CHORUS ONE

Annual Staking Review: 2022

PREPARED BY

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FOREWORD

The crypto ecosystem in 2022 was defined by extreme volatility events signifying the end of the bull cycle. The repercussions include multiple projects and businesses failing, as well as a downturn in many metrics that are used to indicate the growth and success of decentralised networks. From the collapse of the Terra ecosystem initiated by the depegging of its algorithmic stablecoin UST, to the bankruptcy of FTX, hedge fund 3AC, and crypto lenders such as BlockFi, Celsius, Genesis, and others. This deleveraging left a sour taste for crypto in the wider public, since many of the failing actors have been a first touchpoint for users and regulators alike; especially FTX, who had invested large amounts of money and time boasting their public image and engaging with regulators.

The silver lining to these events is that they remind us of the need for decentralised protocols, especially in the financial sector. All bankruptcy cases were a result of cascading effects due to undetected malpractice or outright fraud from centralised actors such as FTX and associated Alameda Research. The goal of DeFi is to build a transparent, auditable system open to everyone that can't be censored or abused by powerful actors. In 2022, the central point of censorship resistance was further put to test when the Ethereum set of smart contracts Tornado Cash was put on the OFAC sanction list.

All in all, crypto reached a point of adoption going into 2022 that highlighted the shortcomings and centralised chokepoints of what the ecosystem is building. Chorus One is a non-custodial staking provider active on the most relevant networks building towards a decentralised

future. As such, we are exposed to the trends and developments in this domain that we want to share with our audience in the following annual report.

This report covers the good, the bad, and the ugly of 2022. We start out looking at the different types of yield and associated risks investors engaging with crypto can get exposure to. Then, we dive deep into MEV and explore the modular scaling thesis before we look in-depth at the, in our opinion, three most important network ecosystems of 2022 summarising the key events across the year.

We hope you get something out of our research and encourage you to reach out to us if you are building in the staking ecosystem, want to stake your own assets, or offer staking to your clients.

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Network Reviews

THE FINANCIALISED STAKING ECONOMY, OR THE QUEST FOR UNCORRELATED YIELD

In his excellent book "Reckless"[1], Jonathan Bier traces a wide ark from the first written records of credit and debt in ancient Mesopotamia, to the emergence of a notable Bitcoin lending market on Bitfinex in 2014, to the recent default of centralised crypto lenders this year, culminating in the failure of Celsius.

The book was published in November 2022, and is, in news-cycle terms, already outdated. At the time of writing, Genesis' solvency appeared guaranteed by the backing of its well-financed parent firm, DCG. This is now in question, and while the final picture is still emerging, the upshot is already clear - widespread defaults continue to rock the industry. The consequence of this is that risk management has taken centre stage in the crypto ecosystem.

The goal of this article is to explain the case for staking as the most attractive risk-adjusted yield source in the cryptocurrency economy, and to explain why proof-of-stake systems in particular are attractive as a source of yield uncorrelated with the wider economy.

[1] RECKLESS

In making this case, the article will differentiate three kinds of yield-bearing activity, via the trust assumptions underpinning them. These trust assumptions are typically cumulative as we progress upwards from the base settlement layer, and the associated base-layer staking income.

An upshot is the case for staking yield as an attractive de-facto base rate, or risk-free rate if denominated in native terms. The last section discusses how the token price risk may be hedged out through trustless solutions

Cryptocurrency yield, sources, and their trust assumptions

Base Layer - any exposure to a cryptocurrency ecosystem requires trust in the technology underpinning the chain.

- This includes staking, and the realisation and compounding of staking yield.
- The yield is based on transaction fees and inflationary rewards. It can be augmented by MEV rewards, depending on validator policy.
- All information relevant for a risk assessment is public and typically well-vetted - this includes inflationary reward variability and its determinants (e.g. ETH staked), chain activity (transaction fee; MEV rewards), and chain security.

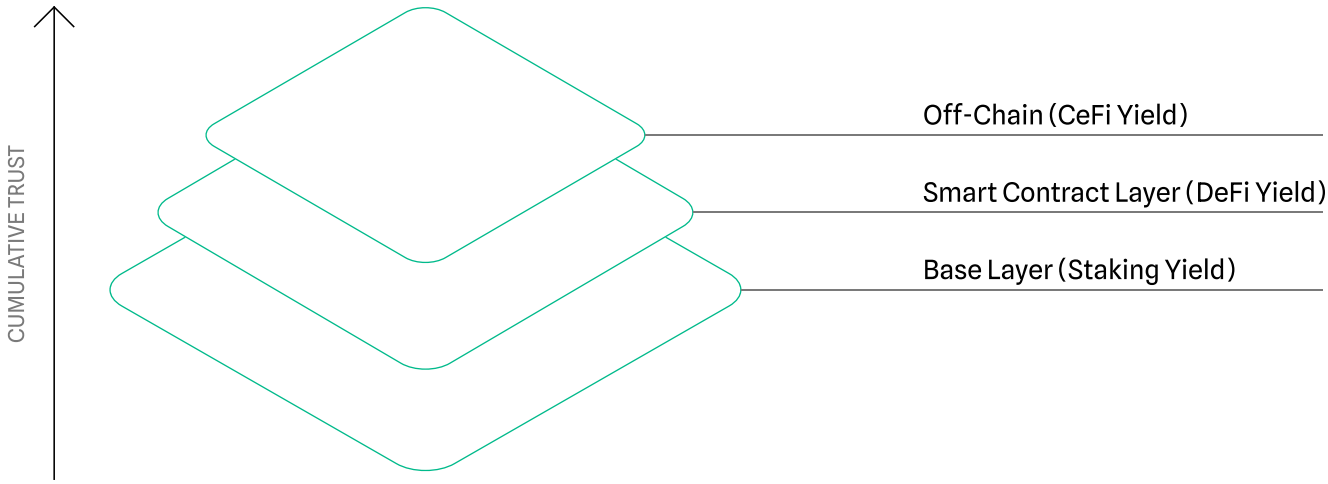
Smart Contract Layer - some ecosystem participants may elect to entrust their assets to protocols which promise to facilitate economic activity.

At a minimum, this requires trust in protocol security and protocol design (e.g. proper collateral management).

- This includes e.g. lending protocols and on-chain exchanges.
- The yield can be based on any value-adding economic activity with a capital requirement, albeit it is often augmented with inflationary incentives to bootstrap community interest.
- All information relevant for a risk assessment should be public. There may be exceptions (e.g. off-chain oracles; opaque multisig structures).

Off-Chain – centralised parties may offer to take custody of assets to engage in some economic activity resulting in interest. Perpetual swap funding rates on centralised exchanges are also processed off-chain. This introduces complex trust assumptions including counterparty prudence, counterparty sophistication, technical security, and appropriate legislation.

- This includes all centralised lenders.
- The yield realised can be based on arbitrary economic activity including uncollateralized lending. The ill-fated GBTC arb, implicated in the collapse of Three Arrows Capital earlier this year, also prominently features in this category.
- The user trusts its counterparty to make appropriate disclosures.



WHY STAKING CAN BE THE MOST ATTRACTIVE YIELD SOURCE IN CRYPTO

Of the above, yield enabled by the base layer, i.e. staking yield, carries the least risk. Specifically, staking yield does not carry any significant idiosyncratic risk beyond the chain risk, which an investor has priced in a priori upon entering the crypto economy. There is some tail risk associated with double signing and node downtime (i.e. due to faulty provider infrastructure), but this can be avoided by choosing a professional validator like Chorus One.

Secondly, staking yield generally consists of three parts – inflationary rewards, transaction fees, and MEV rewards. The first two are protocol rewards, the latter is paid out by validators on a discretionary basis. As validators compete on yield, they are heavily incentivized to distribute MEV rewards so as to stay competitively attractive. Therefore, staking yield has a predictable floor (protocol rewards), while maintaining upside potential correlating with any kind of on-chain activity, i.e. is maximally diversified across all crypto use cases (DeFi, NFTs...). As such, other sources of yield have to exceed the rate of return of the staking yield rate to be attractive to an investor. The key question then becomes – is there sufficient organic activity to do this in a sustainable manner?

For the smart contract layer (broadly DeFi), assuming efficient capital allocation, Uniswap, as the largest Ethereum DeFi App and prime on-chain exchange venue, can stand in as a proxy. Uniswap V3 has been theorised to be a losing proposition for as much as 50% of liquidity providers (LPs)[2]. In the Ethereum ecosystem, staking yield currently amounts to 7.5%.

The upshot is that in the absence of significant on-chain activity, such as in the current environment, DeFi yield sources can be non-competitive vs. staking income not only on a risk adjusted basis. Some of this may be bridged by paying additional rewards (e.g. in protocol tokens) albeit these can typically only carry the value generated by the protocol in question, and are thus value-adding only as a means of speculating on future returns (i.e. prone to an empty flywheel effect; risky).

This also applies to off-chain, centralised lending solutions – firstly, the demand for these services is correlated with on-chain activity, secondly, the number of willing lenders has historically exceeded the number of borrowers significantly.

While it may be possible that the increased flexibility and privacy associated with centralised, off-chain activity can yield a premium, the counter case is straightforward – you'd be hard pressed to find a prominent centralised lender that has consistently outperformed staking yields without coming under pressure in 2022. At the time of writing, the yield paid by Binance Earn's protected account underperforms staking with MEV rewards – it pays 4.5% on ETH[3] vs. 7.5% for the latter case[4].

[2]HTTPS://ARXIV.ORG/PDF/2111.09192.PDF
[3]HTTPS://WWW.BINANCE.COM/EN/EARN [4]HTTPS://ULTRASOUND.MONEY/

There is a relationship between staking yield and DeFi / CeFi yields which extends beyond re-packaging – a high staking rate can render other capital uses uncompetitive on a risk-adjusted basis, and thus reduce on-chain activity. The transaction fee and MEV components provide implicit protection against this – these would fall. Further, e.g. in the case of Ethereum, the staking yield would fall with increased total stake, rendering other yield opportunities more competitive.

Why staking is an attractive source of yield beyond crypto

Proof-of-stake ecosystems do not have an anchor in the real world. This means that the staking yield rate denoted in native terms is completely decoupled from any kind of factor in the wider economy.

This implies that it can be an uncorrelated yield source for two kinds of investors – those that are bullish long-term and denominate their holdings in native units, and those that are hedged.
This is a difference to proof-of-work (PoW) systems, where electricity and hardware costs serve as an unbridgeable anchor to the real economy, directly affecting a miner's yield rate.

For the first kind of investor - those bullish long-term - the combination of a near-absence of idiosyncratic risk beyond token risk, competitive yield, and a detachment from the wider economy may be a sufficient case for staking as a long-term growth vehicle.

For the second kind of investor - those on a quest for uncorrelated yields - cryptocurrency staking can be an attractive source of yield, but a hedge for the underlying token price may be required.

Sources of staking yield and what they mean

Section two of this article differentiates three kinds of staking yield - inflationary rewards, transaction fees, and MEV rewards.

These revenue streams can be deconstructed and used to express certain assumptions about the blockchain economy.

MEV and transaction fees correlate with transaction volume, and reduce to "priority transaction fees" (via tips paid to validators) and transaction fees. MEV correlates specifically with the value of the spacetime of block space[5], whereas transaction fees are a broader metric of usage. This is to mean the timing premium that a particular slot can command. To dive deeper, refer to Anicca Research's[6] excellent series of articles on the cost of block space.

You'd expect MEV to go up if a chain is a venue for market activity. Transaction fees can go up with any kind of usage, e.g. NFTs. There is a relationship - more transactions of any kind increase the marginal cost of an individual transaction.

[5] HTTPS://WWW.ANICCARESEARCH.TECH/BLOG/ETHEREUM-BLOCKSPACE-WHO-GETS-WHAT-AND-WHY
[6] HTTPS://WWW.ANICCARESEARCH.TECH/

MEV varies - some validators may be better at capturing it than others. As validators compete on yield, these revenues typically get distributed to users.

The upshot for an investor is that choosing a validator with a track record in MEV should be a priority. Chorus One has published widely on MEV, executed on-chain MEV transactions, and runs the most competitive block building solutions available.

Inflationary rewards are a more stable rate, and can typically be modelled in a more straightforward manner. For example, for Ethereum, the inflationary yield varies with the share of Ethereum staked.

Hedging staking yield

The token price risk may be hedged out through on- or off-chain solutions. The former case has the advantage of transparency, reflecting in an improved counterparty risk assessment and iron-clad terms. With some of the largest lending desks in the space embroiled in a liquidity crisis, this is a significant factor.

Validators are best positioned to execute on such on-chain transactions as they directly interface with the staking yield source and thus no custody transfer, i.e. additional risk, is required to interface with a counterparty. Secondly, validators are in the relationship business and run a significant risk if misbehaviour were detected - the difference to centralised counterparty risk is that validators do not

[7] HTTPS://MEDIUM.COM/CHORUS-ONE

have custody of the principal, so any risk would be limited to token price risk on the yield accrued in the time it takes to un-stake.

An example of an on-chain hedging solution is Alkimiya[8], which allows validators to swap future staking yield upfront for a USD-denominated stablecoin ("staking yield interest rate swap"). Historically, the roadblock for such instruments has been the buy-side. Alkimiya has ambitions to bridge this by pursuing a wider vision - block space may be bought by e.g. a centralised exchange to hedge for gas fees, or as structured products which allow investors to express their opinions as detailed in the last section. This is a very strong team with stellar backing, including an investment by Chorus One.

Other on and off-chain hedging solutions include classic derivative-based constructs well-known from traditional financial markets, e.g. a protective collar strategy. The staking yield can be used as a way to finance these strategies, and this may be done in a manner which protects the principal.

Chorus One is invested in a range of solutions optimising staking yield for return (i.e. MEV) and risk (i.e. hedging).

[8] ALKIMIYA

Takeaways

- Staking yield does not carry idiosyncratic risk beyond what is already priced in (i.e chain failure).
- There are three discrete sources of staking yield - inflationary rewards, MEV, transaction fees - which can be deconstructed by an investor to express certain assumptions.
- In order to optimise staking return, it is important to choose a validator provably competent in MEV.
- Staking yields are competitive vs. DeFi yields, and correlate with on-chain activity (transaction fees, MEV), while having an inflationary floor.
- Proof-of-stake yields are completely decoupled from the real economy (i.e. there is minimal cost of production), and can be seen as an uncorrelated yield source if hedged.
- Staking yields can be hedged in a transparent manner through on-chain solutions, and validators are ideally placed to execute such transactions.

MEV - A YEAR IN REVIEW

The first conceptual exploitation of the Maximum Extractable Value (MEV) appeared 8 years ago in a pmgoohan reddit post. However, the whole problem was framed only in 2019 by P. Daian et al in the "Flash Boys 2.0" paper, where the word MEV was used for the first time.

MEV can be defined as the additional value that is produced from a blockchain as a consequence of protocols' design and interactions. The produced value can be extracted by including, excluding or changing the order of transactions in the block, and today some types of MEV are seen as a service provided to both the network and protocols built on top of it. For example, by extracting some types of MEV, such as arbitrages and liquidations, the protocols work more efficiently.

Over time, new actors have taken on the role of protagonists in the MEV extraction. Today, a large portion of MEV is extracted by independent network participants, known as searchers, who run algorithms to detect profitable opportunities and have bots to automatically submit those transactions to the network. However, the MEV players are not only searchers competing with each other. To understand the intricate MEV's framework, it is worth mentioning what the MEV supply chain is – i.e. the chain of activity which helps users transform intentions into finalised state transitions in the presence of MEV. It is a concept developed by Flashbots, which does an incredible

amount of work in researching MEV solutions on Ethereum. However, this concept can be easily adapted on each network. The MEV supply chain starts with users, i.e. anyone with an intention to enact a state transition on a blockchain. In order to express their intention in something that is actionable, they use a wallet, or a dApp, or an aggregator. Thus, the supply chain continues with the interface that helps users to express their intentions into a transaction. Once the transaction is submitted, prior or post inclusion in the block – depending on the type of MEV and the specific blockchain structure – searchers can step in to detect if this transaction is producing some type of value that can be extracted. In a MEV dystopia, the MEV supply chain stops here, with the extracted MEV redistributed between searchers – which detect the opportunity and capture the value – and the validators – which collect the fees paid by searchers to prioritise transactions. In this scenario, MEV can be a very centralising force where all the value extracted is captured by few entities which may compromise the healthiness of the network. In a MEV utopia, the MEV supply chain continues and the extracted MEV is redistributed among several entities which participate in the network – e.g. delegators, validators, searchers, block builders, network itself, and users.

MEV represents a business of hundreds of millions of dollars per year, numbers destined to grow with the increase in volumes traded on DEXes. It is known that allowing for a redistribution of captured MEV among stakeholders can increase the security of the network itself (cfr. T. Chitra et al - 2022), and today several solutions that aim to achieve this goal exist - see e.g. Flashbots, Skip, Mekatek, Jito, Osmosis.

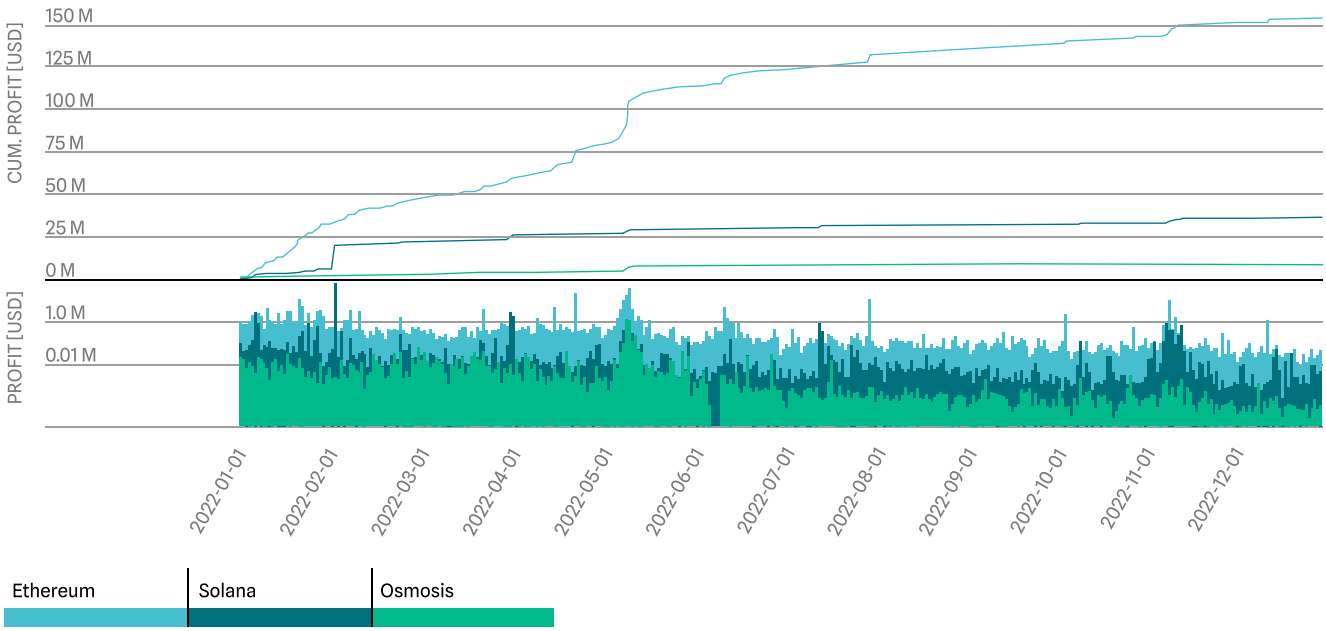


FIG. 1.1: MEV EXTRACTED FROM ARBITRAGES ON ETHEREUM (TURQUOISE LINE), SOLANA (DARK TURQUOISE LINE), AND OSMOSIS (GREEN LINE) IN 2022. NOTE THAT THE Y-AXIS OF PROFITS (BOTTOM PLOT) IS IN LOG SCALE. SOURCE FROM FLIPSIDECRYPTO. HERE WE EXCLUDED THE CASHIO EXPLOIT THAT HAPPENED ON SOLANA SINCE IT HIGHLY BIASES THE DOLLAR CONVERSION OF THE EXTRACTED MEV.

MEV extraction and redistribution can also represent a form of insurance against unexpected adverse market conditions. Indeed, it is well known that some types of MEV - especially arbitrages - correlates with market dynamics. An example of this can be seen in the Luna crash and the recent FTX saga. As we can see from Fig. 1.1, during the Luna crash - May 2022 - the extracted MEV amount spikes for all three networks considered (showing how Luna was interconnected for all three). During the FTX saga - November 2022 - the extracted MEV on Solana and Ethereum increased (Osmosis was not affected). It is worth noting that the increase in MEV captured on Solana in November was more acute due to the increased involvement of FTX in this ecosystem.

In 2022, a total of $195,310,897.39 from arbitrages ($152,900,224.89 from Ethereum, $36,650,027.84 from Solana, and $5,760,644.66 from Osmosis) were extracted. The amount increases if we also take into account liquidations and sandwich attacks. In general, MEV can

generate additional yield for Proof-of-Stake delegators and thus increase the network's security budget; in the case of Ethereum MEV on average comprises over 10% of the final yield ETH stakers earn - check out Felix's talk at the Staking Summit 2022 for more information on this topic.

In what follows, we are going to analyse the implications of sandwich attacks on the network. We know that on Solana it is very difficult to perform a sandwich attack, cfr. U. Natale 2022 and T. Franklin 2022. On Osmosis, the success of a sandwich attack is not deterministic (if the attacker is not a validator) due to the First In First Out (FIFO) implementation of the mempool. For these reasons we will focus on sandwich attacks done on Ethereum. Precisely, we are going to consider the extracted MEV done in the 7 days from Nov 21st to Nov 28th. Here we are not going to express our thoughts on the topic, but we are going to analyse data as-is, without judging to determine whether sandwich attacks are good or bad.

The Dynamics of a Sandwich Attack

The core argument of a sandwich attack is the action of reordering transactions in a block. This is possible by exploiting the fee market or by paying the validators with extra tips to have their transactions included in a given order within the block. In other words, let's assume a user (let's say Alice) wants to buy a token X on a DEX that uses an automated market maker (AMM) model. Let's now assume that an adversary sees Alice's transaction (let's say Bob) and can create two of its own transactions which it inserts before and after Alice's transaction (sandwiching it).

In this configuration, Bob buys the same token X, which pushes up the price for Alice's transaction, and then the third transaction is the adversary's transaction to sell token X (now at a higher price) at a profit, see Fig 1.2. This mechanism is possible only because Bob can squeeze Alice to her maximum willingness to pay (i.e. Bob steals Alice's slippage).

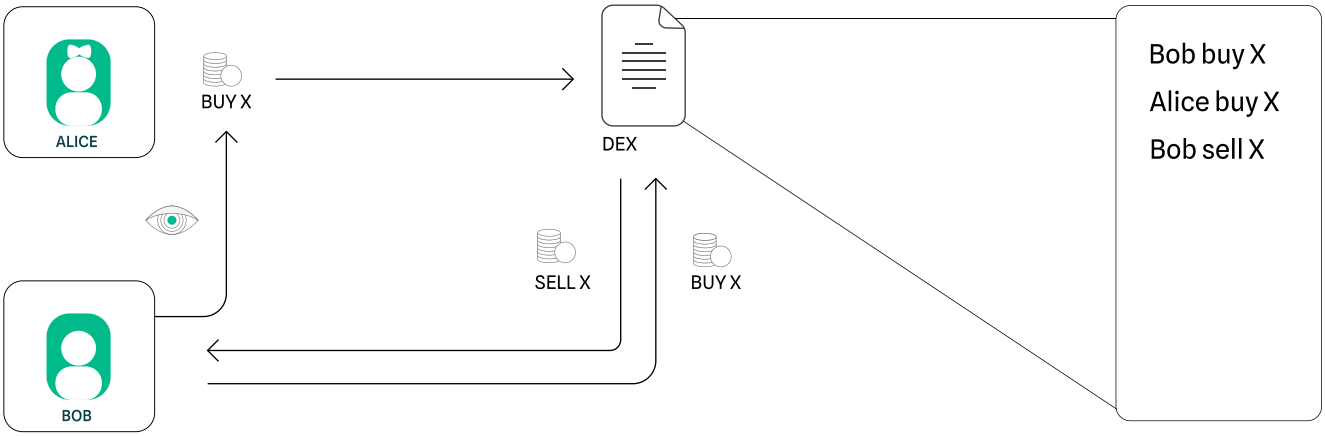


FIG. 1.2: GRAPHICAL REPRESENTATION OF SANDWICH ATTACK.
SOURCE FROM SOLANA MEV OUTLOOK – PART 1

The slippage corresponds to the maximum acceptable price movement set by users. To better understand the slippage we can consider the scenario represented in Fig.1.3. If we take a snapshot of the initial state, let's say state 1, the balance of token amount inside the pool is well established with a 50% of token A and 50% of token B (percentage computed considering the USD price of each token in the pool). Since each pool implements a specific curve type that determines the price of token A with respect to token B - and vice versa - given the state there is an unique amount of output token that a user receives if he submits a transaction that is instantly executed. However, some transactions can be executed prior to this changing the state of the pool (state 2 in Fig. 1.3).

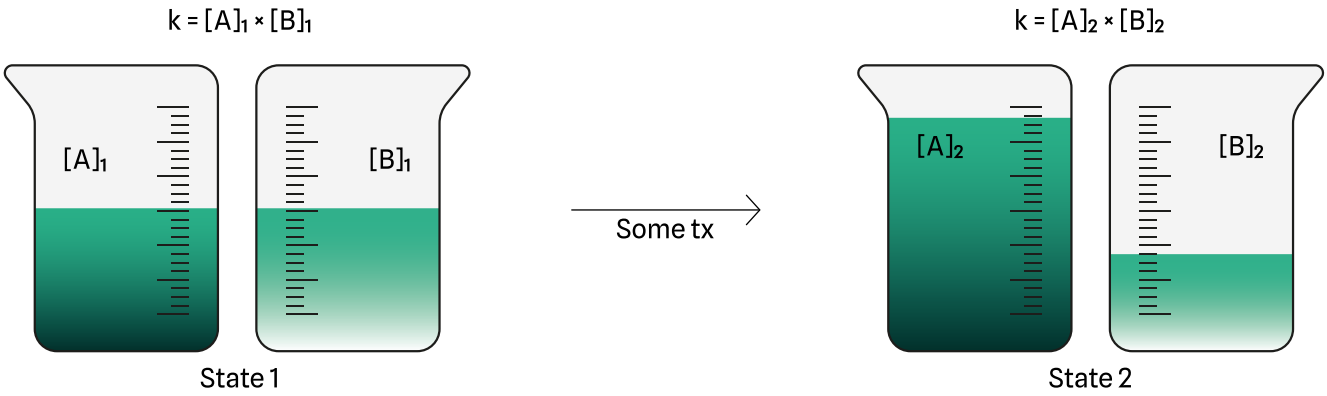


FIG. 1.3: GRAPHICAL REPRESENTATION OF THE STATUS CHANGE OF A POOL ON AMMS. HERE [X] REPRESENTS THE AMOUNT OF TOKEN X INSIDE THE POOL.

The implication of this is that the new amount of the output token is different from the one computed from status 1 - the curve type that determines the output is the same, only the balance of the pool is changed. If users are not willing to accept price movement when submitting transactions, they will see most of them rejected by the AMM. This is why slippage is a mandatory variable to set when submitting transactions to an AMM.

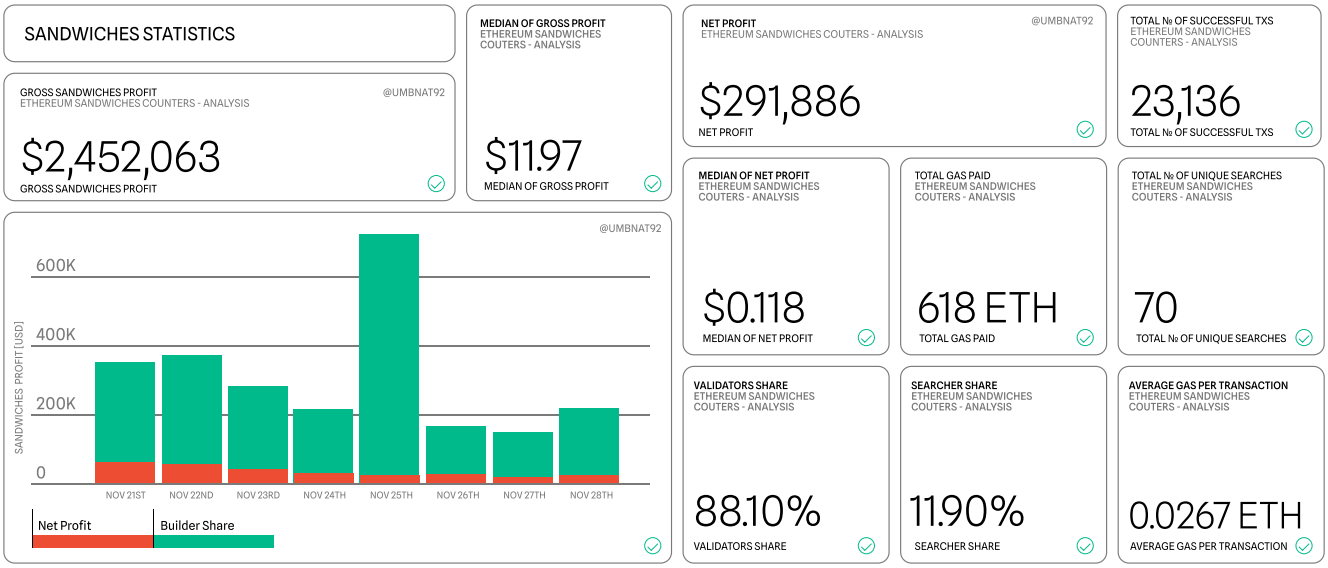


FIG. 1.4: SNAPSHOT OF SANDWICH STATISTICS IN THE TIME WINDOW FROM NOV 21ST TO NOV 28TH. SOURCE HERE

The scenario depicted above is quite common on Ethereum, see e.g. zeromev.org. During the seven days considered in this analysis, we count 23,136 sandwiches performed by 70 distinct bots. The total extracted MEV corresponds to $2,452,063, for a net profit of $291,886, see Fig. 1.4. The 88.1% of the extracted MEV is paid to validators, and this is not only due to the high competition among searchers. Indeed, when performing a sandwich attack you are forced to locate your transactions in a specific place inside the block, an operation that in general has a high cost.

The contracts most targeted by these types of attacks are routers, see Fig. 1.5. This is a clear consequence of the fact that routers (or aggregators) allow users to get the best price when swapping high amounts of tokens. Furthermore, it is also demonstrated that by using aggregators the profit from sandwich attacks diminishes, cfr. K. Kulkarni et al 2022.

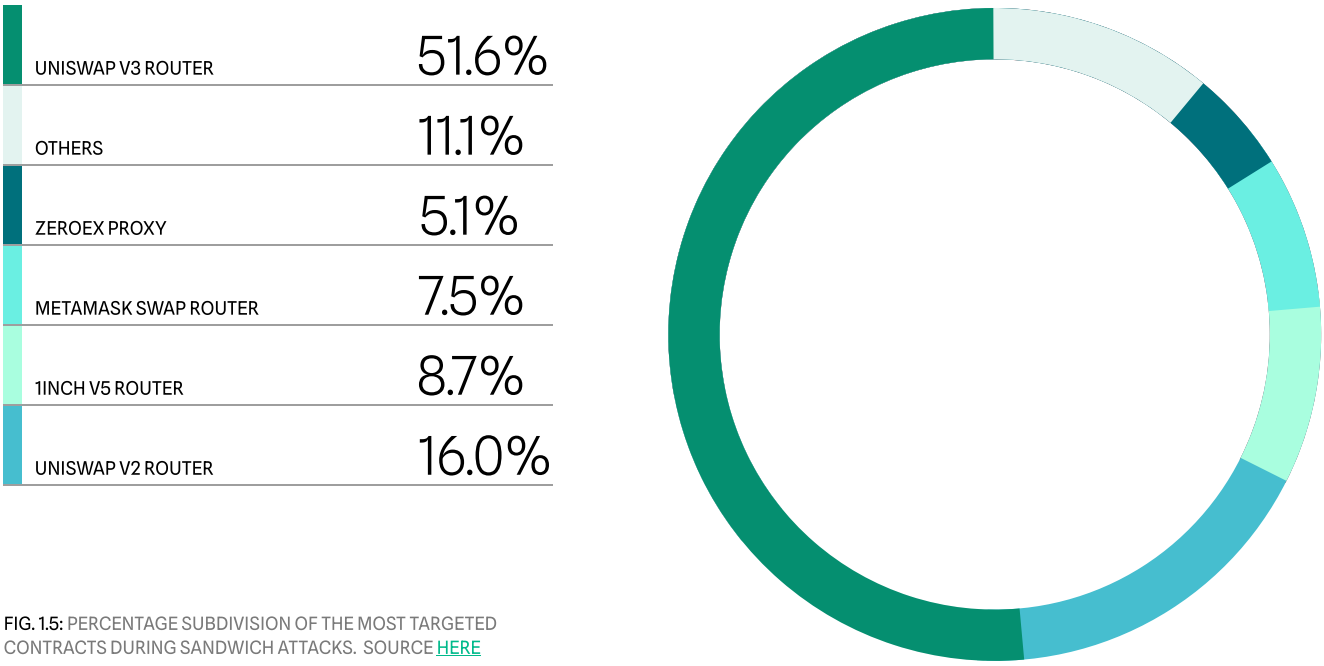


FIG. 1.5: PERCENTAGE SUBDIVISION OF THE MOST TARGETED CONTRACTS DURING SANDWICH ATTACKS. SOURCE HERE

If we use transaction hashes to verify - via Dune Analytics - on which DEXs sandwich attacks move the most volume, we find that 58.4% of the total volume flows on Uniswap (here we are considering Uniswap V1, V2, and V3 as Uniswap for sake of simplicity), see Fig. 1.6. The second position is occupied by DODO, with 26.2% of the total volume.

Project	TVL	7 Days Volume	Flow from MEV
Uniswap	$3.63B	$7.06B	$1.80B
Curve	$3.69B	$3.79B	$0.25B
Sushiswap	$0.42B	$0.21B	$0.10B
DODO	$49.61M	$1.22B	$0.80B

TAB. 1.1: TVL, 7 DAYS VOLUME, AND VOLUME FROM SANDWICH ATTACKS (CFR. FIG. 1.6).

Here we can observe how 25.5% of the total volume on Uniswap comes from sandwich attacks. In general, 22.78% of the total volume across all DEXs comes from sandwich attacks. This, of course, has a huge impact on the health of DEXs, affecting both liquidity providers and DEXs' token holders.

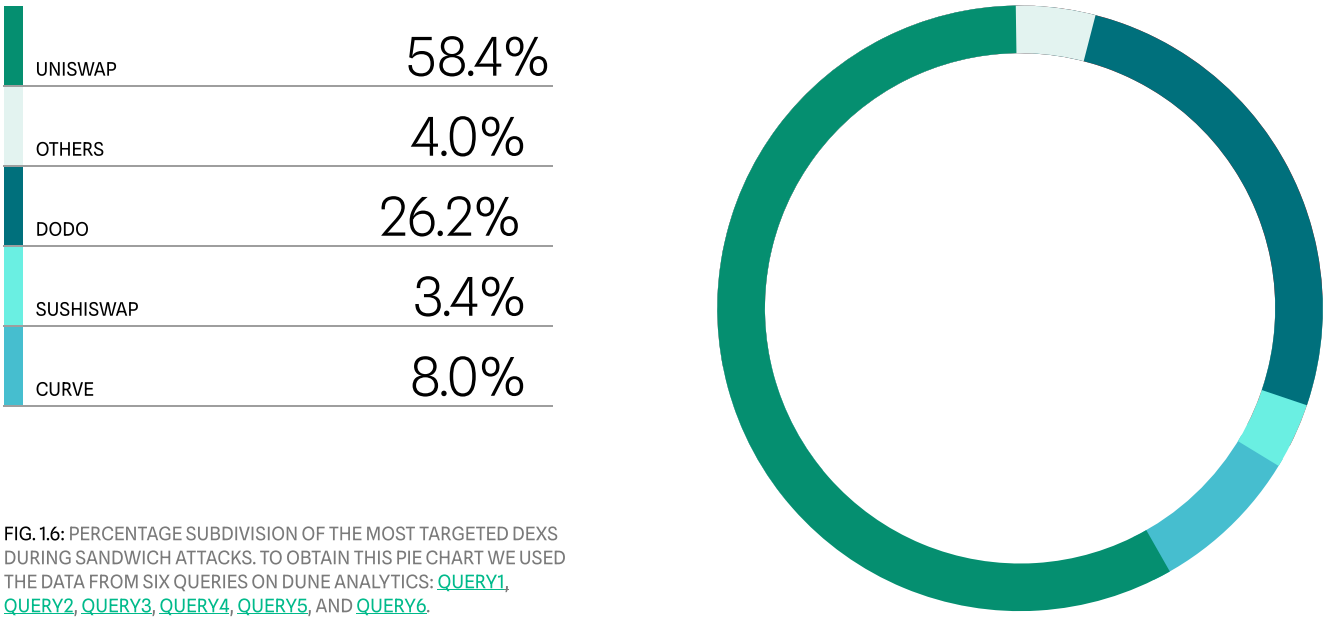


FIG. 1.6: PERCENTAGE SUBDIVISION OF THE MOST TARGETED DEXS DURING SANDWICH ATTACKS. TO OBTAIN THIS PIE CHART WE USED THE DATA FROM SIX QUERIES ON DUNE ANALYTICS: QUERY1, QUERY2, QUERY3, QUERY4, QUERY5, AND QUERY6.

THE GREAT DEBATE WAGES ON - MONOLITHIC VS MODULAR BLOCK-CHAINS

In 2022, the great debate between monolithic versus modular blockchains took place. When Ethereum was conceptualised, it was originally a monolithic blockchain - the world computer.

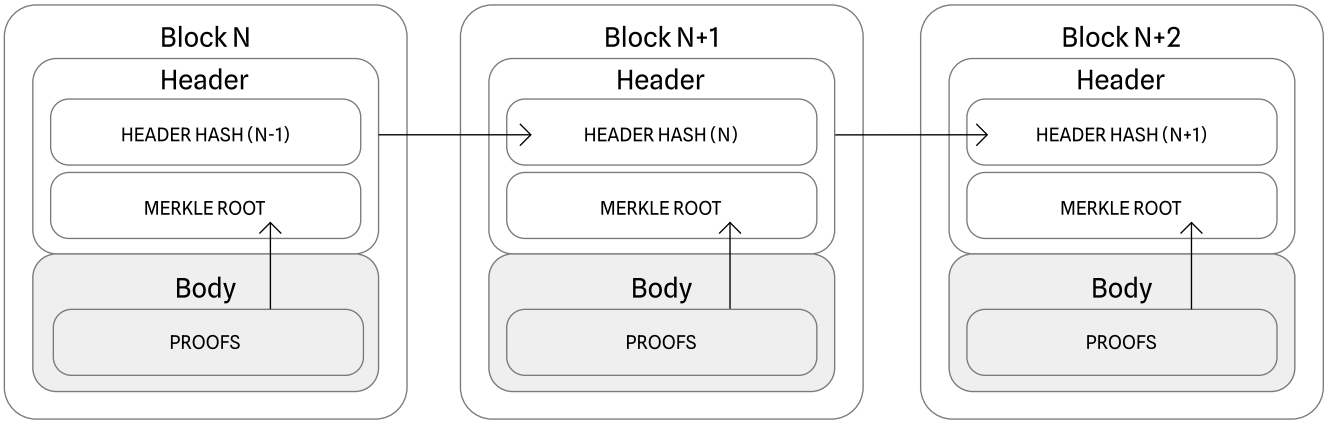


FIG. 2.1 - ETHEREUM AS A MONOLITHIC BLOCKCHAIN

A monolithic blockchain is one in which all nodes operating it perform work on all layers of the blockchain stack, including:

- settlement of transactions (finality),
- consensus (ordering of transactions),
- execution (transaction processing) and
- data availability (ability to verify all data published to blocks is available to the network).

When Ethereum was first created, the blockchain required nodes to perform work for all four of the above-mentioned layers. However, over time, this model ran into scaling issues due to the amount of work that nodes had to perform in the network. Therefore, Ethereum started experimenting with increasing network throughput without trading off network decentralisation. The result of this experimentation was the birth of execution layers in Ethereum (i.e. transaction processing would be done on another blockchain to lower the work expected of nodes on Ethereum network). For the first time in blockchain history, blockchains became more compartmentalised and specialised, also known as modular.

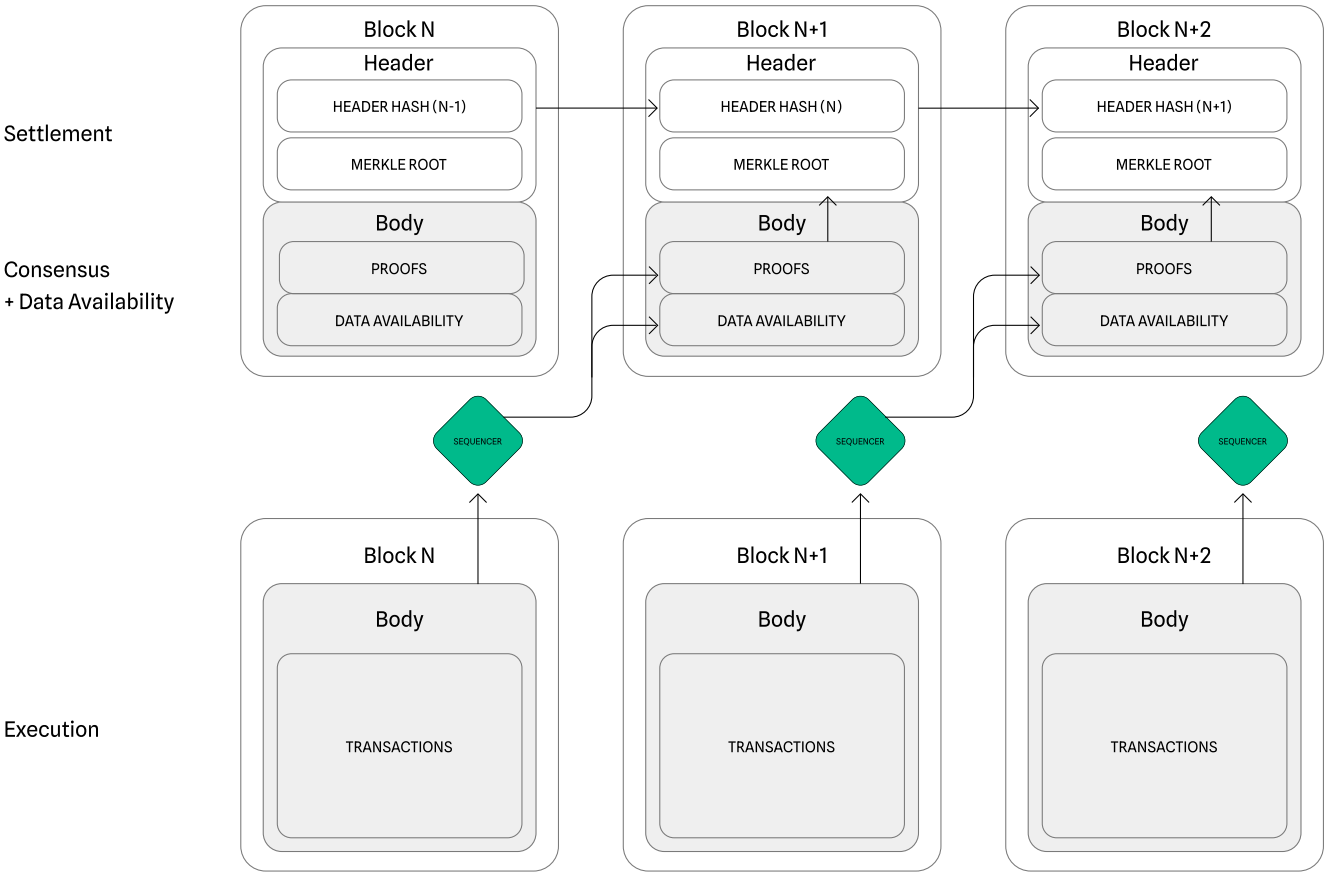


FIG. 2.2 - ETHEREUM AS A MODULAR BLOCKCHAIN

A modular blockchain is really one that decouples actions that nodes would normally take on a monolithic blockchain into smaller parts. The main benefits of decoupling nodes work into different layers is the greater amounts of customisation that can come as a result, due to developers not being limited to one monolithic architecture when building. Instead, developers can plug and play various modular layers from different ecosystems and design the chain most suitable for their needs.

A few years ago, teams in Ethereum started experimenting with optimistic rollups and zero-knowledge rollups on their endeavour to take Ethereum Virtual Machine (EVM) computation off of the Ethereum network. A natural question to ask about taking EVM computation off of the Ethereum network might be - how does the execution layer (off-chain) retain the security of the settlement layer (Ethereum)? The answer is quite simple - execution layers retain the security of the settlement layer they are linked to because computational proofs of transaction execution (on the execution layer) are published to the settlement layer alongside the transaction data itself (CALLDATA), which can then be publicly verified and/or disputed against by anyone. In this scenario on Ethereum, data availability is on Ethereum network itself (CALLDATA being published by the sequencer, which was processed and used to generate the proof on the settlement layer). However, even keeping data availability on the same network as settlement can lead to scalability issues because nodes are still required to download and execute the transactions on Ethereum itself, in order to verify proofs being posted by the execution layer. Therefore, the concept of a specialised data availability layer was proposed by the team at Celestia, to further separate data availability from execution, consensus and settlement layers.

The data availability layer is a layer fully designated to ensure that all data used to generate the proof for the settlement layer is indeed available, which enables anyone to fully recover the state in case of a dispute of transaction execution on the settlement layer.

Data availability is needed because as nodes, we do not want to download and process all transaction data in order to verify that computation has been correctly executed to save us from having to dispute it. Instead, we want to have guarantees that data being used to generate proofs is available and can be recovered, so we can perform work on the data only if a dispute occurs. This, of course, helps with scalability as nodes are required to perform less work in the network. Therefore, the most recent layer to become modularised in the blockchain stack has been the data availability layer. With the advent of the execution, data availability, consensus and settlement layers - innovation around modular blockchains really started to accelerate in 2022, especially in the Ethereum and Cosmos ecosystems.

On Ethereum, the execution layer adoption reached new heights. Arbitrum was the most successful execution layer by Total Value Locked (TVL) on Ethereum in 2022, starting the year with ~600,000 ETH in TVL and ending the year with ~1,800,000 ETH in TVL (~$2bn USD). The other standout execution layer on Ethereum in 2022 was Optimism, which experienced a higher growth multiple throughout the year than its counterpart Arbitrum and is now the second most successful execution layer by TVL. Optimism started the year with ~140,000 ETH in TVL and ended it with ~940,000 ETH in TVL (671% growth). The 3rd most successful execution layer on Ethereum by TVL growth was a zero-knowledge execution layer, called dYdX.

WEEKLY GAS USAGE BY PROGRAM

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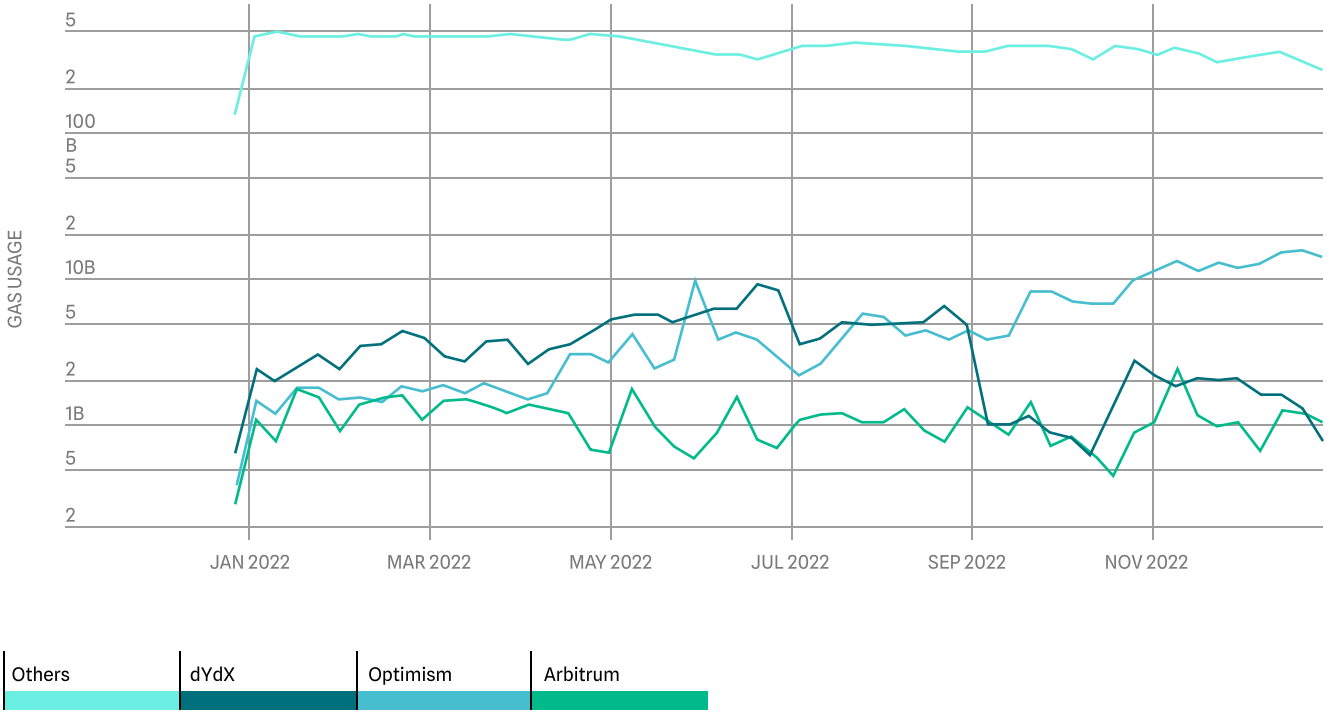


FIG. 2.3 - WEEKLY GAS USAGE BY PROGRAM (LOG-SCALE) ON DYDX, OPTIMISM, ARBITRUM AND OTHERS (ETHEREUM). ETHEREUM SHAVED ~200BN IN WEEKLY GAS USAGE BY THE END OF THE YEAR WITH NEWFOUND USAGE OF EXECUTION LAYERS.

Interestingly enough, dYdX was one of the first teams to move off of the base layer (Ethereum) when it first encountered scaling issues. dYdX has achieved product market fit with its perpetual trading decentralised exchange (DEX) and experienced another successful year in trading activity (data). However, one of the bigger announcements of 2022 was dYdX sharing their intention to transition its exchange to the Cosmos ecosystem and depart as an execution layer in Ethereum's ecosystem, for reasons outlined here. We further discussed the announcement here. dYdX's intentions to become an app-chain is another sub-type of blockchain specialisation. Instead of a blockchain being designed using lots of modular layers, a blockchain can instead become its own app-chain, with its own blockspace.

In a sense, both the modular blockchain and app-chain thesis were somewhat similar and both validated in 2022, due to the sustained growth in TVL of Ethereum Layer 2s and the most popular applications in Layer 2s transitioning to become its own chain (dYdX). dYdX was the first application to venture from a Layer 1, to a Layer 2 to an app-chain. Could this be the future for applications that are able to achieve product market fit (PMF)?

DYDX

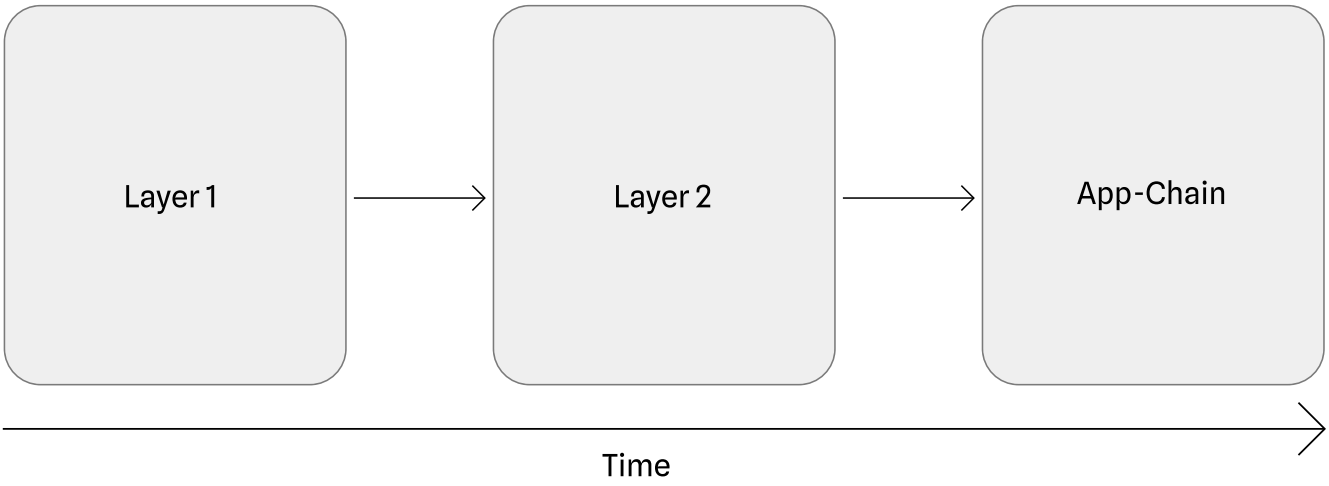


FIG. 2.4 - THE DYDX INFRASTRUCTURE JOURNEY OVER TIME

In terms of the Cosmos ecosystem, modular blockchain innovation was ubiquitous. Teams such as Dymension, Celestia, Nitro and Eclipse started building specialised layers of the modular blockchain blockchain stack. Most innovation in modular stacks in the Cosmos originates from the Celestia ecosystem as Celestia's blockchain is specialised in data availability and consensus and nothing else (e.g. no execution or settlement is done on Celestia). Celestia uses advanced technology to guarantee that data being used to generate proofs for settlement layers is available. Therefore, nodes in Celestia's network do nothing other than verifying that data being used to generate proofs on an execution layer is indeed available and able to be

recovered in case of a dispute. This is why Celestia used to be called 'LazyLedger' before its rebrand. With the arrival of Celestia in the Cosmos, many teams have started focusing on building specialised execution and/or settlement layers that leverage Celestia's network for other work (data availability and consensus). Some examples of teams that have built various specialised layers that interact with Celestia include Dymension, Nitro, Astria and Fuel. To elaborate, Dymension is a settlement layer that enables developers to create 'RollApps'. Nitro is an execution layer that uses the Solana Virtual Machine as an execution layer + Sei (Cosmos SDK) as a settlement layer. Astria is an EVM settlement layer that can be used with any execution layer. FuelVM is an execution layer that can execute programs in parallel with each other and has built its own domain-specific language (Sway), which was created by the same co-founders of Celestia.

In 2023, we expect a lot of innovation in blockchain to be around improving the security, scalability and decentralisation of the modular blockchain architecture. Celestia is expected to launch its mainnet in 2023 and after that, we expect the majority of modular blockchain innovation to come from that ecosystem. In saying that, there is a lot of modular blockchain innovation to look forward to outside of Celestia. In particular, we are excited to see the different ways developers employ various blockchain technologies from entirely different ecosystems as part of a modular stack in 2023. We have already seen early signs of this happening, with the solana virtual machine (SVM) being popular to design an execution layer with (Nitro + Eclipse) and the EVM being popular as a settlement layer (Astria + Cevmos). Modular blockchain stacks might bring rivalling blockchain ecosystems such as Cosmos, Ethereum and Solana closer than ever before.

CHORUS ONE

Network Reviews

IN THIS SECTION:

Ethereum, Solana, Cosmos

Ethereum

Market Capitalization

$187.62bn (-61%)

Staking APR

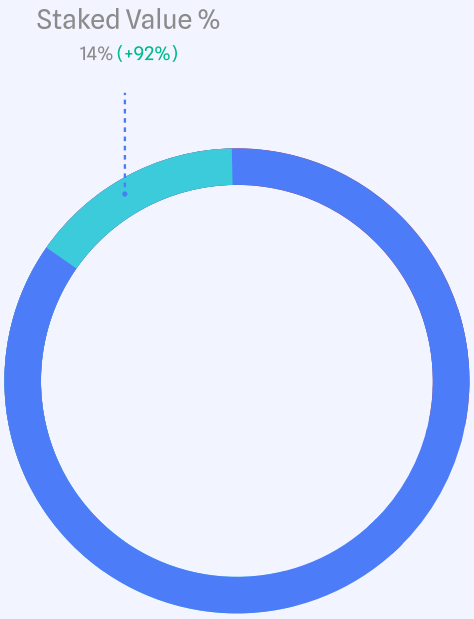
6.17% (+22.9%)

DeFI TVL

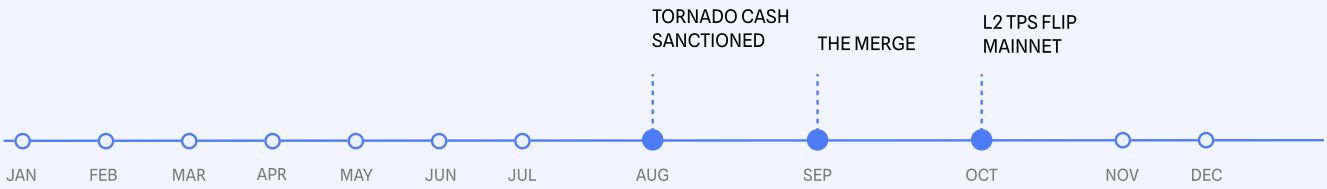
$27.82bn (-82.1%)

Staked Value

14% (+92%)



KEY EVENTS



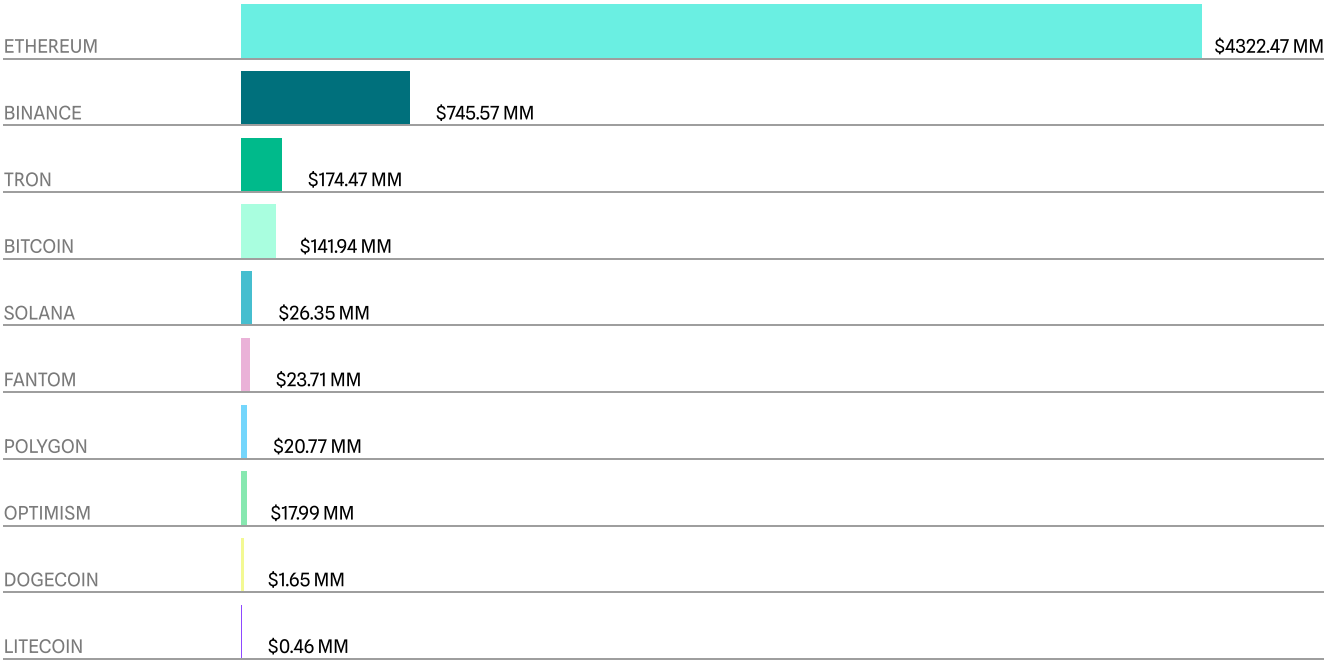
ETHEREUM IN 2022

In more than one way, 2022 was an extraordinary year for Ethereum.

It was a year that tested both the strength and the endurance of the ecosystem, for investors and developers alike. One block after another, Ethereum managed to switch to an entirely new security model, fight the hands of centralising powers, look towards the future and stack the first bricks of a brand new economic model. With more than a few buzzwords: Ethereum was Merged, Ultrasound and Modular. 2022 was also a year where MEV took centre stage, bringing new implications to the network and its users.

Users are a great measure of success for any blockchain. It is hard to argue against the value of something that many are willing to pay for. And in 2022, Ethereum soared above all other blockchains when it comes to valuable blockspace. Fees paid to the protocol reached astronomical heights, as shown in the diagram below, even as prices for ETH (the asset) dropped ~75% from all-time high, and even with a very respectable median gas price of ~28 gwei throughout the entire year. Whether we think transacting on Ethereum mainnet is cheap or expensive, people were very willing to incur the costs in 2022.

TOTAL BLOCKSPACE FEES FOR LEADING PROTOCOLS IN 2022

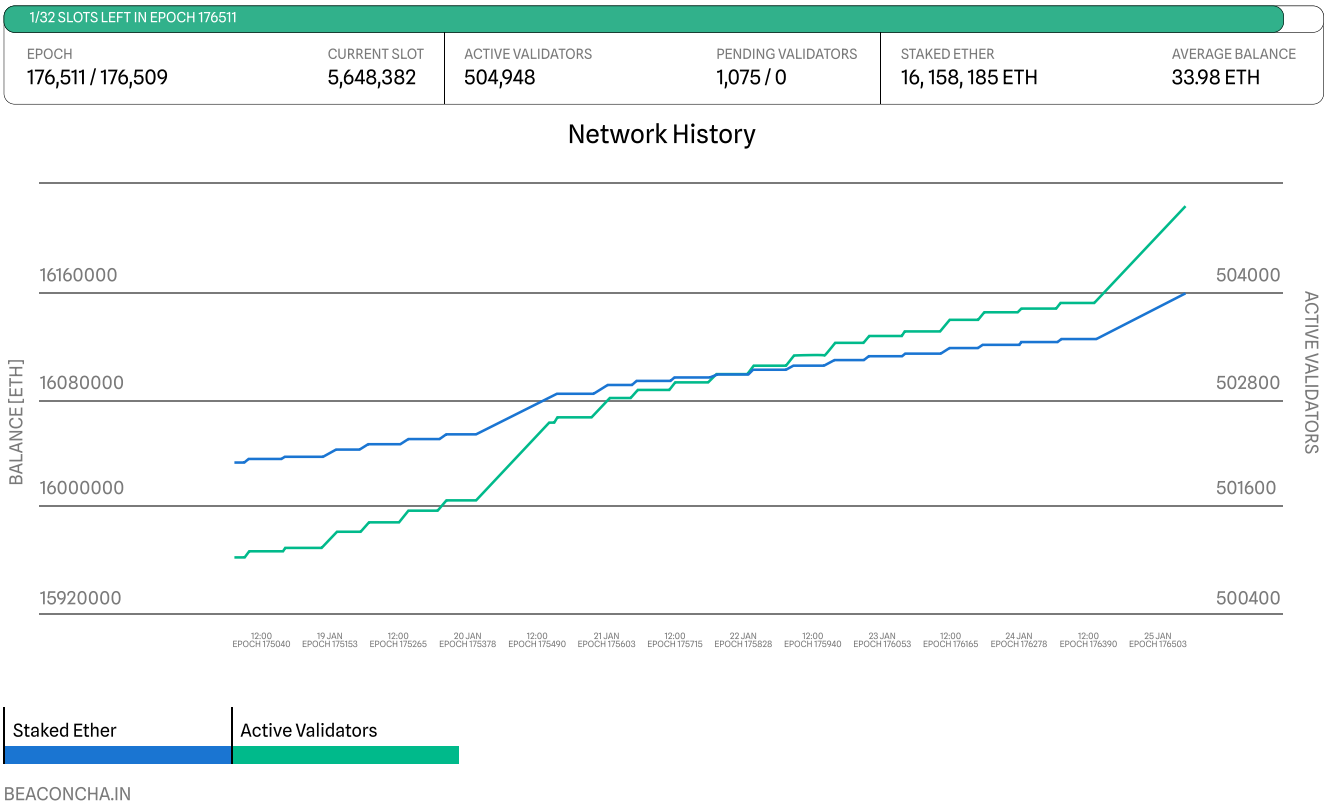


SOURCE(S): DATA ALWAYS, DEFILLAMA

However, it might not be forever the case that Ethereum is only one thing. In 2022, the definition expanded to include a whole ecosystem of solutions, all aligned to scale the network and handle the demands of its most exciting applications: money, DeFi, identity, governance. It has been discussed that hard times bring us closer to the fundamental ideas, and these applications continue to be the centre of innovation that we should strive to actualize in the coming years. This view towards the future gave us an updated Ethereum roadmap in 2022, as we celebrated one year of the beacon chain and the first 3 months of Proof-of-Stake Ethereum.

The Merge. The full transition to a staking security mechanism was a beacon of light in an otherwise tumultuous year. It's hard to overstate such a huge milestone for Ethereum and the crypto industry. Thousands bore witness as the transition happened almost miraculously, in real time and with zero hiccups. It was a spectacular

technical feat, even if after the dust settled, it ended up being quite boring to watch. Articles were written by major publications and Ethereum had its day in the spotlight (before giving space to bleaker news). We celebrated a job well done in Bogota, where the Ethereum community came together for the first Devcon in 3 years. Staking continued to be strong: by mid-2022 Ethereum crossed the threshold of 400 thousand validators.



But it wasn't all good news. A popular tenant held by many in this world of crypto (that swings between the often niche and the sometimes mainstream) was put to the test: the idea of building decentralised systems that don't have a central authority and cannot be held against anyone or controlled by anyone, but rather are carried by a diverse group of coordinated individuals. It all started with the Tornado Cash sanctions by the U.S. Department of the Treasury's Office of Foreign Assets Control (OFAC). The OFAC sanctions (as they

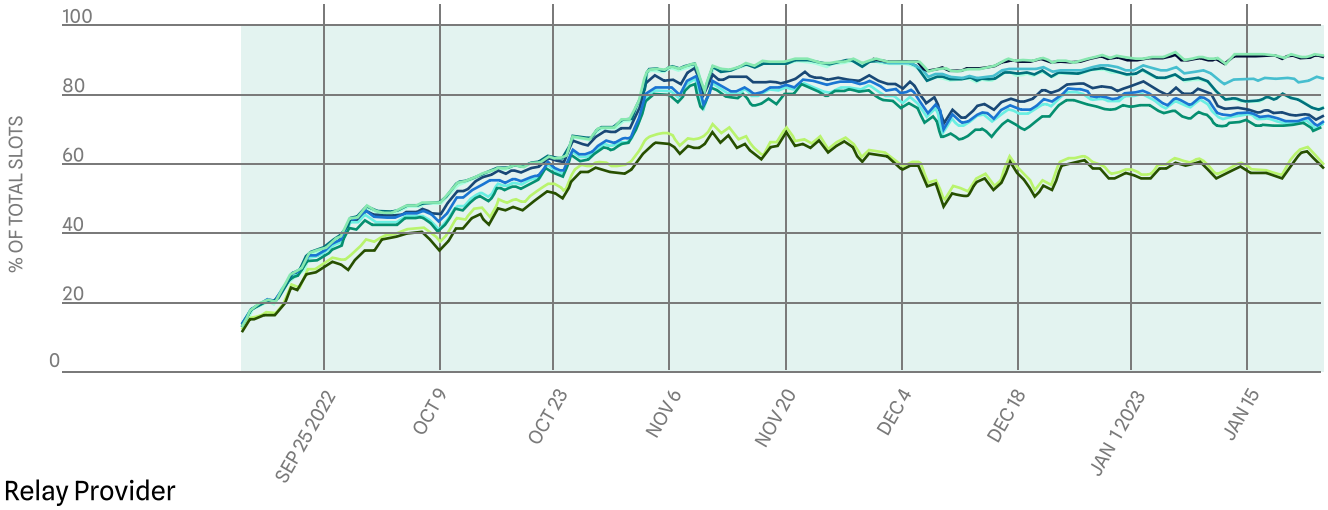
would become known) alleged that the mixing service, that enables private transactions on Ethereum, was an accessory to criminals for illicit activity, with specific pointers to laundering that took place by hackers of the Democratic People's Republic of Korea (DPRK).

As similar privacy-enabling applications on Ethereum faced an uncertain future, the question turned to whether the developers that contributed to the protocol in an open way could face any responsibility for its use. A young developer of the app called Alexey Pertsev was imprisoned in the Netherlands, to large amounts of uproar on and offline. Free-speech protections should include the idea of software as protected speech, which is the outcome that protesters hope to see at the end of this fight that touches both the ideological and material. However, Alexey continues to be imprisoned without any formal charges and will remain so until at least the month of February 2023.

There were second order consequences to the most severe policy ruling against crypto in the year 2022. And there was no space where it had bigger repercussions than in the MEV stage. The success of the Merge not only meant that validators could now access transaction fee rewards paid in the form of tips, but they could also boost their APY by leveraging MEV. Flashbots, the team that successfully built their brand around democratising MEV in 2021, released their PoS-ready middleware application to access this block builder marketplace. Under the name mev-boost, it was quickly adopted by a high percentage of the network, with almost 60% of the validator set enabling the solution just a month after the Merge.

TOTAL SLOT SHARE (CUMULATIVE) - RELAYERS

7D 1M ALL



Relay Provider

Flashbots	Bloxroute (ethical)	Bloxroute (max profit)	Bloxroute (regulated)	Manifold	Eden
Blocknative	Relayooor	Ultrasound	Agnostic Gnosis	Aestus	Other/none

MEVBOOST.PICS

To relay communications between the builders and the block proposers, or validators, a piece of software aptly called "relayer" is necessary (under the current implementation). These relayers, controlled by third-parties, can have their own operational guidelines. Because Flashbots is a U.S.-based company, this left them legally adrift in regards to the OFAC-sanctioned transactions made through Tornado Cash. Their controlled relayer, which at this point was responsible for ~80% of all built blocks in the network, began filtering these transactions. Many worried that this set a path to censorship on Ethereum, if not that it was taking place already.

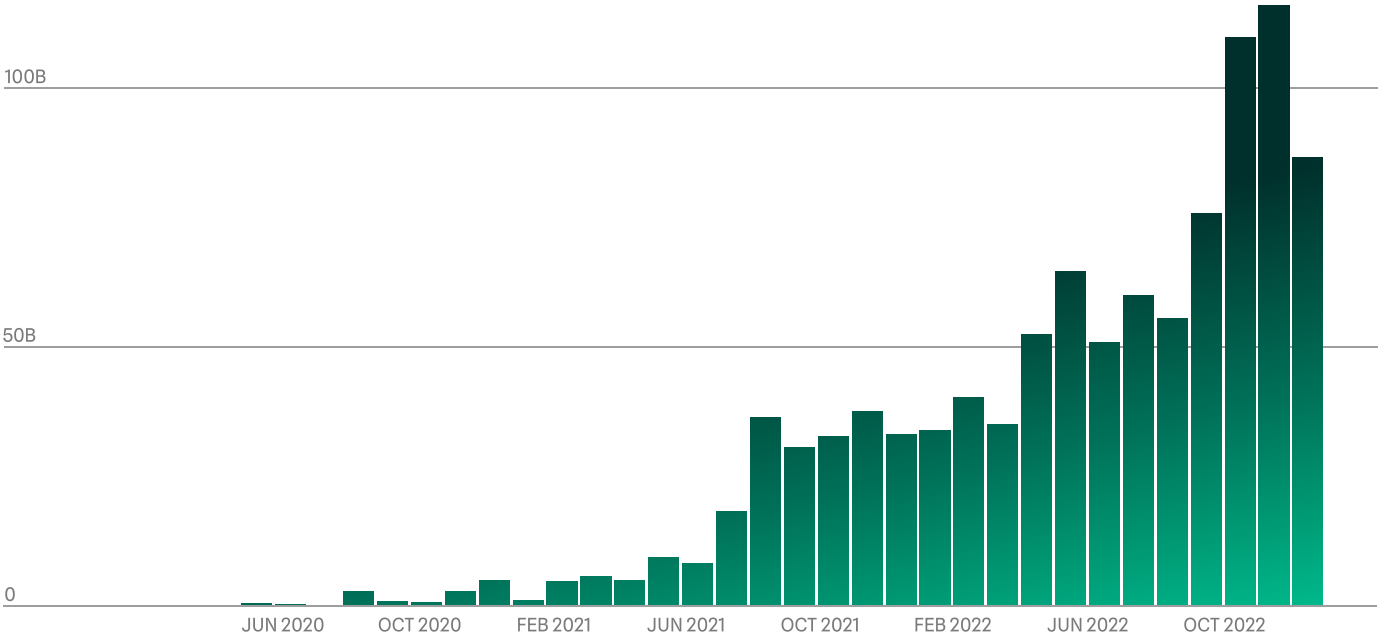
Although there were no simple answers to this question (unattended MEV has been and could also become an existential threat to Ethereum), the current landscape looks more healthy: Flashbots still maintains a majority of the blocks but nonetheless hangs around ~60% of network penetration, and there's at least 10 active relayers

being maintained openly, with 7 of them being non-censoring. This is an issue that will continue to impact the Ethereum community and most likely, the discourse in the year 2023 as MEV becomes more key to the interests of validators and staking providers. We're sure regulators all around the world will also have a part to play in the continuing saga.

Later in the year, decentralisation and centralisation also became the focus of more discussion and controversy, this time surrounding the biggest crypto exchanges. In the wake of the infamous blow up of FTX (covered in the Solana section of this report), the industry got reminded of the dangers of centralising power and resources, and DeFi furthered its product-market fit. It became clear that the way is towards open systems and freedom, and that we must build a path for easy adoption of truly decentralised systems.

When it comes to scaling Ethereum, there are many edges to grab. The second half of 2022 saw an exponential growth in rollup adoption, and the year closed with December becoming a record-breaking month in regards to gas spent to settle L2 activity on Ethereum. Optimistic and generalised (EVM-compatible) rollups such as Arbitrum and Optimism continue to lead the pack, with 2,119,873 ETH already bridged into the Arbitrum contract. In October 2022, L2 transactions-per-second (TPS) flipped Ethereum mainnet's TPS for the first time, and this explosion does not consider activity on sidechains such as Polygon's MATIC and Gnosis Chain.

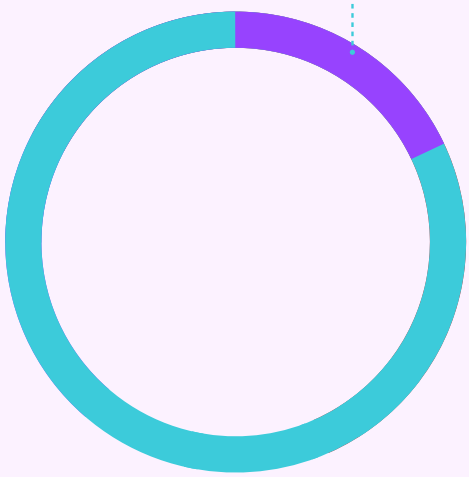
MONTHLY ETHEREUM GAS SPENT TO SETTLE L2 ACTIVITY



Again, the Ethereum of the future will not be a single entity, and might look very different from what we are accustomed to. With the Merge safely in our past, the developers are ready to push forward the innovations outlined in the roadmap with increasing speed, starting with withdrawals in March. What this might mean for the future of staking and ETH as an asset is to be seen, but the changes have already had some impact on Ethereum's economic model. Because token issuance was reduced by ~90% and considering the burn mechanism implemented back in August 2021 (EIP-1559), ETH is now a net deflationary asset with real yield. Ethereum might be the only network that is working on bootstrapping economically for the longer term. Now unto the next big challenges.

Solana

Staked Value %
70.7% (-6%)



Market Capitalization

$12.57bn (-86.7%)

Staking APR

7.03% (+15.4%)

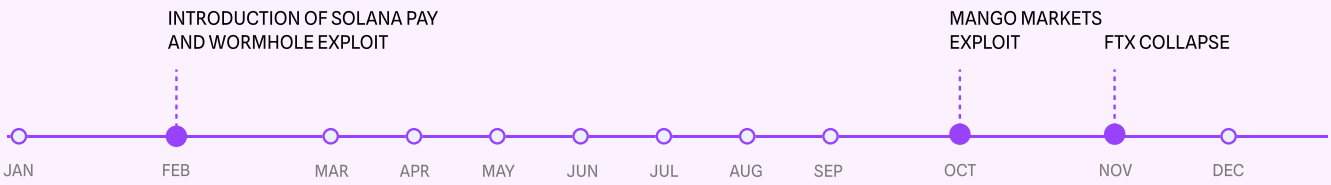
DeFI TVL

$266.6mn(-97.6%)

Staked Value

70.7% (-6%)

KEY EVENTS



SOLANA'S 2022 IN REVIEW

Ecosystem

The Solana ecosystem showed the most expressive growth, according to Alchemy's Web3 Developer Report, more than doubling the number of Github repos and the number of daily unique programs year-over-year despite SOL prices dropping -95% over the same time period. Solana's events like Breakpoint, Solana Hacker Houses, Games Day and MEV Camp created spaces for Solana developers to build, learn, and showcase their projects.

2022 was the year when the privacy-focused browser Brave finalised integrating Solana into their wallet, making it much easier for non-crypto native internet users to get started on Solana. Google Cloud also announced the Blockchain Node Engine - the easiest way to run your own node, and the support for Solana data to be queried using Big Query. Solana Pay was introduced in February, targeting a permissionless payment ecosystem. It's now reported to be in use by stores and brands alike. In June, the Solana Mobile Stack and Saga phone were announced to seamlessly, securely free the blockchain from the desktop. Beta "DVT-1" units were shipped to developers by August and the plan is to ship to the public in early 2023.

On the other hand, relevant applications were targeted in malicious attacks during the last year. In February, the Wormhole interoperability protocol was exploited to make off with close to $325 million - the 5th biggest hack on the Rekt leaderboard. The attack seems to have resulted from an update to the project's GitHub repository, which revealed a fix to a bug that had not yet been deployed to the project itself. Then, the Mango Markets exploit happened in October with Avraham Eisenberg and his team manipulating the value of their posted collateral - the platforms' native token, MNGO — to higher prices, then taking out significant loans against their inflated collateral, which drained $117 millions from Mango's treasury. After negotiations, $67 million worth of crypto was returned to the platform and used to reimburse affected users under a plan approved by the DAO. The exploiter was recently arrested in Puerto Rico and charged with market manipulation.

Still, before the year end, another exploit happened. This time on Raydium, one of the top AMMs/swap programs on Solana. The team reported approximately $4.4 million were transferred from constant product pools to the exploiter account. A compensation plan was created to allow LPs to claim 90% of native tokens back plus the 10% remaining in RAY tokens. Concentrated liquidity pools were not affected and the DEX continued to work as usual, closing the year with total value locked (TVL) close to $30 million, according to Solscan.

Technology

During 2022, Solana has announced three main changes to improve the stability and resilience of the network:

1. QUIC: replaced its old data transfer protocol, UDP, since it allows for greater control over data flow.
2. Stake Weighted QoS: because connections are verifiable through QUIC, validators can prioritize and limit the traffic for specific connections.
3. Fee Markets: launched in June, it allows sophisticated (algorithms) traders to offer a bigger fee to validators to prioritize a time-sensitive transaction. According to Solana additional fee analysis, around 30% of transactions are being bumped.

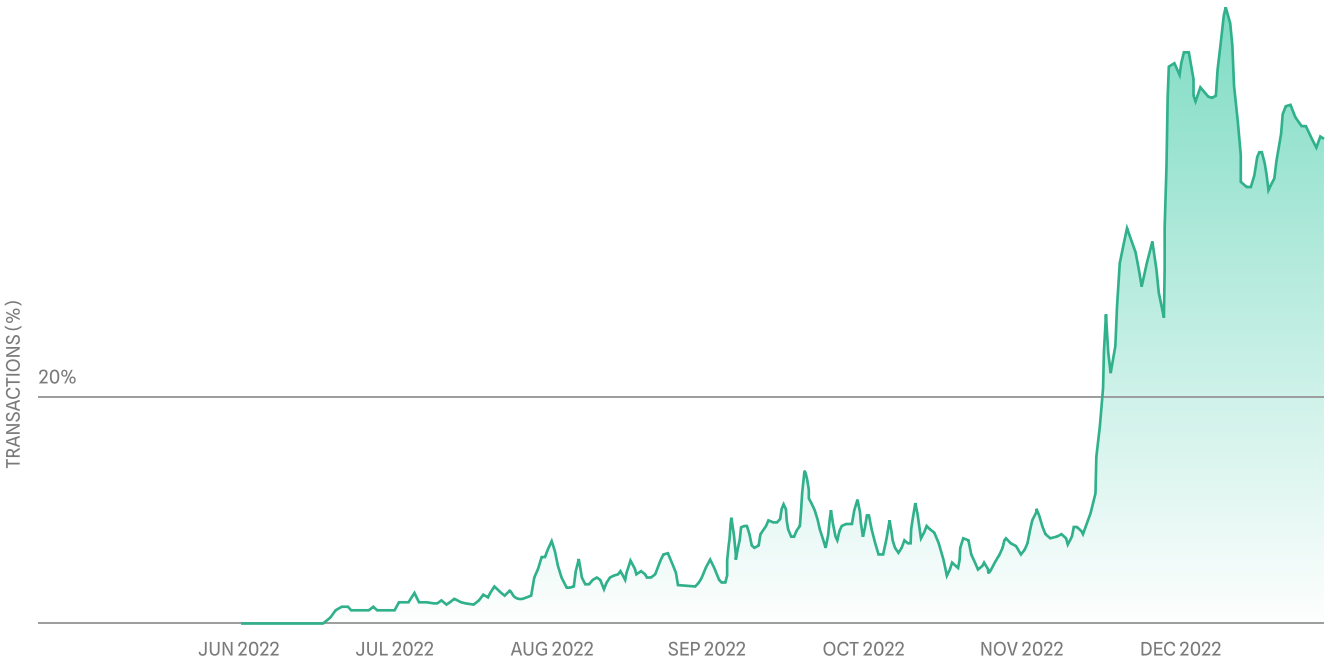


FIG. 3.1: TRANSACTIONS WITH BUMP AS % OF TOTAL NON-VOTING TRANSACTIONS. SOURCE: VALIDATORS DASHBOARD

These changes were explored in detail in the article 3 Major Upcoming Upgrades on Solana That Will Improve Network Performance.

Even with those improvements in place, Solana was down in September. This time caused by a restriction in the fork-choice algorithm that prevented the network from choosing forks involving duplicated blocks. When a duplicated block received enough votes to be considered valid, the nodes were not able to adopt that version of the state and the network needed a coordinated restart to continue. Incidents like this could be minimised by the adoption of multiple clients. And this is another segment that gained visibility, after Jump Crypto announced Firedancer, an independent Solana validator client. According to Jump's presentation, a huge improvement can be made just by algorithm simplification and hardware acceleration. The expectation is that Firedancer will lead to a solidification of the Solana codebase and, in addition to being a highly performant client implementation, improve the Solana Labs client itself.

Solana also gained a MEV focused client with the launch of the jito-solana client by Jito Labs. The client runs a block building marketplace that allows MEV searchers to create bundles of transactions before submitting them to validators.

Network Activity

Solana validator's set grew significantly across the year, reaching the mark of 2,000 active nodes in September. The number of validators fell to 1,584 in early November, after Hetzner blocked all crypto-related activities. Hetzner is a German web-hosting company, who hosted over 40% of the network's validators and over 20% of the stake. Since then, the set has stabilized around 1,800, and as a positive effect, nodes are more geographically distributed.

In terms of network activity, the number of transactions continued to be high, with the major part of what is currently processed refers to validators voting on block validity. According to this dashboard, on Jan '22, the network hit an average of 700 transactions per second, with more than 400 tx/per block. In December, TPS was half of that, around 350 TPS on average. Despite the reduction in TPS, the network has been producing blocks faster, keeping validators' rewards (when measured in SOL) at a similar level as on periods with higher activity. The biggest factor for validators' economics, however, is the decrease in SOL price, making it harder for node operators to reach breakeven when considering operational costs. Professional validators who tend to have an expressive dollar outlay were even more impacted by the drop in SOL price. A professional validator would now require 4.7 million SOL to reach breakeven, in contrast to 1.3 million SOL required in our previous analysis on Validator Economics.

REQUIRED STAKE (SOL)

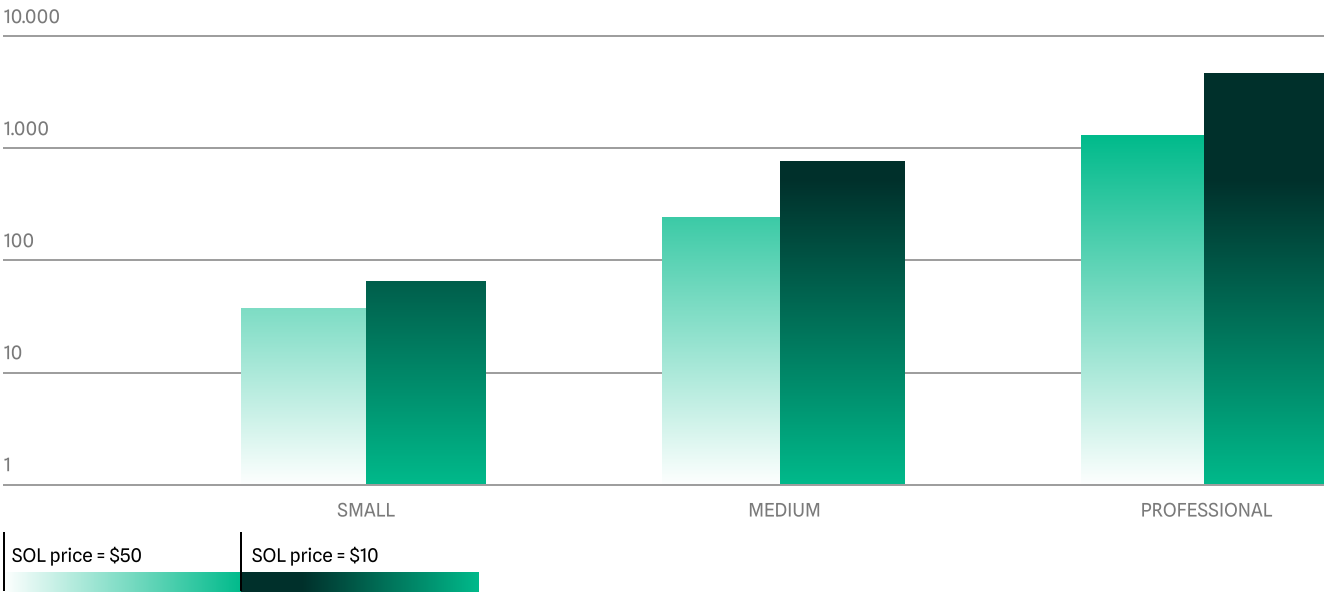


FIG. 3.2: MINIMUM AMOUNT OF SOL REQUIRED TO VALIDATORS TO BREAK EVEN, CONSIDERING OPERATIONAL COSTS AND TWO DIFFERENT SCENARIOS FOR SOL PRICE.

FTX Collapse

Once upon a time, there was hope for the current bear-market to soothe. But in November, what could be seen as a shy optimism starting to show up in the crypto space, was ruined by the centralized exchange FTX filling bankruptcy. Triggered by a liquidity crisis that - sadly - dragged down depositors' capital with it - and much more, the episode brought even more stress into the industry and has a major impact on Solana. That's because FTX and Alameda - the same owner's trading firm - had been largely present in the ecosystem, funding projects since its genesis, trading digital assets and providing liquidity to Solana markets.

FIG. 3.3: SOL PRICE (USD) THROUGHOUT 2022. SOURCE: COINBASE

In an official communication, the Solana Foundation published its exposure in terms of cash and assets, which includes $1m in cash or cash equivalents on FTX.com, 3.2m shares of FTX Trading LTD common stock, 3.4m FTT tokens and 134m SRM tokens.

The price of SOL dropped by over 65% since the release of the Coindesk article about FTX and on-chain liquidity disappeared. DeFi protocols were left with bad collateral, such as the wrapped assets from the Sollet bridge, as the real assets were in custody of FTX. The Solana Foundation estimated the exposure to Sollet-based assets on Solana around $40 million as of Nov 10, 2022.

Serum Protocol was one of Solana's core DeFi infrastructures with a Central Limit Order Book (CLOB) mechanism that ensured optimal order matching on decentralised exchanges. Serum powered some of the biggest DeFi protocols on Solana including Raydium, Mango Markets and Jupiter Aggregator. Serum's update keys were not controlled by the DAO, but by FTX. To protect the project against any threats, the community orchestrated and deployed a new verified build of Serum called OpenBook. To read more about that, we recommend this article.

SOLANA DEFI - TVL

FIG. 3.4: TOTAL VALUE LOCKED IN SOLANA DEFI APPLICATIONS SINCE JANUARY '22. SOURCE: DEFILLAMA

Cosmos

Market Capitalization

$3.75bn (-48.3%)

Staking APR

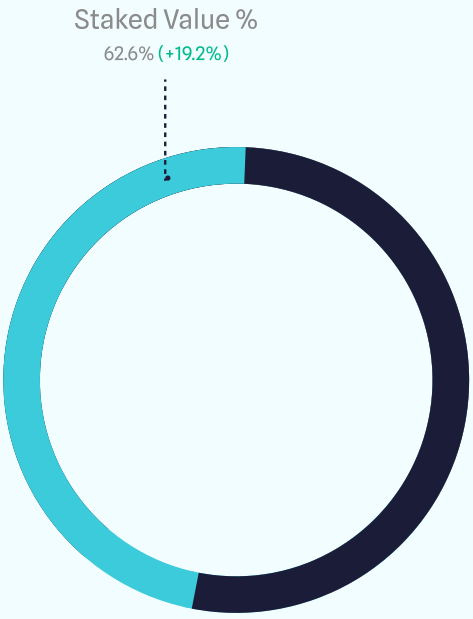
21% (+68.4%)

DeFI TVL

$1.15bn

Staked Value

62.6% (+19.2%)



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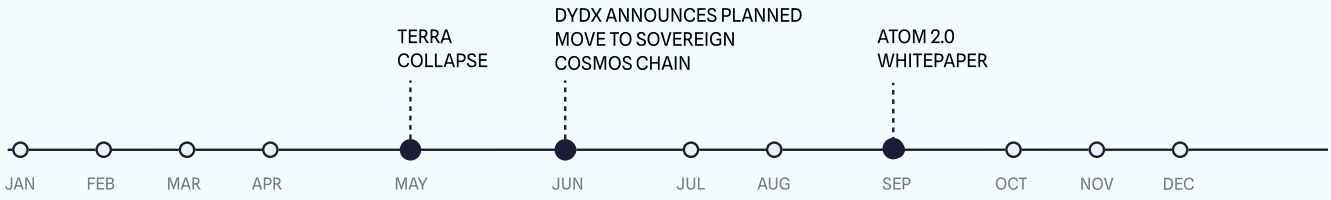


COSMOS IN REVIEW: 2022

At Chorus One, we have supported the Cosmos ecosystem since the start. Cosmos is an ecosystem of interconnected blockchain networks that allows for interoperability. The Cosmos network is driven by the Cosmos Hub, a single hub that connects numerous different blockchain networks, known as "Zones", via interblockchain communication, or IBC, mechanism. To obtain agreement and validate transactions, the Cosmos Hub employs Tendermint BFT, a variant of the Practical Byzantine Fault Tolerance (PBFT) method. It is modular in design, allowing for the creation of unique, independent blockchains that may link to the Cosmos Hub, allowing for the transmission of data and currency between them. It makes use of the native token ATOM for governance, transaction validation, and network bonding. Cosmos has been on the spotlight during 2022 for various reasons:

The bad - Terra/Luna Collapse

In May 2022, we saw the biggest wealth destruction event in crypto's history (until FTX) following the depegging of Terra's UST stablecoin and the resulting collapse of LUNA and fallout impact on many of the projects building in or integrating with the Terra ecosystem.

Background

Chorus One had been a Terra validator since the network's genesis. Terra was the second Cosmos SDK network we decided to onboard after the Cosmos Hub in 2019. The Terra team was bringing new ideas to the Cosmos SDK and Tendermint, at that time largely centered around the CHAI payments app. The Terra ecosystem worked with a double coin peg algorithm that connected the UST stablecoin and the LUNA coin.This entailed utilizing a smart contract-based mechanism to maintain the price of TerraUSD (UST) at $1 by burning LUNA tokens in order to mint new UST tokens.

Over the course of 2021, as alternative layer-1 networks such as Solana and others gained more traction, the focus for Terra shifted more and more to the algorithmic stablecoin UST and Anchor. Anchor offered a highly attractive and unmatched stablecoin APY of 20%, leading to increasing demand and as a result UST minted, ultimately making it the largest decentralised stablecoin in the market. Discussions to lower the Anchor yield to decrease the attractiveness of UST were held - as many felt the initial growth goals were met and a more sustainable model should have been introduced at this stage - but only minor adjustments that had no measurable impact on the growth were made. In parallel, Terra's UST presence across ecosystems increased through various business development efforts and integrations, e.g. on decentralised exchanges such as Curve and Osmosis.

In the meantime, the Luna Foundation Guard (LFG) was set up and endowed with funds (BTC) with the goal to collateralize and stabilise the UST peg. But assets held by the LFG never collateralized more than a low double-digit percentage of the UST in circulation. In addition, the

core mechanism of stabilisation which involves inflating LUNA supply, was increasingly put into question as UST supply had outgrown LUNA market capitalization.

Depegging and Remediation: Key Events From A Validator's Perspective

- Terra UST begins to de-peg slightly following market movements which are speculated to resemble an attack, but may well also be attributed to macroeconomic factors
- Mechanisms to defend the peg begin, but don't seem to take effect. Over the course of multiple hours, confidence is widely lost, and the much anticipated "death spiral" effect takes course as LUNA investors and UST stablecoin holders seek to remove their liquidity from the system.
- Excessive LUNA minting leads to serious risk of attack on the Terra blockchain as an attacker could buy up enough stake to remove collateral still locked on the Terra blockchain (e.g. Lido's bETH). TFL/LFG buy $LUNA and stake with reputable node operators to avoid this.
- Bridge connections (including Wormhole and IBC) are shut down to avoid the ability for an attacker to transfer out cross-chain collateral held on Terra, such as bETH. CEXes suspend trading and deposit/withdrawals of LUNA and UST.
- As hyperinflation and devaluation of LUNA continues, a hard fork to remove delegation and create-validator functionality is coordinated to ensure the safety of collateral on Terra.

- Bridge connections are reopened to allow collateral to leave the Terra network. Notably, Osmosis, the biggest Cosmos-based DEX, decides to do an emergency upgrade to allow liquidity providers with Terra assets to prematurely un-pool their assets to avoid further impermanent loss from LUNA devaluation and UST depegging (Osmosis LPs can choose to bond/lock their assets for up to two weeks. This emergency mechanism only allowed them to remove the liquidity from the pool, with their assets still remaining locked for the duration of the chosen locking period).
- Discussions about a remediation plan start. Proposals of a fork that would restart the network without algorithmic stablecoins and distributing tokens to holders to allow for a re-emergence of the Terra developer ecosystem, as well as an effort to try and compensate the parties most severely affected by the collapse of the system are put live. Community discussions around the exact parameters and alternative approaches are taking place.

Ultimately, we made the decision to wind down our infrastructure for the "classic" Terra blockchain, and will not be joining the rebooted Terra network at its genesis. We wish the Terra community the best and invite Terra developers to look at other options in the Cosmos ecosystem as an alternative for their projects.

The good - technology and community appreciation by large players

Over the course of the year, we saw multiple new projects built with CosmosSDK, new VCs deploying into ecosystem startups, and large crypto players shifting strategies to launch app chains in Cosmos.

For example, dYdX announced that the protocol is moving to Cosmos to build its own native chain on Cosmos SDK and Tendermint Proof-of-stake with the hopes of regaining the market dominance it once had. By moving to Cosmos, dYdX will add a new group of customers to the Internet of Blockchain's ecosystem; for example, its 24h trading volume is presently $1Bn+, compared to $4.9M on Osmosis, the network's largest DEX. Additionally, as stated by Messari's recent article, StarkWare's (where dYdX currently runs) latest valuation alone in private markets was $8 billion. Cosmos' current valuation in public markets ($ATOM) is $3 billion.

Using the Cosmos Tendermint proof-of-stake consensus engine, Cosmos makes it simple to create a blockchain with cross-chain capabilities. Cosmos is a decentralised and configurable blockchain with its own validators and staking tokens. Other L1s or L2s would not be suited for dYdX since they cannot handle the throughput required (10 operations/second and 1,000 places/cancellations per second). Because Cosmos app-specific chains are not dependent on other protocols on the network, the network congestion faced by Ethereum is not a worry. Interchain Security from the Cosmos Hub can also help projects boost stability and security.

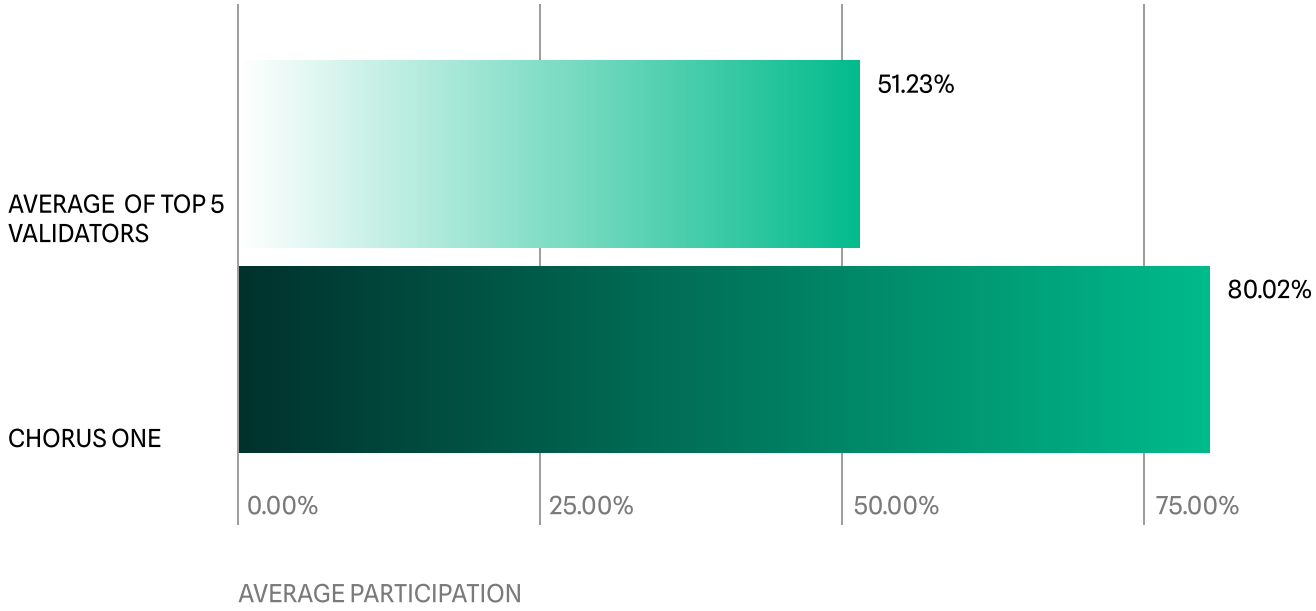
Cosmos Governance

During 2022 we took a step forward and considered governance as a critical aspect for our validator operations. In the cryptosphere, scalability, security and decentralisation (technical systems) have been the biggest problems to solve, with governance being

a secondary concern. At Chorus One, we believe that governance will adopt an increasingly important role in the near future. The rationale is simple: in an increasingly digital environment, blockchain is the best instrument available for instilling accountability in a governance structure. We performed an analysis of the 13 chains in which we have been active for the longest time and have had significant gubermental activity.

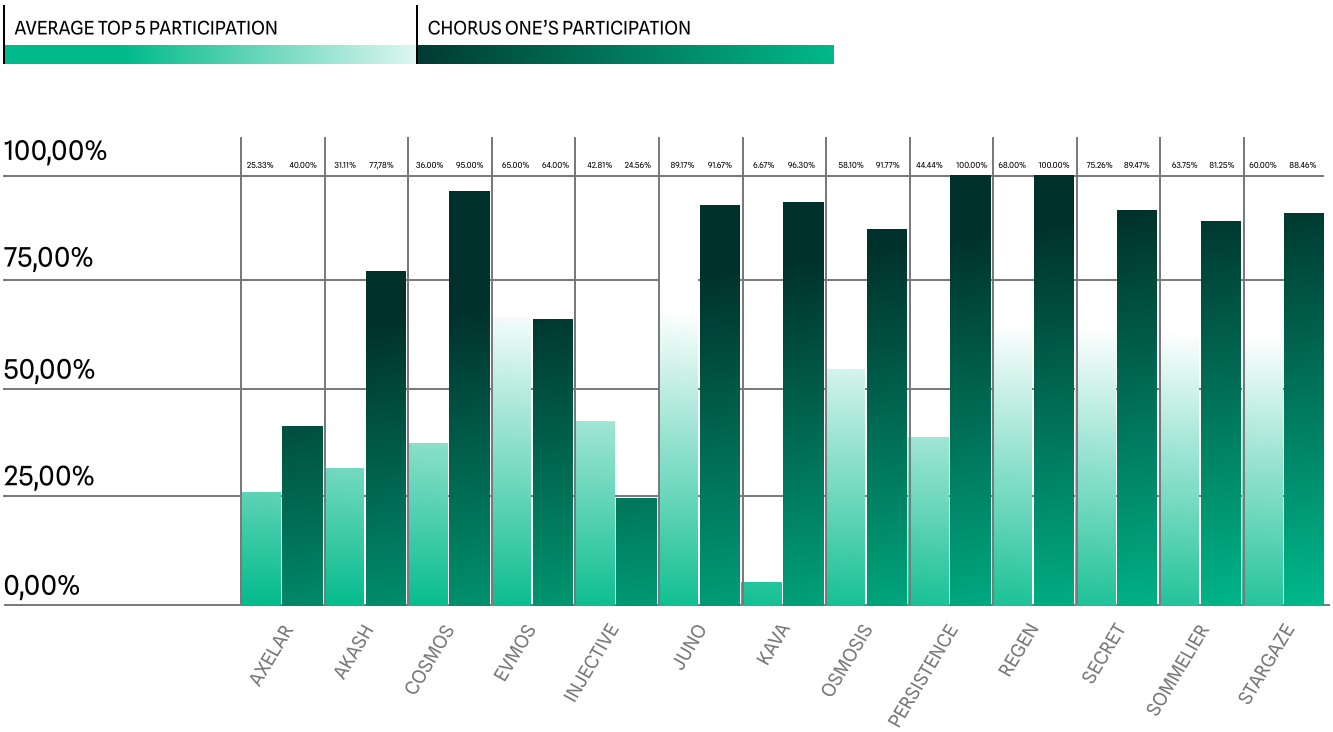
To evaluate our performance, we studied Chorus One's average participation in the selected chains and compared it to the top 5 validators by stake. As you can see in the chart below, we voted in 30% more than the average of the Top 5 validators. However, it is important to note that the top 5 validators vary significantly on every chain.

AVERAGE PARTICIPATION BY TOP 5 VALIDATORS VS CHORUS ONE



We also analysed the participation numbers on every network:

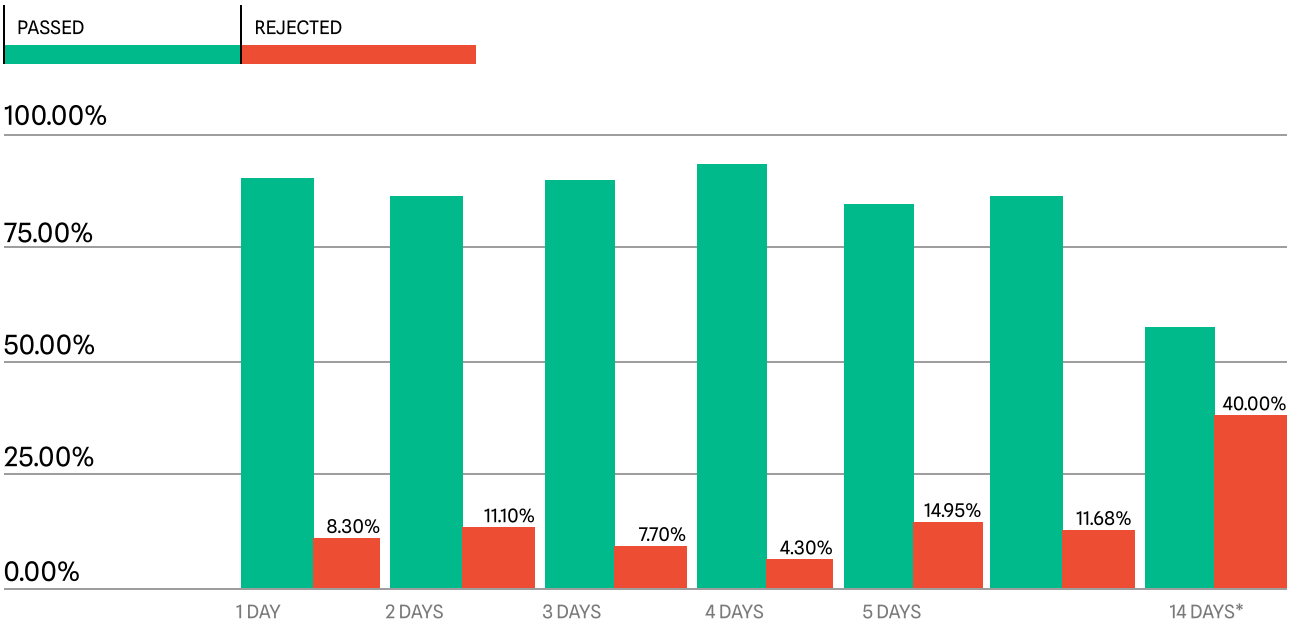
AVERAGE TOP 5 PARTICIPATION VS CHORUS ONE'S PARTICIPATION



We found out that we voted 100% of the time in 2 networks, we were ~90% above the average in 1 Network (Kava). We were only below average in 2 cases - Evmos (by 1%) and Injective (both Evmos and Injective do not support Ledger, so we had to create new accounts with Authz permissions to vote). The above chart helps us understand the areas we did well and areas of improvement too.

An interesting outcome was the pass vs rejected ratio of proposals depending on the voting period of the chain. The average pass percentage in the networks that we studied was 86%. To put things in perspective, only around 4% of proposed bills in the US become laws. We expect the percentage of rejected proposals to increase with time as communities and networks consolidate. When we studied the voting period versus the outcome of the proposal, our theory was vindicated:

PASSED AND REJECTED VS VOTING PERIOD



*THE LAST BAR REPRESENTS THE DATA FOR COSMOS HUB AS IT IS THE ONLY COSMOS CHAIN WITH A VOTING PERIOD OF 14 DAYS

Until we examined the Cosmos Hub (14 days), which has a far longer voting period, the rejection average remained pretty consistent. The Cosmos Hub rejection rate has been four times greater than the norm. Because the Cosmos Hub is the most established network, it is reasonable to expect that less changes will be necessary over time. Furthermore, there are more stakeholders and greater decentralisation with differing viewpoints. As a result, more bids are turned down.

Furthermore, as shown in the ATOM 2.0 initiative, modifications require additional time to be considered. Nevertheless, pre-voting discussion might be even more important. This was demonstrated by the ATOM 2.0 proposal, in which the pre-voting proposal was released three weeks before voting. This was still not enough to get the community and proposers to agree or to modify the proposal for its approval.

The most important result of this research was to give assistance to delegators when selecting a validator. Delegators should strive to spread their staking approach among validators who care about and value governance. For example, we've seen that centralised exchanges need to improve in this area, especially as they frequently have the most voting power. We have yet to see an explosion of economic and governance solutions in which various techniques are tried at the speed of code. As a result, the governance potential of blockchain is just now beginning to surface. Chorus One will continue to care for and monitor the governance of the ecosystem in order to contribute to a more resilient future.

Atom 2.0

Atom 2.0 is possibly the most famous proposal the Cosmos ecosystem has seen so far. The proposal included a new whitepaper with several new implementations and drastic modifications that are meant to drive the ecosystem forward through innovation. The proposal was ultimately rejected, but it set the path forward to achieve innovation through a novel architecture. Here are the basics:

<table>
<tr><td>Hub-specific Functionality</td><td colspan="2">Interchain Scheduler</td><td>Interchain Allocator</td></tr>
<tr><td>Secure Economic Scaling</td><td colspan="2">Interchain Security</td><td>Liquid Staking</td></tr>
<tr><td>Cosmos Stack</td><td>Tendermint</td><td>IBC
Relayers</td><td>Cosmos SDK
CosmWasm + Cosm JS</td></tr>
</table>

We voted yes to support the work done and maintain the momentum, but the proposal ended up being vetoed. This was mainly because too many implementations were introduced at once. The way forward for Cosmos Hub is to divide the whitepaper into several proposals, and let the community discuss which parameters are best for each. It is important to mention that the signalling proposal was introduced to the community before the voting period started, and the whitepaper was modified listening to the community calls. Having extra time to discuss before putting the proposal on chain should be included to adopt the best method for listening to and acting on community demands.

Conclusion

To conclude, 2022 was undoubtedly a historic one for the Proof-of-Stake industry with the success of the Ethereum merge to Proof-of-Stake (PoS) consensus from Proof-of-Work. In an instant, Ethereum became the biggest market for staked assets after the network merged with the Proof-of-Stake (beacon) chain. Ethereum's success in 2022 contributed to the success of the entire Proof-of-Stake industry. Regardless of turbulent market conditions, yield was still able to be captured on-chain at the base layer (staking yield) and smart contract layer (DeFi yield) across all Proof-of-Stake networks. In fact, staking yield at the base layer became more attractive in 2022 as revenue streams deriving from maximal extractable value (MEV) continued to grow. However, although the MEV market grew in 2022, so too did its controversy around how and where the MEV growth originated from and its impact on the centralization of a network. Our research found that ~25% of transactions on Uniswap from x to y were 'sandwiched'.

The value that was extracted from these transactions was shared by the searcher bidding on its inclusion in the block with the block proposer (i.e. the validators proposing blocks where MEV transactions were included). The MEV being captured from this type of strategy (sandwiching) on Ethereum is in stark contrast to what is being captured in other Proof-of-Stake ecosystems, such as Cosmos. In the Cosmos, sandwiching MEV strategies are seen as 'bad MEV' and Cosmos chains are usually designed to circumvent sandwiching from occurring on the network. In 2022, we observed the MEV space closely on both Ethereum and Cosmos, especially given the similar trajectory both ecosystems seem to be taking with its architecture. In fact, by the end of 2022, we believe that Cosmos and Ethereum ecosystems are closer than ever before, especially with both ecosystems focusing on blockchain modularity going forward. Ethereum is certainly the bigger ecosystem and achieved amazing technological feats in 2022. However, growth continued in the Cosmos ecosystem in 2022, with major announcements such as dYdX moving to the Cosmos from Ethereum validating the potential of the ecosystem. Our research into Cosmos governance also revealed the uniqueness of the ecosystem's participation in governance proposals. This alone continues to be a distinctive feature in the Cosmos versus other Proof-of-Stake blockchains.

The PoS industry in 2023 is shaping up to be another eventful year as newer types of PoS blockchains such as Aptos and Sui arrive on the scene. Legacy PoS blockchains such as Solana will aspire to return back to the great heights it achieved back in 2021. However, it is likely Ethereum will be the major PoS victor again in 2023, as new stake enters the network once withdrawals are enabled. It is unknown whether Cosmos can continue the momentum it managed to

accumulate in 2022 going into the new year, however we are optimistic on the quality of upcoming Cosmos blockchains launching in 2023. At Chorus, we will continue to comprehensively support networks that increase freedom and sovereignty in the new year and beyond.

Thank you for reading our research and to all contributors, as well as data providers and other sources that helped put together this report. If you'd like to learn more about our staking services and custom in-depth research offerings, feel free to reach out to **research@chorus.one**

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