zeitgeist and Subsocial, two projects that migrated from Kusama, Polkadot's "canary" network, won new parachain slots on Polkadot.
- **Developer Activity:** Polkadot recorded a record 19,090 developer contributions in March, marking the highest monthly figure for any Web3 network.
- **Nomination Pools Growth:** Nomination pools introduced last November continued to attract interest, with over 2.96 million DOT bonded by the end of Q1.
- **XCM v3 Implementation:** Polkadot began rolling out XCM v3, enhancing cross-chain functionality and interoperability.
- **Beatport** - the global leader in electronic music for DJs, producers, and their fans - launching a digital collectible marketplace on Polkadot parachain Aventus.

- **KILT** announced a collaboration with Public Pressure to issue identity credentials on NFT collections, helping artists add certificates of authenticity, and DJs to verify that individual songs are part of their playlist, building the identity of the assets.
- **KILT and Moonsama** also joined forces to help launch the first NFT drop organized by Public Pressure and fashion giant Diesel, which sold out in just four hours.
- **DUNDAS** designer brand provided Proof of Attendance tokens to 340 guests at **Paris Fashion Week**, minted on Unique Network's carbon-neutral advanced NFT infrastructure.
- **Astar Network** collaborates with Toyota and Sony on hackathons and a Web3 incubation program, and partners with Shibuya to host Web3 events.

8. Looking Ahead - 2024 and beyond

The decision to move the runtime code to a repository managed by the Technical Fellowship marks a significant shift towards a community-centric governance model for Polkadot. This means that the future roadmap for Polkadot is now in the hands of the collective, promising a future shaped by transparent and collaborative efforts from the community. With the release of [Polkadot runtime 1.0](#), Polkadot's codebase is in the hands of the community. Anyone can open a [Request For Commit (RFC)](#) to propose and discuss changes to the network protocol, runtime logic, and public interfaces, and other technical matters.

The following are some of the significant upgrades discussed and evolved by the expert community which are expected to be part of Polkadot's technical roadmap, pending approval within the Governance process. Also listed are noteworthy upgrades proposed and managed by independent ecosystem teams.

Asynchronous Backing

Polkadot is implementing a groundbreaking upgrade called [Asynchronous Backing](#) to significantly elevate the network's performance and scalability. This enhancement allows validators to process multiple parachain blocks simultaneously, increasing the network's throughput and efficiency. Asynchronous Backing decentralizes block production, dynamically distributing the workload across validators and removing the need for them to wait for global consensus, leading to faster block times.

The upgrade has undergone rigorous testing on Polkadot's testnet, Rococo, and is poised to be deployed on Kusama, Polkadot's canary network. The successful implementation on Kusama will pave the way for its release on the Polkadot mainnet. This represents one of the most substantial changes to Polkadot's consensus mechanism since its inception and is expected to more than triple the number of validators, scaling to support around 1,000 validators by the end of 2024.

Agile Coretime

The [RFC-0001](#), titled "Agile Coretime," discusses a novel approach to scheduling and managing core time—essentially the computational capacity of the Polkadot network's Relay Chain. The document proposes a flexible system that allows for dynamic allocation of core time to different parachains based on demand, rather than a static allocation. This system aims to optimize the utilization of the network's resources, ensuring that parachains with urgent or high-volume needs can access more core time when required, while less active parachains use fewer resources.

Minimal Relay

The [RFC-0032](#) proposes optimizing the Relay Chain further by transferring certain functionalities to system parachains. This approach aims to decentralize more processes and boost the network's efficiency by allowing system parachains to handle tasks that were initially managed by the Relay Chain. It suggests a minimalistic design for the Relay Chain, offloading subsystems like Identity, Balances, Staking, and Governance. The migration of these subsystems will free up resources, potentially increasing block space and improving the network's scalability.

Snowbridge - expected in Q1 2024

Snowbridge, the project aimed at creating a trustless bridge between Polkadot and Ethereum, is making significant strides. The team is merging their pallets and support code into the Polkadot-SDK monorepo using git subtree, which will simplify the synchronization process. They plan to publish their crates and add their pallets to the BridgeHub runtimes once the ongoing re-audit is complete.

Significant improvements include enhancing the resilience of the BEEFY light client against attacks and refining the Solidity API for transferring ERC20 tokens to Polkadot parachains. The project also focuses on utilizing static exchange rates for Ether-DOT conversions, governed by Polkadot governance, to maintain decentralization and reduce transfer costs.
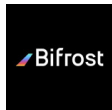
For message traceability across the bridge, the SetTopic instruction is being used, and protocol-level data formats now support versioning to facilitate seamless live upgrades. The BEEFY light client has passed a re-audit and is ready for production, with a re-audit of the remaining codebase in progress.

As the project nears completion, the focus is shifting to final integrations, bug bounty programs, and additional application-level features for post-launch upgrades.
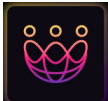
For more detailed information, visit [docs.snowbridge.network](#) and [GitHub](#).

9. Appendices and Resources

9.1. Polkadot Parachains

Parachain	Category	Applications
Acala	De-Fi	Acala is the all-in-one DeFi and liquidity hub of Polkadot. It's an Ethereum-compatible platform for financial applications to use smart contracts or built-in protocols with out-of-the-box cross-chain capabilities and robust security.
Ajuna Network	Gaming; NFT; Scaling	Incentive layer that allows game developers to integrate blockchain technology into Unreal and Unity games, enabling secure and scalable decentralized gaming with tokenized virtual goods.
Astar	Smart Contracts	Astar Network, Japan's leading blockchain, supports EVM, Substrate, WebAssembly (Wasm), and ink! environments, offering a scalable, cross-layer & cross-machine protocol for the development of multichain smart contracts, with its unique Build2Earn mechanism empowering developers to earn incentives.
Aventus	DAO; Bridge; NFT	Scalability of a permissioned network along with the security and interoperability of public blockchains, targeting businesses with a range of use cases like NFTs, gaming, loyalty, and supply chain, and fostering accessibility to blockchain technology.
Bifrost	DeFi; Smart Contracts	Bifrost Finance on Polkadot is a decentralized, non-custodial cross-chain finance platform that focuses on staking liquidity through its unique protocols, allowing users to earn rewards and maintain liquidity for staked assets like DOT and KSM, while also facilitating cross-chain asset swaps and other DeFi functionalities.
Bitgreen	DeFi; Smart Contracts; Sustainability	Eco-friendly blockchain platform designed for NGOs and ESG-focused organizations, facilitating investments in sustainable markets through its green DeFi platform, including the purchase of tokenized carbon credits.
Bit.Country	Gaming; SocialFi	Bit.Country enables everyone to start their own metaverse for their people with the 3D world, NFTs, play-to-earn & build communities to earn, and takes community engagement to a new dimension on web3.0.

Parachain	Category	Applications
Centrifuge	DeFi; RWA	Centrifuge parachain is engineered for decentralized finance of real-world assets, streamlining transactions between borrowers and lenders, and facilitating the tokenization and securitization of various assets to democratize finance for SMEs.
Clover	DeFi	Parachain that aims to simplify blockchain infrastructure for developers, offering a foundational layer for cross-chain compatibility and efficient on-chain trading services between different chains.
Composable Finance	DeFi; Smart Contracts	Composable Finance's parachain enables interoperability among diverse blockchain networks by running multiple bytecode types, facilitating the integration and communication of various smart contract languages and enhancing cross-chain functionalities.
Crust	Data	Crust Network is a decentralized storage platform on Polkadot, leveraging TEE, MPoW, and GPoS to offer secure and efficient decentralized storage for applications like website hosting, NFT storage, and P2P content distribution, serving as a user-friendly alternative to traditional cloud services.
Darwinia	DeFi; Bridge; NFT; Gaming; DAO	Darwinia Network offers a programmable cross-chain messaging infrastructure for the Polkadot ecosystem, enhancing interoperability and smart contract functionality for applications like DeFi and gaming, with faster transactions and lower costs than Ethereum.
Equilibrium	DeFi	Equilibrium is a DeFi parachain that combines a money market and an orderbook-based DEX, enabling high-leverage trading and borrowing of digital assets with its native EQ token used for communal governance.
Energy Web X	Sustainability	The Energy Web is unleashing blockchain's potential in the energy sector. Energy Web Foundation (EWF) has pioneered an enterprise-grade blockchain platform tailored to the sector's regulatory, operational, and market needs.
Frequency	Data; Identity; Privacy; SocialFi	Frequency is a Polkadot parachain designed to enable scalable, decentralized social media functionality, bridging the gap between Web3 and traditional social media platforms by accommodating high volumes of social interactions like messages and posts at Web2 scale.

Parachain	Category	Applications
Hashed Network	DeFi	Hashed Network, a parachain in the Polkadot ecosystem, orchestrates native Bitcoin Core standards like PSBTs, Schnorr signatures, and Tapscript. It uses Substrate to ensure secure address generation, verified addresses, spending policies, and security, especially in proof-of-reserves reporting for each vault.
Hydra DX	DeFi	HydraDX is a next-generation DeFi protocol on Polkadot, featuring the HydraDX Omnipool, an innovative Automated Market Maker (AMM) that consolidates all assets into a single trading pool for unparalleled efficiency in liquidity provision.
Integritee	Privacy	Integritee combines the speed and confidentiality of trusted execution environments with the trust of a decentralized network, creating the most scalable public blockchain solution for securely processing sensitive business or personal data.
Interlay	DeFi	Interlay is a decentralized network focusing on bridging Bitcoin to DeFi platforms like Polkadot and Ethereum, enabling secure and efficient interaction of cryptocurrencies across various blockchains.
InvArch	DAO; NFT; Governance	InvArch Network is a blockchain and service parachain in the Polkadot ecosystem, providing a dynamic multisig solution called Saturn to serve the entire ecosystem and enable efficient IP management, utility, and authentication across multiple blockchains.
Kapex	Data; DeFi; Exchange	Kapex / Totem is a live accounting blockchain parachain on Polkadot, designed to facilitate real-time collaborative accounting and auditing processes, aiming to revolutionize traditional financial practices with its decentralized approach.
KILT	Data; Identity; Privacy	KILT Protocol is a blockchain-based identity platform on Polkadot, enabling the creation of decentralized identifiers (DIDs) and verifiable credentials, focused on providing secure identity solutions for both individuals and enterprises.
Kylin	DeFi; Oracle	Kylin Network is a Polkadot parachain focused on providing advanced, decentralized data feeding and oracle services, enhancing the reliability and interoperability of on-chain data across multiple blockchain platforms.
Litentry	Data; Identity; Privacy	Litentry is a Web3.0 identity aggregation protocol on Polkadot that enables cross-chain credit computations, empowering users with control over their digital identities and facilitating

Parachain	Category	Applications
		interoperability and privacy in the decentralized ecosystem.
Logion	Legal Tech	Logion is a Polkadot parachain that offers a legal protection layer for digital assets and data, providing secure, decentralized, and legally compliant services for asset recovery, inheritance, and data certification.
Manta	DeFi; Privacy; Smart Contracts	Manta Network is a privacy-focused parachain in the Polkadot ecosystem, utilizing advanced cryptographic techniques like zk-SNARKs to ensure end-to-end privacy for blockchain applications, thereby enhancing interoperability and ease of use across various platforms.
Moonbeam	Smart Contracts	Moonbeam is a highly Ethereum-compatible smart contract parachain in the Polkadot ecosystem, enabling developers to seamlessly port projects and dapps with minimal code changes, thus connecting Polkadot's assets and capabilities with Ethereum's developer ecosystem.
Moonsama	Gaming; NFT	Moonsama is an EVM-compatible Polkadot parachain designed to support a diverse range of games, NFTs, tokens, and applications, providing a decentralized and interoperable platform for the Moonsama ecosystem.
Nodle	Data; IOT; Privacy; Scaling	Nodle is a decentralized wireless network parachain on Polkadot, using Bluetooth Low Energy via smartphones and routers to connect IoT devices to the Internet at low cost, while maintaining privacy and security, especially for enterprises and smart cities.
OAK Network	DeFi; Smart Contracts; Scaling	OAK Network is a Web 3.0 hub specializing in DeFi and payment automation, providing a platform for trustless automation of blockchain transactions with an event-driven execution kernel, enhancing the efficiency of financial infrastructure in the Web 3.0 ecosystem.
OmniBTC	DeFi	OmniBTC is an omnichain financial platform for web3,including omnichain swap and BTC omnichain lending.
OriginTrail	Data;	OriginTrail is a decentralized knowledge graph parachain on

Parachain	Category	Applications
	Knowledge Graph	Polkadot, designed to organize, discover, and verify the world's most important assets, enhancing their value and accessibility in various sectors like supply chain, healthcare, and scientific research.
Parallel	DeFi	Parallel Finance is a DeFi super DApp protocol in the Polkadot ecosystem, aiming to bring decentralized finance to a broader audience by building a decentralized future that enhances DeFi accessibility, capital efficiency, and security.
peaq	DeFi; Identity; IoT; RWA; DePIN	peaq is a decentralized economy platform on Polkadot that enables the tokenization of machines and services, fostering a user-driven, efficient, and sustainable Machine Economy.
Pendulum	DeFi	Pendulum is a parachain that integrates DeFi applications with the foreign exchange market, allowing for the creation of Automated Market Makers (AMMs) for fiat currencies and scalable liquidity pools, fostering yield earning opportunities and a decentralized future for fiat tokens.
Phala Network	Data; Privacy	Phala Network is a privacy-preserving cloud computing service in the Polkadot ecosystem, leveraging the TEE-Blockchain Hybrid Architecture to offer secure and trustless computing while enabling confidential smart contracts and data protection.
Polimec	SocialFi	Polimec is a decentralized community-driven funding protocol developed on Polkadot to accelerate the Web3 ecosystem. The open-source and module-based blockchain system facilitates fundraising in a regulatory compliant and sustainable manner using on-chain credentials.
Polkadex	DeFi; Exchange; Bridge	Polkadex is a decentralized peer-to-peer trading platform that merges the benefits of both centralized and decentralized exchanges into a single ecosystem, featuring high transaction throughput and low latency to facilitate efficient and trustless trading on the Polkadot network.
Subsocial	SocialFi	Subsocial is a decentralized social networking platform on Polkadot, designed for the future of social networks with built-in monetization and censorship resistance, enabling users to own and control their content and social graphs.
t3rn	Smart	t3rn is a multichain protocol designed to enable trust-free

Parachain	Category	Applications
	Contracts	collaboration between blockchains, facilitating interoperable smart contract execution and fair developer rewards within a decentralized ecosystem that spans across various blockchain networks.
Unique Network	NFT	Unique Network is a scalable blockchain designed for NFTs with advanced functionalities, offering tools for flexible economic models, sponsored transactions, re-fungibility, sustainable NFTs, and interoperability on Polkadot and Kusama.
Watr Network	DeFi; Smart Contracts; Sustainability	Watr is an open, ethics-driven platform for programmable commodities on the Polkadot network, connecting commodity flows with a robust ecosystem of participants, and encompassing commodities financing and trade, thereby enhancing the transparency and efficiency of the global commodities market.
Zeitgeist	Oracle	Zeitgeist is a decentralized prediction market protocol built on the Polkadot network, enabling users to create, participate in, and resolve prediction markets across a wide range of topics, leveraging its native ZTG token for network governance and dispute resolution.

Explore 300+ dapps in the Polkadot ecosystem: https://polkadot.network/ecosystem/dapps

9.2.   Resources

https://polkadot.network

https://wiki.polkadot.network

https://parachains.info

https://substrate.io

https://polkadot.polkassembly.io/opengov

https://polkadot.subsquare.io

https://substrate.stackexchange.com

https://forum.polkadot.network

https://github.com/paritytech/polkadot-sdk