



BENTLEY BLOCKCHAIN ASSOCIATION

State of the Industry Q4 2022
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Content

Introduction	4
Crypto Macro Overview	5
Recent Overview	5
Q4 Narrative	5
Major Chain Analysis:	8
BNB Chain (BNB)	9
Ethereum (ETH)	21
Solana (SOL)	41
Avalanche (AVAX)	51
Q1 2023 & Beyond	62

Introduction

The cryptocurrency market has been disrupting the financial world since Bitcoin's inception in 2009. Despite its volatility, the market has grown exponentially in the last decade, with the total market capitalization of all cryptocurrencies reaching over \$2 trillion in Q4 2021. However, 2022 has been a year unlike none other for cryptocurrencies, as the current total market capitalization is down 70% year-over-year to roughly \$800 Billion in Q4 2022. Regulators are stepping in more aggressively than ever due to major liquidation events and bankruptcies of FTX/Alameda Research, various centralized lending platforms, and even crypto-centric hedge funds.

The Federal Reserve in the United States has been focused on curbing inflation, raising interest rates at a faster pace than most are predicting, and holding them higher than most expect. With the U.S. dollar strengthening as investors flee to it for safety, risk assets across the board, including cryptocurrencies and highly-levered technology companies, have entered a significant bear market. Money, as in U.S Dollars, are becoming increasingly more expensive, in order to curb the United States's record-setting inflation rate averaging 7% in Q4 of 2022. The cryptocurrency market is set to be impacted further by a high interest rate environment and ultimate risks of global recession. It is important to note that the nature of cryptocurrency makes it susceptible to global macroeconomic conditions, so decentralized applications will be an important theme for the future of the market.

In Q4 of 2022, cryptocurrencies have significantly declined in value, yet the market is still disrupting the financial world and is one of the most compelling stories going into 2023. Questions remain about how regulators will decide the fate of centralized platforms, central bank digital currencies, distinguishing between which cryptocurrencies are securities versus commodities, and ultimately how to protect investors in such a vibrant, innovative capital market. Data and narratives are important to understand the current state of the cryptocurrency and Web 3.0 market, as well as where it may be going in 2023. This research paper will provide an overview of the state of cryptocurrency in Q4 2022, an analysis of four major

layer-one blockchain networks, and potential macroeconomic risks and growth opportunities for the cryptocurrency market in 2023 and beyond.

Crypto Macro Overview

Digital asset markets are a prime example of macro-economics. As stated previously, there has been significant drawdowns in the market price of cryptocurrencies, NFTs, and other digital assets. However, price going down is not an adequate indicator of the resilience of the industry, in that partnerships and institutional integration have not stopped in the bear market.

Q4 Narrative

2022 has been a year of deleveraging for the cryptocurrency market and broader markets as a whole. During the bull run from 2020 to 2021, interest rates were zero; therefore, money was essentially free, so leverage was key in pushing prices all the way up to \$69,000 in November 2021. Throughout 2022, market participants who still decided to take on leverage to the long side have been liquidated in some of the largest events in recent financial history. These events began with the infamous Terra Luna protocol. Terra is an open-source blockchain protocol created in 2018 by Do Kwon and Daniel Shin of Terraform Labs. It issued Luna, a smart contracts-based cryptocurrency, and TerraUSD (UST), an algorithmic stablecoin pegged to the US dollar and backed by Luna. The UST maintained its peg to \$1 using an arbitrage mechanism, however, a coordinated attack in May caused UST to de-peg, leading to a "death spiral" for both Luna and UST. The massive amount of leverage that Luna had in their protocol set the stage for the contagion in the crypto markets in 2022.

Market participants of all sizes were impacted by the Luna implosion, including Three Arrows Capital (3AC). The Singapore-based cryptocurrency hedge fund utilized a strategy where they borrowed funds from centralized crypto lenders, such as FTX, Voyager Digital, and BlockFi. Many of these loans were collateralized with 3AC's positions, which were in cryptocurrencies like Luna and UST. When Luna protocol imploded, the value of 3AC's collateral evaporated. On June 27th, 2022,

3AC was forced by a court in the British Virgin Islands to liquidate their entire fund. 3AC's founders Kyle Davies and Su Zhu had confirmed they took on about \$200 million in losses related to LUNA and UST, per CoinDesk. By receiving loans from centralized lenders like BlockFi and Voyager Digital, the spread of credit-risk in the market was in full effect after the fall of 3AC. Centralized lending platforms, such as Celsius, BlockFi, and Voyager, filed for Chapter 11 bankruptcy after their exposure to Luna and 3AC. Users of centralized platforms and algorithmic stablecoins are now seeking security in self-custody wallets and decentralization through on-chain exchanges run by strict code. However, it is evident that these bankruptcies were nothing compared to what has transpired in the second half of 2022.

The current landscape is stained by the *need* for trust and centralization, which allows for events like FTX to come to fruition. FTX is the byproduct of privileged parties, closed-source dependencies, and collusion and proprietary gatekeeping. It was a trusted, centralized exchange that went insolvent on November 11, 2022 because it was lending customer funds against their native asset, FTT. Rather than customer deposits being safely custodied, they were lent to a cryptocurrency trading firm, Alameda Research founded by FTX's CEO, and used for highly leveraged speculative trades. Ultimately, Alameda's Q2 balance sheet was leaked creating a downward spiral for FTX and its subsidiaries.

Although deleveraging caused the bankruptcies of centralized lending platforms (BlockFi, Voyager, Celsius) and the second-largest centralized exchange in the world (FTX), decentralized exchanges and institutional activity have not stopped in the bear market. After FTX fell, Uniswap, the largest DEX on Ethereum, surpassed Coinbase in the amount of Ethereum-based transactions on its exchange. Additionally, decentralized lending platforms, such as Aave and MakerDAO, have had to liquidate loans without any losses and no withdrawal halts for users. Both decentralized exchanges and lending platforms are largely run by code in a DAO governance model. Based on a key argument of Satoshi Nakomoto in the Bitcoin whitepaper in 2012, there is a need to take monetary control out of the hands of centralized authorities and create a truly peer-to-peer method of exchange. The fact that DeFi (decentralized finance) was able to withstand such high volatility was a perfect example of a peer-to-peer method of exchange in capital markets. The

push for decentralized finance will lead to more education in the blockchain space, as well as more people exploring self-custodial wallets on-chain for their digital assets.

Institutions are beginning to develop their own custodial wallets for clients who are interested in allocating a portion of their portfolio to cryptocurrencies. JPMorgan recently announced a trademark to create their own custodial wallet after purchasing Greece-based Viva Wallet for \$800 million. This announcement comes after JPMorgan facilitated their first currency swap on-chain between two Singapore banks on the Polygon blockchain. Following the deleveraging of influential players in the market, JPMorgan's confidence and investment into custodial wallets and digital payment infrastructure will continue to be a theme into 2023. However, there is a risk that JPMorgan's custodial cryptocurrency wallets could be analogous to a centralized bank account for their client's cryptocurrency. If the firm is able to report that they hold each asset 1:1 on their balance sheet, then there should be no issues in the future for JPM and other institutions that adopt a similar strategy. Regulation will have to be put in place to make sure institutions can show proof of reserves.

The state of the industry today has taken this moment of correction as a great reflection, focusing its capital on technically vetted projects. There is undoubtedly more apprehension in investors about backing cryptocurrency or blockchain native projects, at least without an engineer to translate them. After all, some of the smartest minds in venture capital bought into FTX: Sequoia Capital, Tiger Global Management and the Ontario Teachers' Pension Plan, among many more. In wake of FTX, the industry can expect further regulation, which may act as a headwind for current builders, but a vote of confidence for investors.

Nonetheless, venture capital and private equity continue to invest in this climate under the promise that web3 can harness the possibility of seamless infrastructure fabric for data and services. With FTX in mind, investors are taking note of the tailwinds of decentralization, privacy, confidentiality, trustlessness, and connectivity; and grasping onto ideas of zero-knowledge proofs, interoperability infrastructure, and trustless technology.

Major Chain Analysis:

Valuing Four Major Layer-One Blockchains

BNB Chain (BNB)	9
Ethereum (ETH)	21
Solana (SOL)	41
Avalanche (AVAX)	51

BNB Chain (BNB)

Key Takeaways

- Although Total Value Locked decreased by more than 24% in Q4 thus far, Total Unique Addresses on BNBCHAIN continued to increase by over 46 million, bringing the total number of BNBCHAIN wallets to 233 million.
- Average Unique Daily Addresses have increased by 30% this quarter to over a million and the average number of transactions per day amassed to over 3.5 million.
- The vast network usage called for BNB to devise zk scalability solutions. BNB Smart Chain introduced zkBNB TestNet to the public and plans to launch the Mainnet in Q1 2023.
- BNB chain's comparatively low Hype-To-Activity™ ratio suggests BNB is driven more so by sound project fundamentals, ecosystem development, and great user experiences for builders and users rather than social media hype.

Blockchain Overview

BNB Chain is a public, open-source blockchain built to achieve composable, financially-autonomous applications in a permissionless and decentralized manner. BNB Chain is comprised of four blockchains:

1. The BNB Beacon Chain for BNB Chain governance, staking, and voting
2. The BNB Smart Chain (BSC) that is EVM compatible and can support smart contract functionality
3. The BNB Sidechain framework for creating side chains in the BSC network to provide scalability solutions
4. The ZkBNB (the ZkRollup, Layer-2 solution) for scaling BSC

The multichain framework of BNB seeks to have block times faster than Ethereum, to be as compatible as Etheruem, to have no inflation, to have block rewards shaved off from transaction gas fees, and to have governance as powerful as Cosmos. Thus,

BNB Smart Chain implemented the Proof-of-Staked-Authority (PoSA) consensus protocol where a centralized group of validators are responsible for verifying transactions, generating blocks, and ensuring the network's security in exchange for native asset rewards. This gives BSC a shorter block time and makes it invulnerable to the 51% attack while preserving Ethereum compatibility. This is coupled by the Beacon Chain built on Cosmos for staking and governance.

The BNB Chain Fourth Quarter Narrative

Despite Binance's multiple appearances in flashy news headlines, BNB Chain continued to innovate and develop the ecosystem with its zkBNB rollup layer-2 scaling solution, Finance Account Bound (BAB) Soulbound tokens, and innovation incubator. Nonetheless, the beginning of the quarter began with the BSC Token hub exploit on October 6th, 2022. The bridge exploit occurred between the old BNB Beacon Chain and the BNB Smart Chain. A hacker performed an unauthorized transfer of \$586M (equivalent to 2M BNB) by leveraging a bug to make the bridge mint 2M BNB to them.

BNB Chain halted operations for 8 hours by requesting all validators temporarily suspend the BNB Smart Chain. Once the chain analysis was finished, BNB Chain ushered the Moran hard fork, mended the vulnerability, and issued the v1.1.15 hot fix release. This resulted in a portion of the attacker funds frozen and a mitigation of the losses by an estimated \$476M. In spite of the exploit, BNB continues to outperform Ethereum, Solana, and Avalanche in unique daily addresses, suggesting BNB presides as one of the most suitable networks for investors and developers.

BNB chain continues to facilitate breakthrough solutions with the launch of the zkBNB testnet to the public – and upcoming Mainnet release – and a plethora of network updates. BNB Chain continues to grow its ecosystem and adoption via builder grants, innovation incubators, hackathons, Soulbound token rewards, and NFT campaigns.

The following report will analyze the state of BNB chain via its quantitative performance analysis and qualitative narrative as a testament to BNB Chain's progression, despite the present market environment.

Q4 Performance Analysis

The BNB coin price is currently ~\$240 and its market cap is ~\$38 billion. It ranks #5 in market capitalization for all cryptocurrencies, keeping its spot in the top 10. See the custom table below, comparing the most important metrics for valuing the BNB Smart Chain ecosystem accompanied by supporting descriptions below:

B State of BNB Chain Q4 2022				
Quarterly Metrics	Q1 2022	Q2 2022	Q3 2022	Q4 2022
Network Usage				
Average Active Unique Daily Addresses ¹	1,179,248 (+23%)	1,042,120 (-12%)	889,280 (-15%)	1,157,721 (+30%)
Average Daily Transactions ¹	5,627,705 (-43%)	4,653,114 (-17%)	3,390,008 (-27%)	3,501,126 (+3%)
Network Financials				
Circulating Supply ²	165,116,761 (+1%)	163,276,975 (-1%)	161,337,261 (-1%)	159,966,674 (-0.85%)
Quarterly Revenue ³	\$117,142,768 (-99%)	\$113,792,960.00 (-5%)	\$66,832,327.00 (-4%)	\$49,464,359 (-26%)
Circulating Supply (P/S) ³	1,239x 106%	1,247x 0.65%	1,875x 50%	1,838x (-2%)
Ecosystem				
Total Value Locked (TVL) ⁴	\$17,854,491,386.00 (-12%)	\$7,450,000,000.00 (-140%)	\$8,809,461,047.00 (+15%)	\$7,056,013,674.00 (-25%)
Quarterly Contracts Verified ¹	154,813 6%	121,530 (-21%)	96,033 (-21%)	60,988 (-36%)
Sentiment				
NVTweet Ratio ²	33.8 (-40%)	52.83 56.30%	35.86 (-32%)	60.92 70%
Hype-to-Activity Ratio ²	1.8 (-65%)	0.36 (-80%)	0.93 158%	0.55 (-41%)

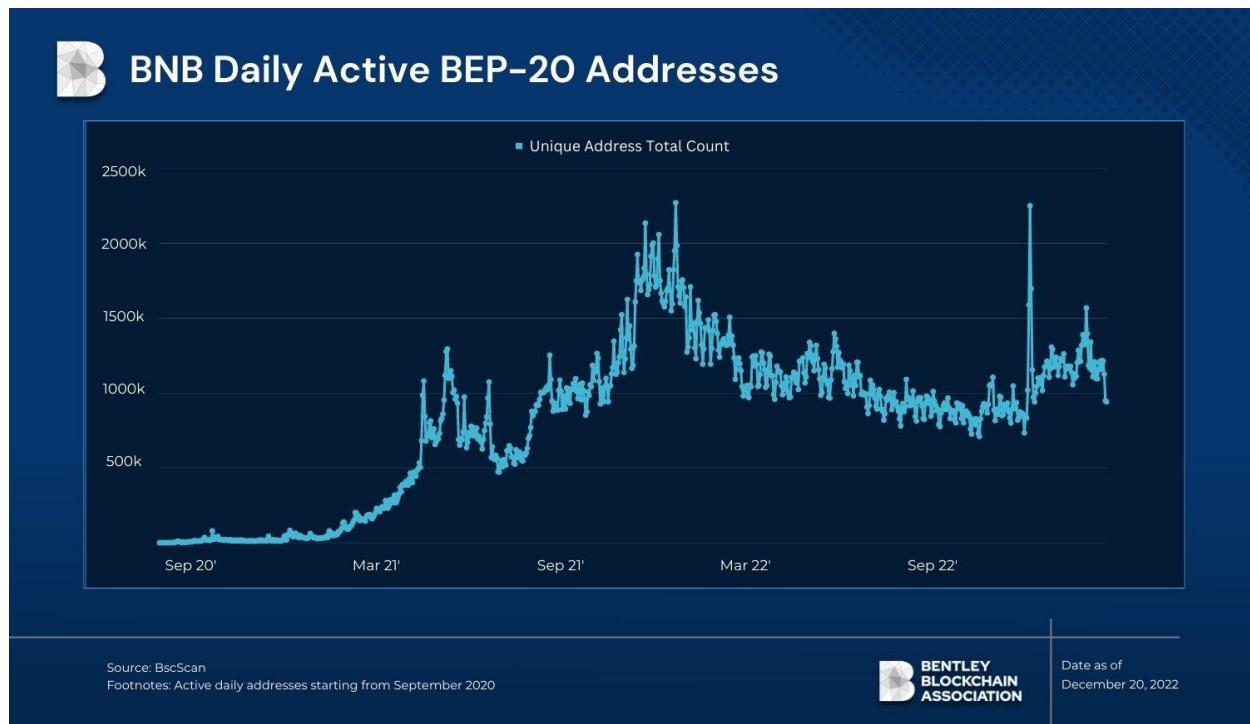
Source: BscScan¹, The Tie Terminal², Token Terminal³, DeFiLlama⁴
 Footnotes: The percentage values in italics are quarterly changes

Date as of
 December 20, 2022

Network Usage

Network usage, measured by average active unique daily addresses and daily transactions, has increased in Q4, despite its previous quarter-over-quarter decline. While daily active addresses are only a little over 1.1 million this quarter, the total

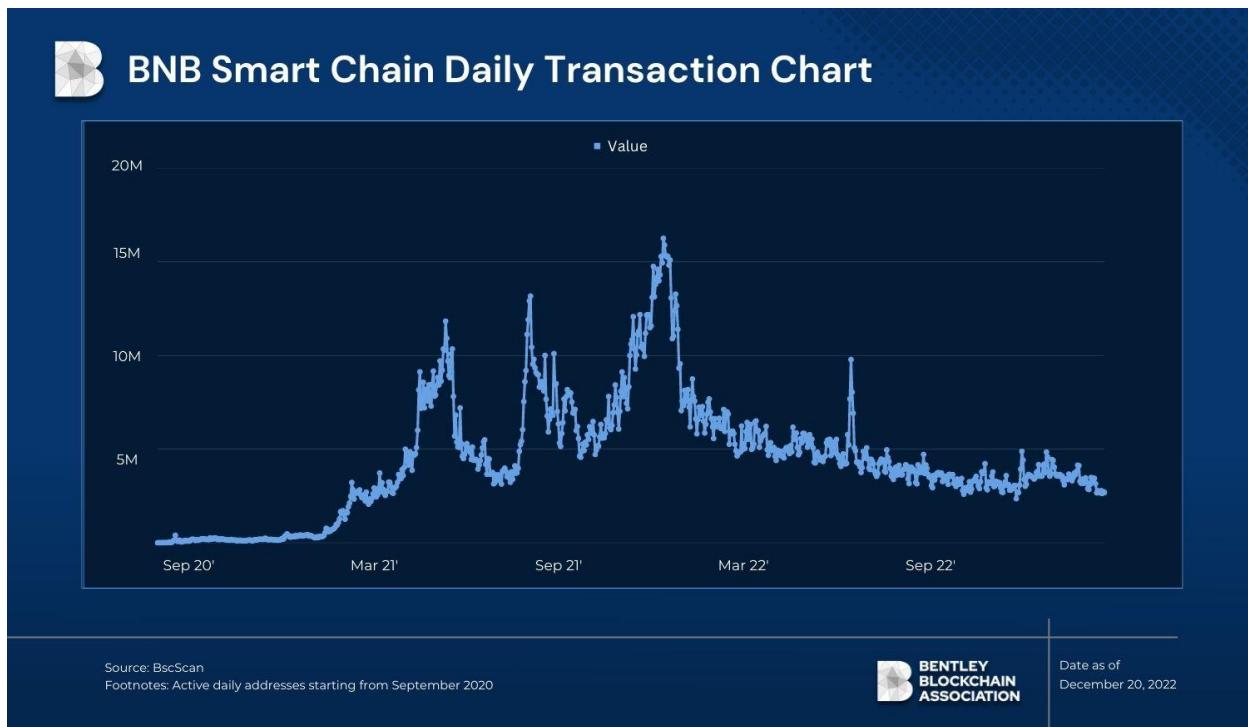
number of addresses has amassed to 233 million, driving the BNB chain to seek scalability solutions to combat network congestion. BNB Chain, a public blockchain that is designed to support high-throughput, low-cost transactions, has placed a large focus on storage optimization throughout 2022.



It also appears daily addresses peaked on October 12th. This event – date of October 12th – was preambled by a sharp inflection on October 7th and followed by sideways movement at new heights. This may suggest an increasing foundation of users on the BNB chain. It should be noted this movement correlates directly with the BNB Chain bridge (BNB Token Hub) exploit and subsequent ‘Moran’ hard fork to address the vulnerability.

In spite of the exploit fluctuations, BNB continues to outperform Ethereum, Solana, and Avalanche in total unique addresses, suggesting BNB presides as one of the most suitable networks for investors and developers.

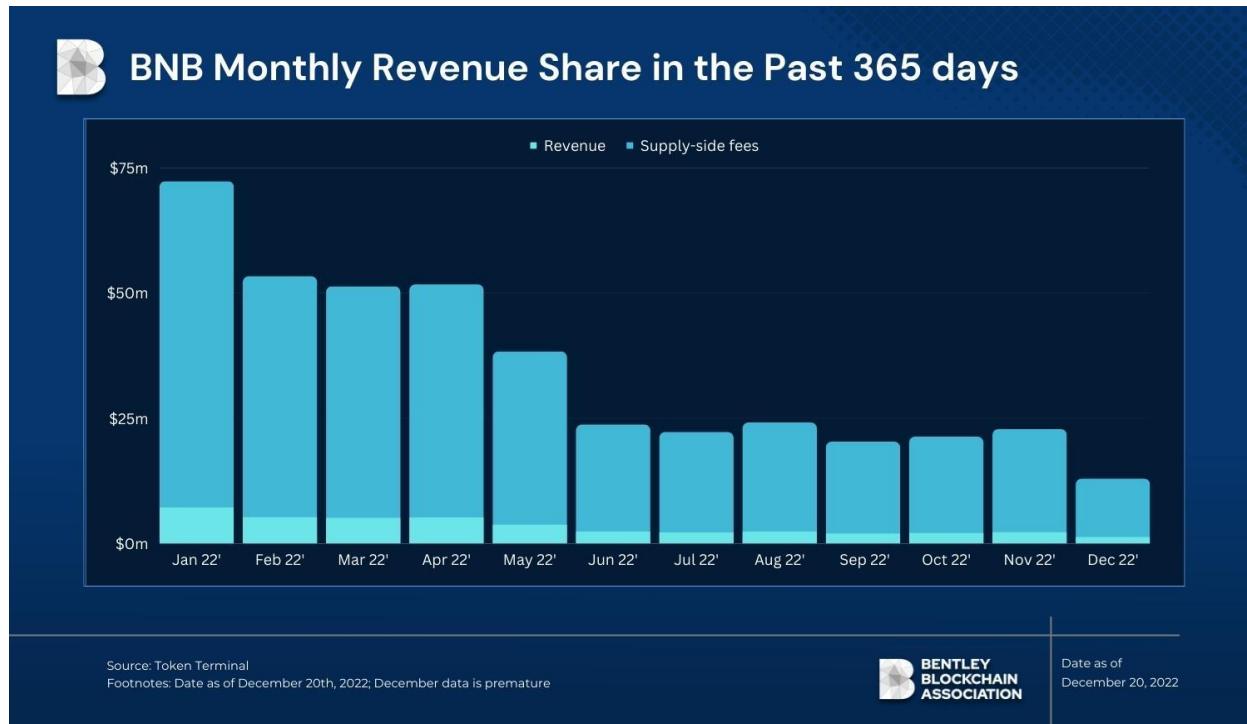
Following the fork, bridge operations resumed and BNB Chain took to the community for a vote on how to proceed. The community voted to freeze the funds inside the hacker's wallet and burn the BNB inside it. Thus, on October 13th BNB completed its 21st Quarterly burn, burning 2,065,152 Binance coins on-chain via BEP95 burn.



Daily transactions followed a similar pattern, at scale, as daily addresses. The previous three quarters have depicted a downtrend in the average daily transactions, while this quarter has output a 3.28% growth in average daily transactions. However, the average transaction value of 3.5 million is still 60.55% down from Q4 2021's average daily transactions (8.8 million).

Looking further at daily transactions, BNB Chain is over three times as active as Ethereum because of its fast transactions and cheap gas fees (average gas fee for Q4 was \$0.0007). Because of these cheap fees and fast scalability, BNB is seen as preferential for users, developers, and dApps alike.

Network Financials



BNB Chain's revenue is divided by supply-side fees (validator operating fees) and protocol revenue (token holder accrual). BNB chain revenue and market cap appeared to correlate throughout the quarter, with daily activity trends predicting both revenue and market cap. Market cap experienced a 15% decline this quarter while revenue declined 26%.

BNBs market cap and revenue are mirroring the rest of the crypto market during this bear cycle. At this date, as of December 20th, the BNB market cap remains nearly 1000 times the value of the quarterly revenue thus far compared to being 700 times the quarterly revenue last quarter (Q3). This is in line with the circulating P/S ratio.

There appears to be a direct correlation between the (low) P/S ratio and market cap. This would indicate that BNBS revenues have stayed consistently high, even throughout the bear cycle. That being said, BNB chain appears to be overvalued, measured by their circulating P/S ratio, to their comps – namely, Ethereum. This

metric, however, should be taken with a grain of salt as crypto markets remain in their infancy with high volatility.

Ecosystem

BNBs prominence is also attributed to its ecosystem fundamentals and positioning in the DeFi landscape. BNB chain was one of the breakout performers in Q3 for TVL with the release of three liquid staking platforms: Ankr, Stader, and pStake. However, their TVL has since declined by nearly 25% this quarter. This can partly be attributed to the 24% decrease in the PancakeSwap Defi activity, which dominates 44.24% of BNBs total TVL. PancakeSwap has seen outflows in TVL this past quarter (Q4), mirroring the other protocols on BNB Smart Chain and other chains in the industry – Solana and Avalanche.

 BNB Chain Top 3 Protocols by TVL				
Quarterly Metrics	Q1 2022	Q2 2022	Q3 2022	Q4 2022
Protocol TVL	PancakeSwap \$6,919,587,405.00	PancakeSwap \$3,593,323,947.00	PancakeSwap \$4,168,220,021.00	PancakeSwap \$3,162,553,564.00
Protocol TVL	Venus \$2,695,871,906.00	Venus \$972,368,943.40	Venus \$995,840,300.80	Venus \$1,124,925,055.00
Protocol TVL	Alpaca Finance \$925,166,628.60	Alpaca Finance \$449,043,360.70	Alpaca Finance \$548,261,326.90	Alpaca Finance \$414,578,294.30

Source: Token Terminal
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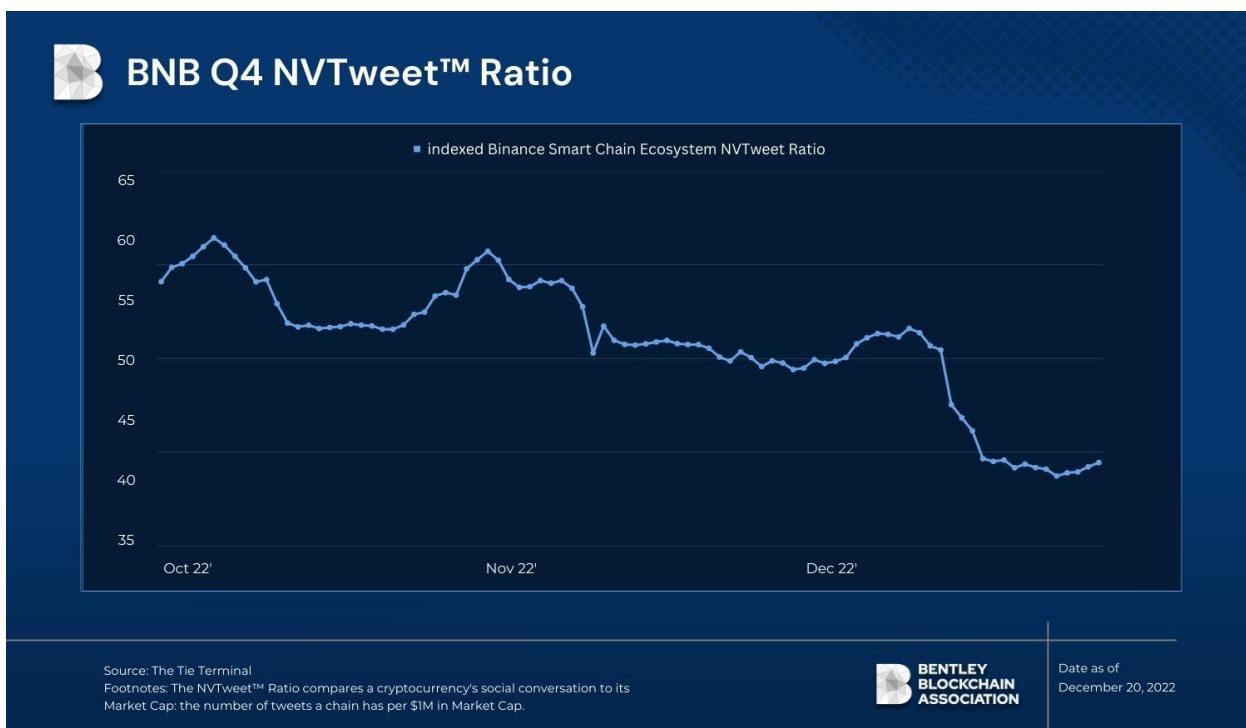
PancakeSwap held a leading position in DeFi throughout 2022 as its router handled more transactions than any other contract – close to 300M transactions in the past year. It is the number one AMM and yield farm on BNB Smart Chain. Across these

300 million transactions, PancakeSwap's V2 contract consumed nearly \$150 million in gas over this past year. This translates to 15 times the number of transactions Uniswap V2 & V3 on Ethereum for the same time frame.

Thus, it makes sense that this moment of correction for PancakeSwap's TVL has had a subsequent effect on the BNB Smart Chain TVL. The silver lining here is that this correction for PancakeSwap may diversify the concentration of BSC TVL and DeFi TVL as a whole. It should also be noted that while BNB chain decreased nearly 25% in USD terms, it only depreciated 10% in BNB terms, meaning BNB still retained much of its ecosystem value.

Sentiment

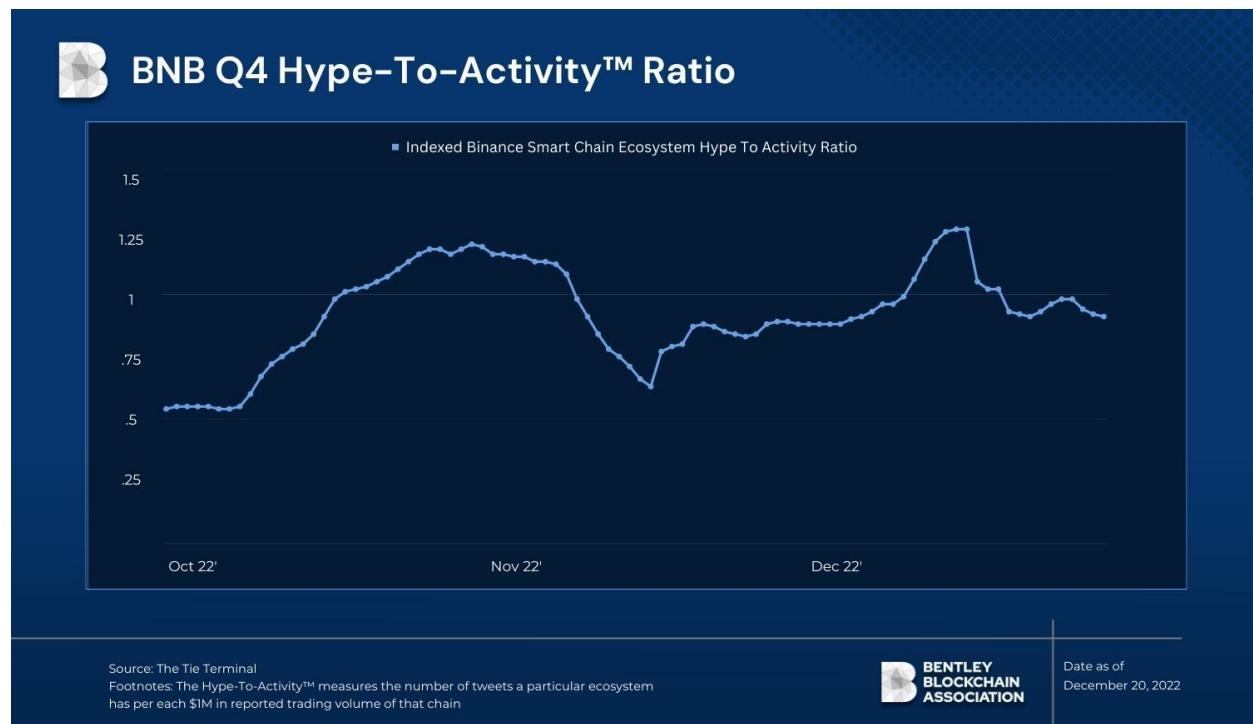
Nearing the end of Q4, BNB is shown to have a long term sentiment of 34, a value on the lower end of the spectrum. BNB Chain ecosystem has an average tweet volume of 6,855 and 3,052 twitter accounts.



At the onset of the quarter, BNB Chain saw a 70% increase in their NVTweet™ Ratio from the previous quarter. The NVTweet™ Ratio compares a cryptocurrency's social conversation to its Market Cap, particularly how many tweets a chain has per \$1M in Market Cap. The relatively high ratio at the beginning of Q4 suggests less tweet volume per each incremental stride in market cap. This may suggest more institutional trading as market cap outpaces its social conversation counterpart.

Nearing the end of Q4, as of the date December 20th, BNB Chain has seen a 37% drop in its NVTweet™ Ratio suggesting a market cap that is more sensitive to tweet volume. This may suggest more retail involvement in the market.

Conversely, at the genesis of Q4, BNB Smart Chain Ecosystem saw a 41% decrease in their Hype-To-Activity™ ratio compared to the beginning of Q3. The Hype-To-Activity™ measures the number of tweets a particular ecosystem has per each \$1M in reported trading volume of that chain; the average for this metric across all cryptocurrencies is 1.02 tweets per \$1M trading volume. Thus, the 41% decrease in hype-to-activity for BNB Chain may suggest that social conversation is being diluted in regards to its dominance over trading volume.



The Q4 figure suggests more organic trading volume and that the chain's success is driven more by fundamentals and less by 'hype.' However, as of December 20th, the BNB Chain Hype-To-Activity™ ratio has returned to Q3 heights, with a 69% increase in social conversation relative to trading volume. Despite the increase, the BNB chain is still lower than the average ratio across cryptocurrencies.

Overall, this ratio suggests BNB is driven moreso by network functionality, ecosystem development, and great user experiences rather than hype – which has been known to quickly and sharply ignite many projects in the industry.

Qualitative Analysis

Although the landscape this quarter was stained by sequential exploits and cases of fraud and proprietary gatekeeping, BNB Chain continued to build for the future of market.

In wake of the bridge exploit, BNB Chain released the BSCv Client Update v1.1.15 followed by v1.1.16 as a temporary remedy to the cross-chain infrastructure. This is a hard fork release for both testnet and mainnet. This was followed by the v1.1.17, v1.1.18, and v1.1.18_hf updates.

BNB Chain was able to swiftly respond to the exploit bringing praise for their effective action taken by validators as well as concerns on their level of decentralization. To that end, BNB Chain has a Nakamoto Coefficient – the number of nodes that must be compromised to affect the blockchain and obstruct it from functioning correctly – of 8, which is less than Ethereum, but still within industry median. There appears to still be an overhang on the decentralization front on how 'coordinated responses' and decentralization should be mutually exclusive.

Nonetheless, BNB Chain continues to add improvements for dApp builders and users to engage cross-chain frictionlessly. The Gibbs hard fork (v1.1.18) arrived in December and allowed for native staking models on BNB Smart Chain directly, rather

than having to transfer assets to the Beacon Chain, and allow for dApps to launch their staking services on the protocol.

The Einstein testnet upgrade is also scheduled to be executed on January 2nd and will allow any BNB address to become validators or delegators by staking their coins and entrusting their tokens to credible validators. This will also grant them voting rights to community decisions – a larger push for community engagement and decentralized initiatives.

ZkBNB testnet was launched in November and the anticipated mainnet release is scheduled for Q1 2023. The blockchain plans to couple this with BNB hackathons for developers to deploy on zkBNB.

To that end, BNB Chain continued to expand its ecosystem and engage its community. October initiatives such as the launch of the European Innovation Incubator, Innovation Pitch Day in San Francisco, and the partnership with P12 and Quest3 to Launch Web3 Gaming Carnival strengthened the community and kicked off the quarter. This contributed to their November new milestone of unique addresses.

This was followed by hackathons and innovation pitch days to close off the quarter and end of the year. BNB Chain continued to ignite builders globally in their attempt to achieve mass adoption.

Conclusion

While BNB Chain's ecosystem performance is down this quarter, this moment of correction is an opportunity for BNB to diversify their total value locked and give rise to other killer dApps. To that end, BNB is continuing to innovate around scalability, decentralization, dApp development, Oracle Networks, and DeFi, GameFi, and SocialFi.

Despite FTX and exploit headwinds this quarter, BNB Chain began to establish an increasing foundation of users. It coupled this performance and increased network

demand with technical advancements such as the zkBNB testnet release. The sidechain is seen as a breakthrough for scalability and confidentiality and a way to preserve BNB Chain's maxims of low costs and high speed. BNB Chain also implemented strategies earlier this year (BEP - 131) to expand the validator set and decentralize reward opportunities. BNB Chain has also made extensive strides in their blockchain technology with BNB Sidechain, Binance Oracle, and security initiatives like AvengerDAO.

BNB Chain set the pace for trends in Gaming and NFTs with the launch of their Soulbound Tokens. They will also be taking initiative at the beginning of Q1 2023 to have a debate on the hottest web3 trend of 2023. Participants can vote via DappBay and can mint their voting NFT to decide between DeFi (represented by Stader), GameFi (Era7), and SocialFi (Yuliverse), for a chance to predict the next biggest trend and win 100 BUSD. BNB Chain will be exercising community-driven engagements like this to grow their ecosystem in the coming year.

BNB Chain will continue to grow their community and facilitate network functionality – in speed, costs, and security – in order to “onboard the next billion users into web3.”

Ethereum (ETH)

Key Takeaways:

- Despite a slight QoQ decline in average daily transactions, December 9th saw new records in single day transactions and active daily users. An ATH in these categories during a bear market is nothing to skim over.
- ‘The Merge’ to a PoS consensus algorithm was a success as transaction fees are much lower and ETH inflation is minuscule, even briefly turning deflationary.
- Total value staked on Beacon Chain grew more than 11% QoQ and represents over 13% of the total ETH supply. In addition, Over two thirds of the staked ETH is locked and illiquid. Staking with pools and on CEX’s could become a threat to decentralization
- Layer-2 scaling solutions, specifically optimistic rollup protocols Arbitrum and Optimism, exploded in terms of daily transactions.
- Solidity is the Web3 standard for programming languages and developers are building through the bear market. Smart contract creations skyrocketed in Q4.

Blockchain Overview

Ethereum is a decentralized, open-source blockchain platform that enables the development of smart contracts and decentralized applications (dApps). It was created in 2015 by Vitalik Buterin with a mission to decentralize the internet and give people the power to control their own data, assets, and identities without relying on any third-party intermediaries. Ethereum uses its own native cryptocurrency, Ether (ETH), to fuel the network and pay transaction fees associated with using or creating smart contracts and dApps. Ethereum also uses a computer programming language called Solidity to write smart contracts and build dApps. On September 15th, 2022, Ethereum switched from a proof-of-work (PoW) consensus mechanism to a more complex proof-of-stake (PoS) algorithm. This move is part of a larger effort to make the network more efficient, sustainable, and secure. With many competitors in the programmable, layer 1 blockchain space, Ethereum’s main competitive advantage

and value comes from its existing ecosystem's sheer size and network effect. As a result, the Ethereum network has created an industry standard infrastructure for future developments through leading utility, scale and connectivity that is evolving the network into an independent economy.

The Ethereum Fourth Quarter Narrative

External Catalysts:

2022 has not been friendly to the cryptocurrency/web3 space and this trend continued in Q4. Many external factors like FTX—and its contagion—, a hawkish FED, and political uncertainties sent shockwaves through the industry, triggering mass FUD (fear, uncertainty, and doubt) and panic selling throughout the markets. Starting with major macroeconomic events, the FED remained hawkish and rose interest rates by 75 and 50 bps in both of their Q4 meetings to a current Fed Funds Rate of 4.25–4.5%. As rates rise, money becomes harder to come by and risk is not needed to secure attractive yield so money is reallocated away from them to more conservative assets. With natural outflows due to tighter macroeconomic conditions, cryptocurrency sustained their low prices and wreaked havoc on under diversified, over-leveraged balance sheets.

FTX, for example, went from congress representative to bankrupt in a blink of an eye. During the FTX collapse news break, ETH fell 28% in 6 days starting from the publishing of the CoinDesk article on Alamedas aggressively large position in FTT tokens on their balance sheet (11/02) . Similarly, back in Q2, during the de-pegging of UST and collapse of Terra Luna, ETH fell 33% in 9 days beginning 05/03. In addition to the FTX collapse, its subsequent contagion is still playing out today as more recently, Blockfi, Genesis filed for bankruptcy in its wake. Finally, political tensions among world leaders (Russia, China, EU, US, etc.) continue and crypto policy remains uncertain, both looming dark clouds over crypto's future.

Between macroeconomic conditions, bankruptcies, and political chaos, all Q4 news seems to be bad news for the cryptocurrency space. One note-worthy fact is that

this is the first bear market this industry has experienced with mainstream media coverage, potentially contributing to additional volatility and volume.

ETH Token:

Ethereum has seen its native token, ETH, depreciate ~75% since its all time high (ATH) of \$4,891.70 in November 2021 and 7.33% since the start of Q4 to its current price of ~\$1,219. Since the large sell off from ATH's and increased volatility in 2022, it seems as if ETH has found a consolidation channel in Q4. Since the start of Q4, we have seen a relatively low volatility compared to Q3 and a narrower channel between lows of \$1,099 (11/08) after the FTX collapse and highs of \$1,675 (11/04).



ETH price (in USD) going back to Q3 2021. Chart as of 12/20/22.

This lower volatility is confirmed by The TIE Temrinal's "Realized Volatility" index as the standard deviation of daily returns over a 90 day window has fallen QoQ from a high of 91.6% at the end of (high of over 110% in Q3) to a current 81.55%. As a comparison, over the same window, the SPY index is currently at ~30%. With a declining volatility trend, firm support at the \$1000 level, a failing resistance line

sourcing from the start of the bear market, and improving/neutral market sentiment (discussed further in the sentiment section), the BBA Research team interprets this data from the past quarter as Ethereum's bottoming process and time of consolidation. Any price movements outside of ETH's current sideways price range of \$1,000 (strong level of support) to \$1,600 (strong level of resistance) would result from positive or negative external catalysts. Some positive examples being a FED pivot, lower than expected inflation prints, or higher than expected unemployment numbers while negative examples may be another unwanted surprise in the industry (bankruptcy, collapse, etc.) or more extreme hawkish FED activities in Q1 2023. Furthermore, BBA Research Team's technical analysis shows a key event to watch for in Q1 2023 as long-term resistance and short term support converge and potentially clash.



ETH price going back to Q3 2021. Imagine containing a long-term resistance line from all time highs in Q3 2021 (A), a short-term resistance line starting in Q2 2022 (B) and a short-term support line starting Q2 2022 and a key event regarding a convergence spot (O). Chart as of 12/20/22.

Performance Analysis

Ethereum's ETH price is currently ~\$1,200 and its market cap is ~\$145 billion. It ranks #2 in market capitalization for all cryptocurrencies, keeping its spot in the top 10. See the custom table below, comparing the most important metrics for valuing the Ethereum ecosystem accompanied by supporting descriptions below:

State of ETH Q4 2022					
Quarterly Metrics	Denomination	Q1 2022	Q2 2022	Q3 2022	Q4 2022
Network Usage					
Average Daily Transaction ¹	#	1,173,122	1,094,934 (-6.7%)	1,150,166 (5%)	1,075,096 (-6.5%)
Average Transaction Size ³	ETH	2.78	4.01 (44.2%)	3.13 (-22%)	3.21 (2.6%)
Average Daily Active Addresses ¹	#	595,584	524,600 (-12.1%)	540,065 (3.1%)	547,165 (1.3%)
Average Smart Contract Deployment ⁵	#	112,275	73,234 (-34.8%)	62,142 (-15.1%)	345,692 (456.5%)
Network Financials					
Average ETH Price ²	USD (\$)	3,282	1,042 (-68.3%)	1,327 (-27.4%)	1,219 (-8.1%)
Market Cap (End of Quarter) ²	USD (\$)	387,730,731,486	123,793,364,397	158,895,635,211	149,379,301,478
Average Daily Revenue ³	USD (\$)	27,577,288	14,030,367 (-49.1%)	2,998,566 (-78.6%)	2,985,091 (-0.5%)
Average Fee / Transaction ¹	USD (\$)	23.32	12.51 (-46.4%)	2.61 (-79.1%)	2.76 (5.75%)
Ecosystem					
Total TVL on Beacon Chain ⁵	ETH	10,987,218	12,984,421 (18.2%)	14,080,071 (8.4%)	15,723,895 (11.7%)
Average Daily Transaction on Optimism ⁴	#	37,228	92,479 (148.4%)	141,516 (53%)	315,528 (123%)
Average Daily Transaction on Arbitrum ⁴	#	58,252.26	97,827 (67.9%)	130,051 (32.9%)	331,254 (154.7%)
Ecosystem					
Average Daily Tweet Volume ²	#	58,142	38,246 (-34.2%)	37,014 (-3.2%)	34,764 (-6.1%)

Sources:

- 1. Etherscan
- 2. The TIE Terminal
- 3. Coinmetrics
- 4. The Block
- 5. Dune Analytics

Notes:

Each percentages represent quarter to quarter changes


**BENTLEY
BLOCKCHAIN
ASSOCIATION**

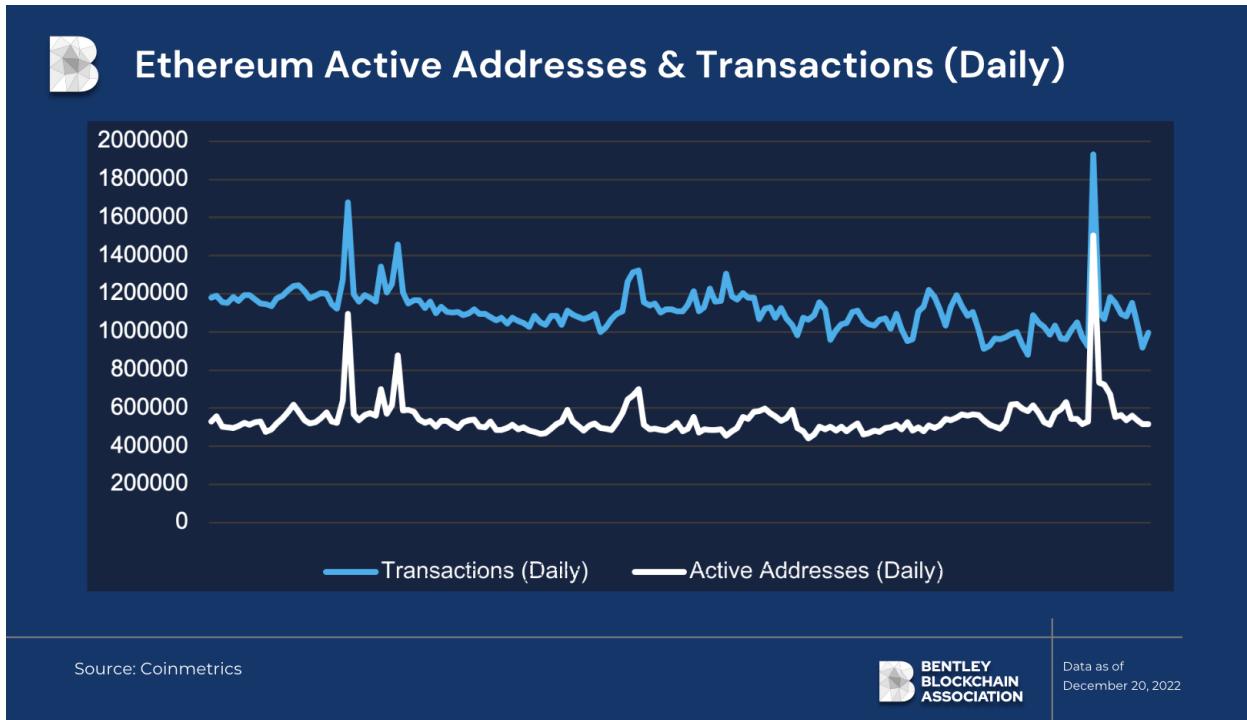
Date as of December 20, 2022

Overall summary of Ethereum Network performance in Q4 compared to the rest of 2022.

Network Usage

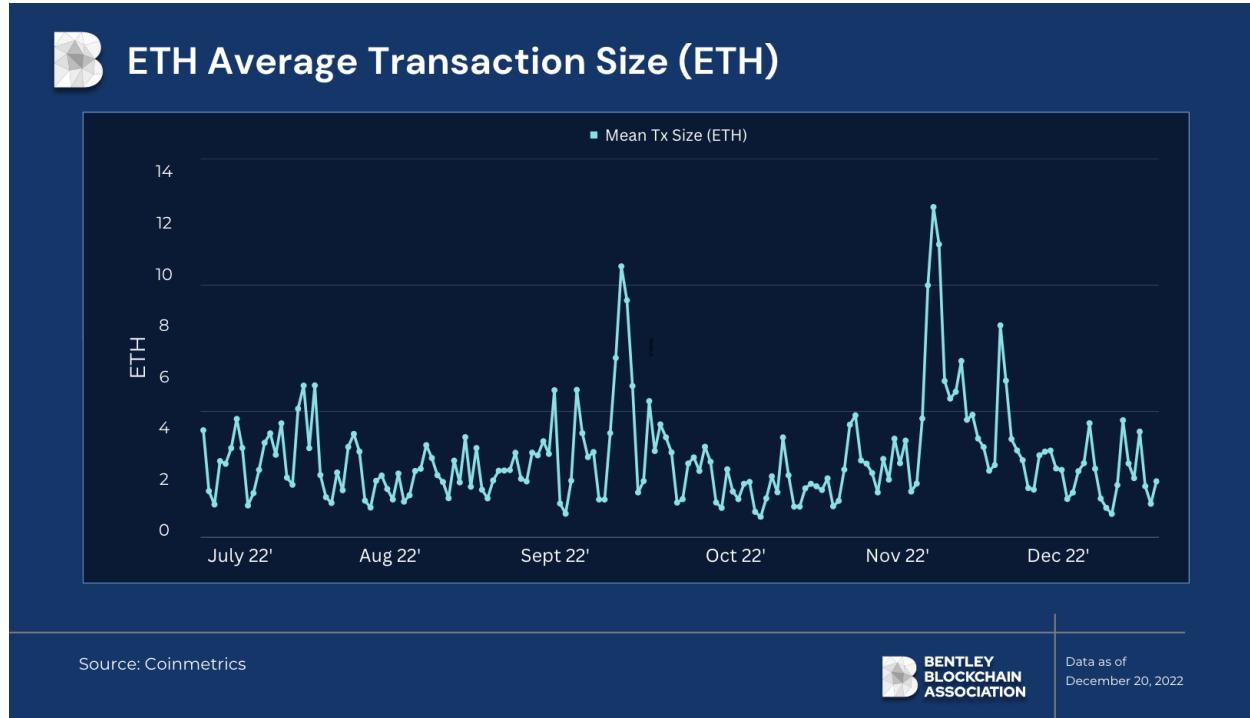
In Q4 2022, the Ethereum network grew in terms of active addresses but these users performed less transactions as the bear market deepens and recession looms. Q4 saw an average of 1,075,096 daily transactions for a 6.5% QoQ decline while average daily active users increased by 1.3% in Q4 to 547,165. Regarding these data points, December 9th, 2022 marked a milestone for the network as daily transactions and active addresses reached 1,932,711 and 1,505,652 respectively. After further analysis, the bulk of these transactions came from ERC20 tokens and more

specifically, stablecoin assets. The exact cause is unknown, but most likely large activity among exchanges as Binance halted withdrawals to USDC to execute a “token swap” in an effort to reallocate their reserves around this time.



Daily Transaction (light blue) and Daily Active Wallet Addresses (white) over the past 2 quarters. Chart as of 12/20/22

With a continued downward trend QoQ in transactions, we saw the average size of these transactions (in native units) increase in Q4 by 2.56% to 3.21 ETH. This is partially due lower token prices (more units to compensate for lower USD value) but mainly from the chaos following the FTX collapse as a large spike in average transaction size occurs in response to the news. With slightly higher transaction size (in native units) and a slightly decreasing transaction frequency, overall network volume remained roughly unchanged in Q4.

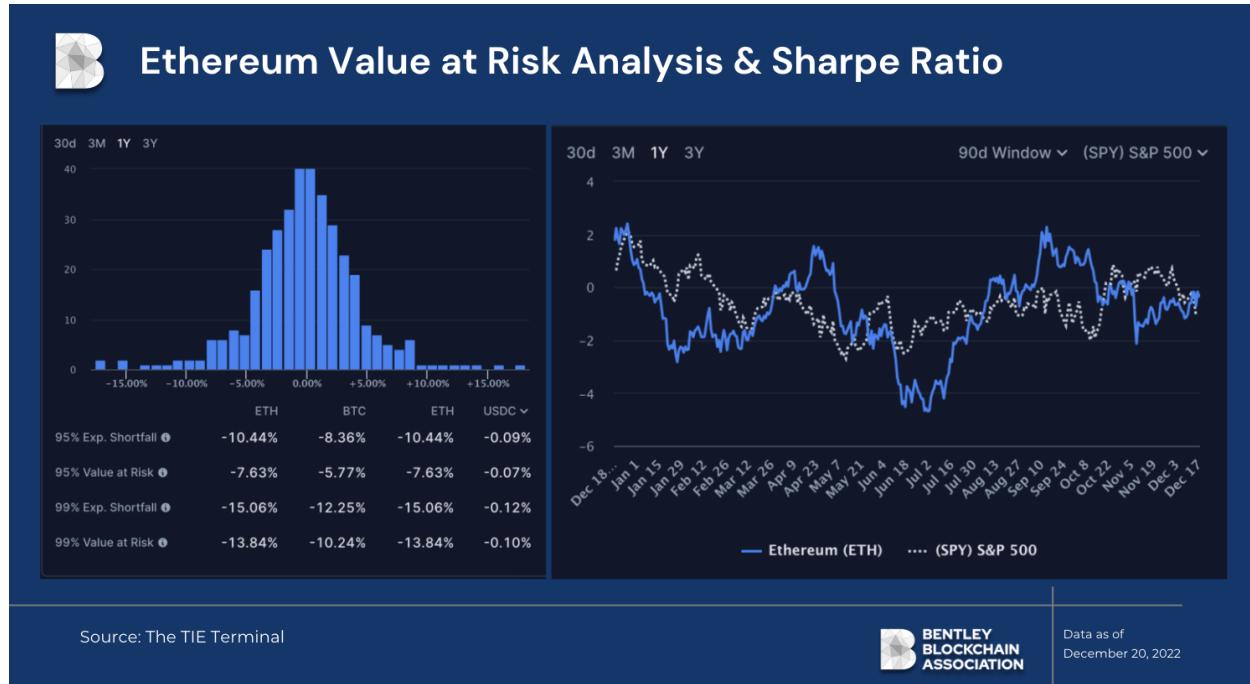


Average Daily Transaction size (in ETH) over the past 2 quarters. Chart as of 12/20/22.

As for network development, the number of commits per repository and developers per repository in GitHub using the Solidity programming language remained relatively consistent QoQ—disregarding December as the holiday season negatively skews the data. With this, there was a massive spike in smart contract creation and deployment in Q4. The sustained developer activity on GitHub and explosion of smart contract deployments indicate that developers have been and are still building on the network during the bear market. This positions Ethereum very well long-term as developers are the core foundation and builders to sustaining, improving and adding utility to Ethereum.

Network Financials

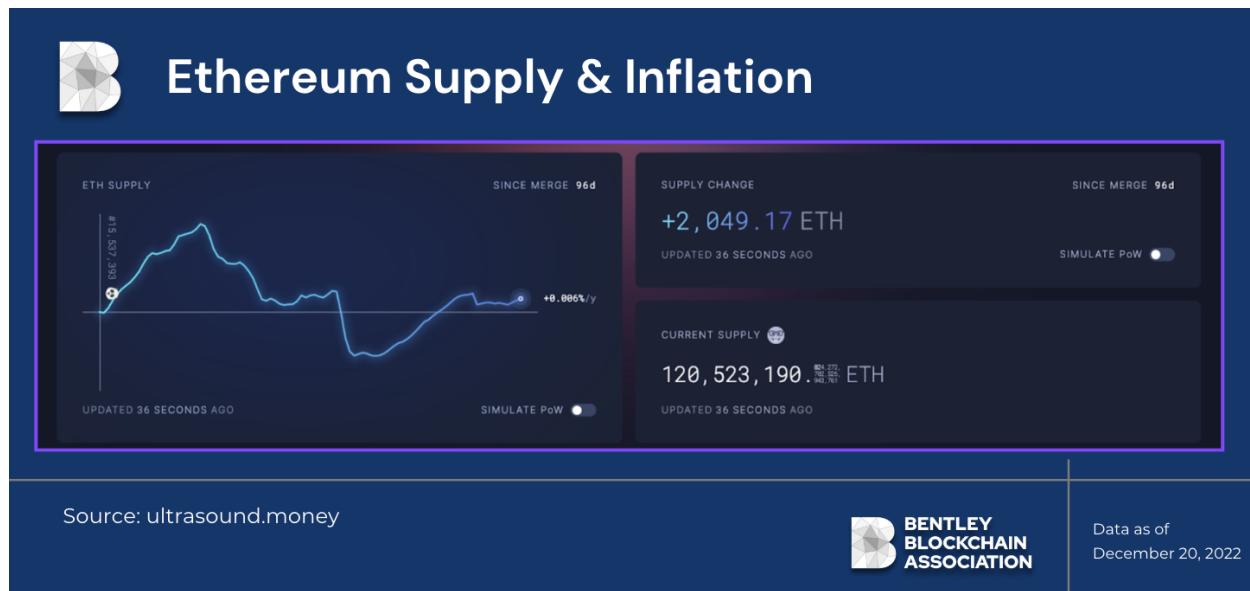
Given the decline in token price (ETH), Ethereum market cap also declined to its current value of \$149.3 billion USD. A “Value at Risk Analysis” of ETH from The TIE Terminal over the past year shows us that the average daily return worse than the 5th percentile is ~10.44%. In terms of a Sharpe Ratio, which measures risk-adjusted returns, as of December 20th, ETH was -0.07 while SPY, a S&P 500 index, was -1.22.



Value at Risk Analysis (Left) measures how big the losses are in the worst cases & Sharpe Ratio measures risk-adjusted returns, both with a 1 year perspective. Chart as of 12/20/22.

In terms of internal financials like revenue, transaction fees, and inflation we have very unique data as Q4 was the first full quarter with Ethereum 2.0 and its PoS consensus mechanism. Looking at network fees, Q4 had an average fee of \$2.76 slightly higher than the \$2.61 in Q3, but both drastically lower than \$12.51 experienced during the last full PoW quarter (Q2 2022). Building into network revenue, we see that the average daily total transaction fees in Q4 was \$2,985,091. This is a slightly higher than last quarters average daily revenue (which was split with PoS and PoW) of \$2,998,566 but drastically lower than the last full PoW quarter (Q2 2022) of \$14,030,366. Since average daily revenues and fees increased while average daily transactions decreased, we can determine that the QoQ difference in fees was the dominant variable (since number of transactions and transaction fees are variables in network revenue). While Q4 produced marginally higher fees and revenue, the main takeaway is that the transition to PoS drastically lowered transaction fees for the Ethereum network as the past two PoS quarters strengthened the trend.

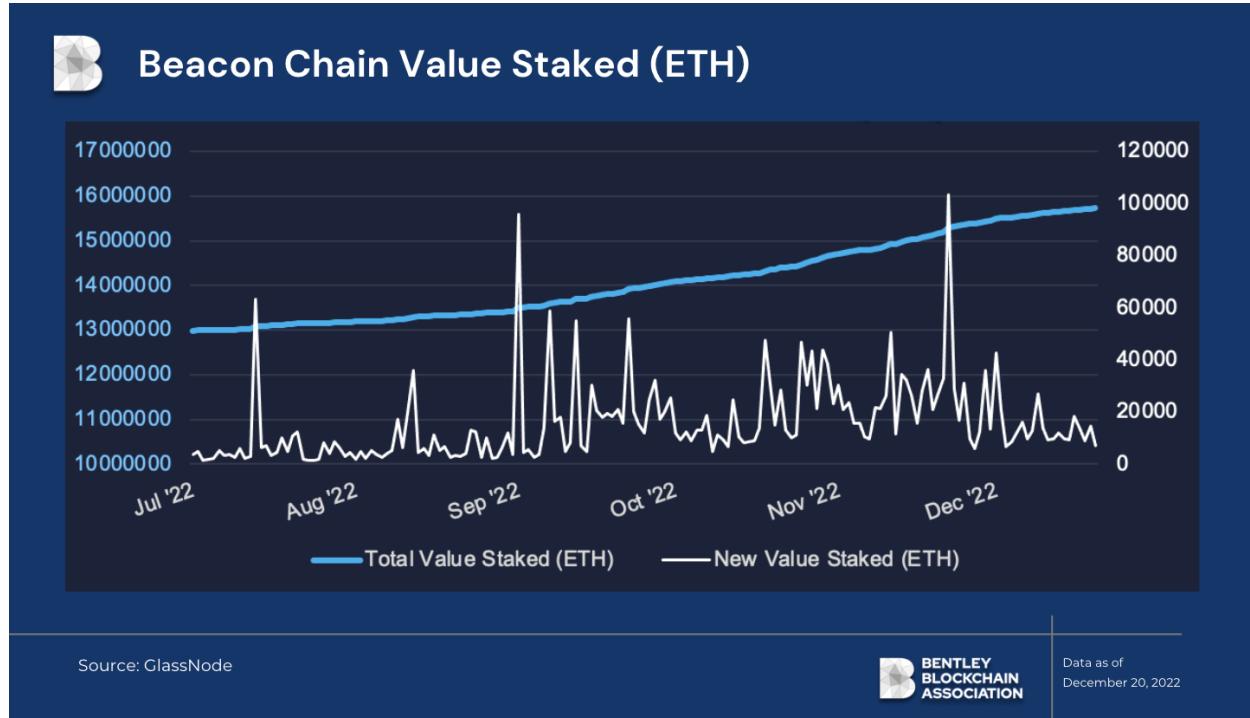
Not only has transaction fees decreased significantly since the transition to PoS, but the network's inflation rate has plummeted as well. The transition to PoS was paired with an Ethereum Improvement Proposal (EIP-1559) that 'burns' a proportion of each transaction fee and block reward which gives a deflationary property to the token. This burning mechanism has led to periods of deflation in the ETH token in Q4 and most likely more to come in the future. Since the Merge on September 15th, there has been roughly 2,053 ETH minted for an annual inflation rate of 0.006%.



ETH's real time annualized inflation rate since The Merge (left), the number of ETH tokens minted since The Merge (top right), and the total ETH circulating supply (bottom right). Chart as of 12/20/22.

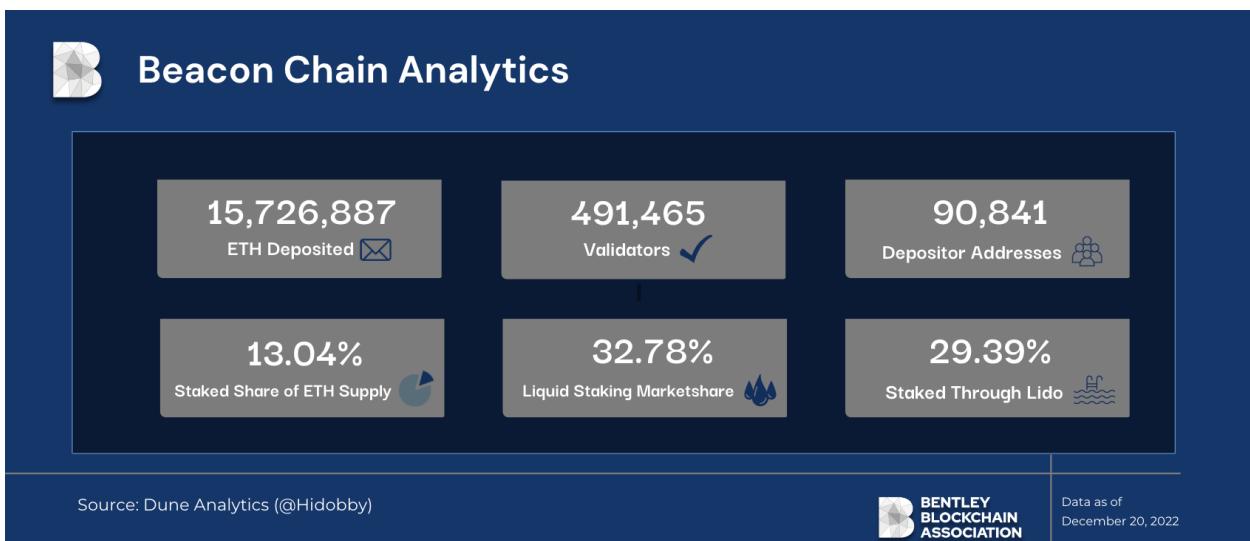
Ecosystem

Ethereum's total value locked/staked (TVL) has increased dramatically during Q4 stepping up the upward trend of TVL. At the end of Q3, there were 14,080,071 ETH staked and as of 12/20/22, there was 15,723,8956 ETH staked (13.01% of total supply) for a QoQ growth rate of 11.7%.

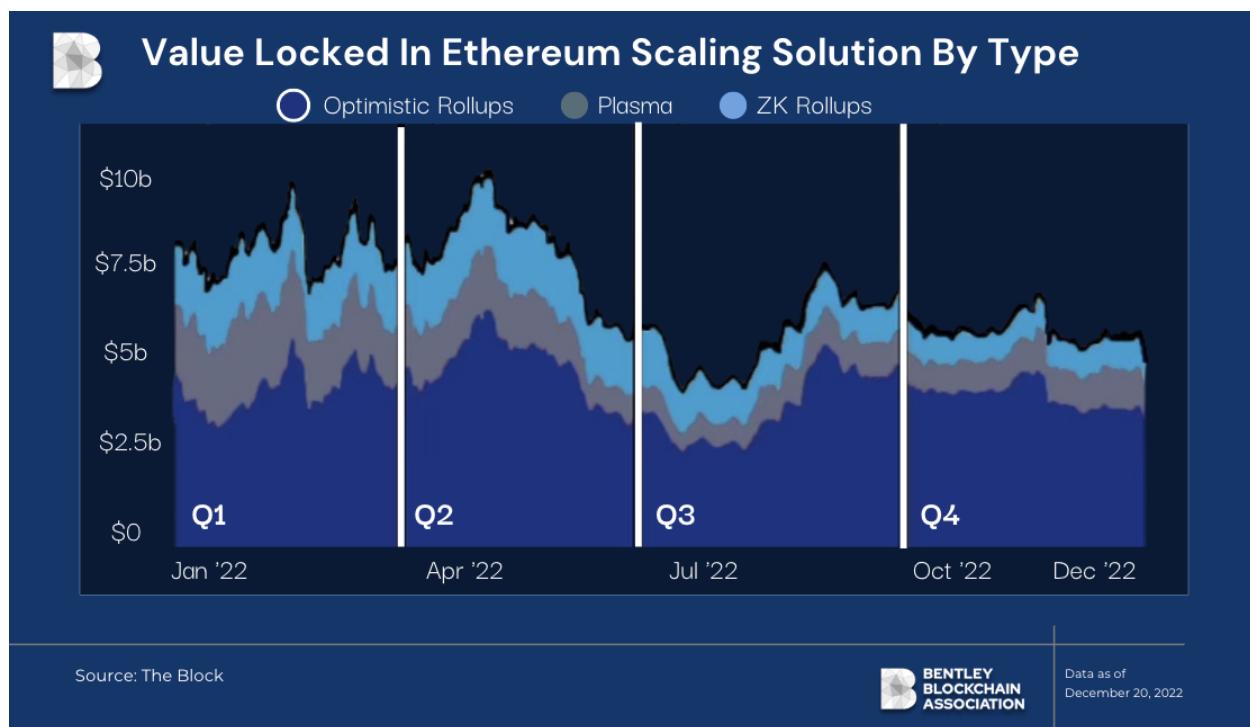


Total Value Staked on the Ethereum network (blue) and New Value Staked (white). Q4 saw a drastic increase in staked ETH. Chart as of 12/20/22.

Of the staked ETH, 32.78% of it is in liquid protocols whereas the other 67.22% is illiquid. This staking activity is distributed between 491,465 validators and 90,841 distinct addresses. Many validators aggregate, or ‘pool’, their deposits together to increase frequency and consistency of rewards. The largest single depositor is Lido with 29.39% of the total pooled staking value.



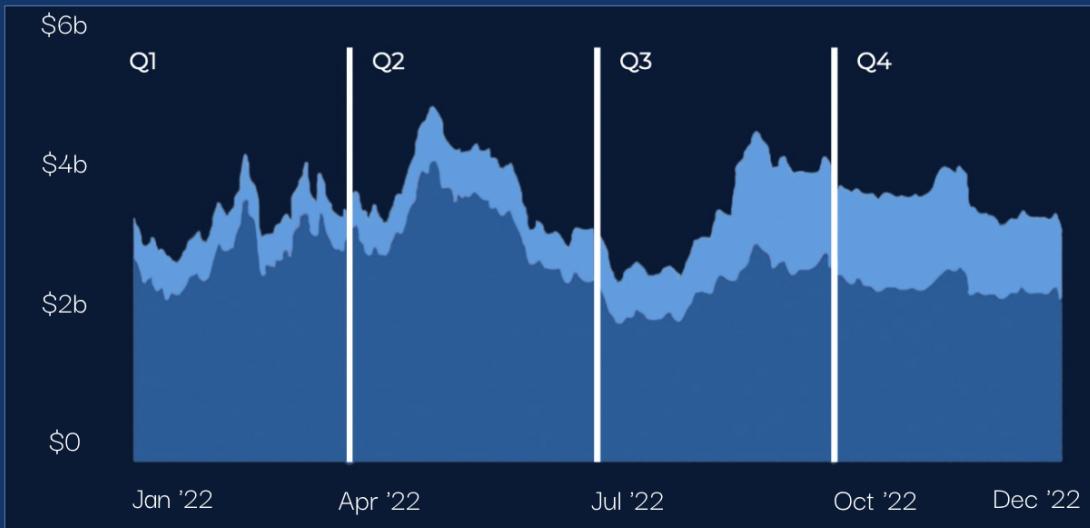
With this TVL and staking analysis, Ethereum's security and decentralization is strong, but the network is not very scalable as transaction prices—although much lower than before PoS as analyzed in the financial section—are still expensive compared to other networks. As a result, Ethereum has adopted Layer-2 scaling solutions into its roadmap to further scale the network. Analyzing these layer 2 scaling solutions, TVL within ZK rollups, Optimistic rollups, and others have declined slightly in Q4, but mainly held steady in Q4 considering the high growth in Q3.



Optimistic rollups are the largest category (purple area in the above graph) among scaling solutions and Optimism and Arbitrum are the largest protocols in that category. In Q4, Arbitrum and Optimism saw a relatively slight decline in TVL. With that, both protocols saw massive growth in Q3 so holding onto most of this growth in Q4 is a sign of longevity. Also, it is important to note that the parameters of TVL are in dollar values and are subject to token price volatility even if no deposits or withdrawal take place.



Value Locked In Ethereum Optimistic Rollups



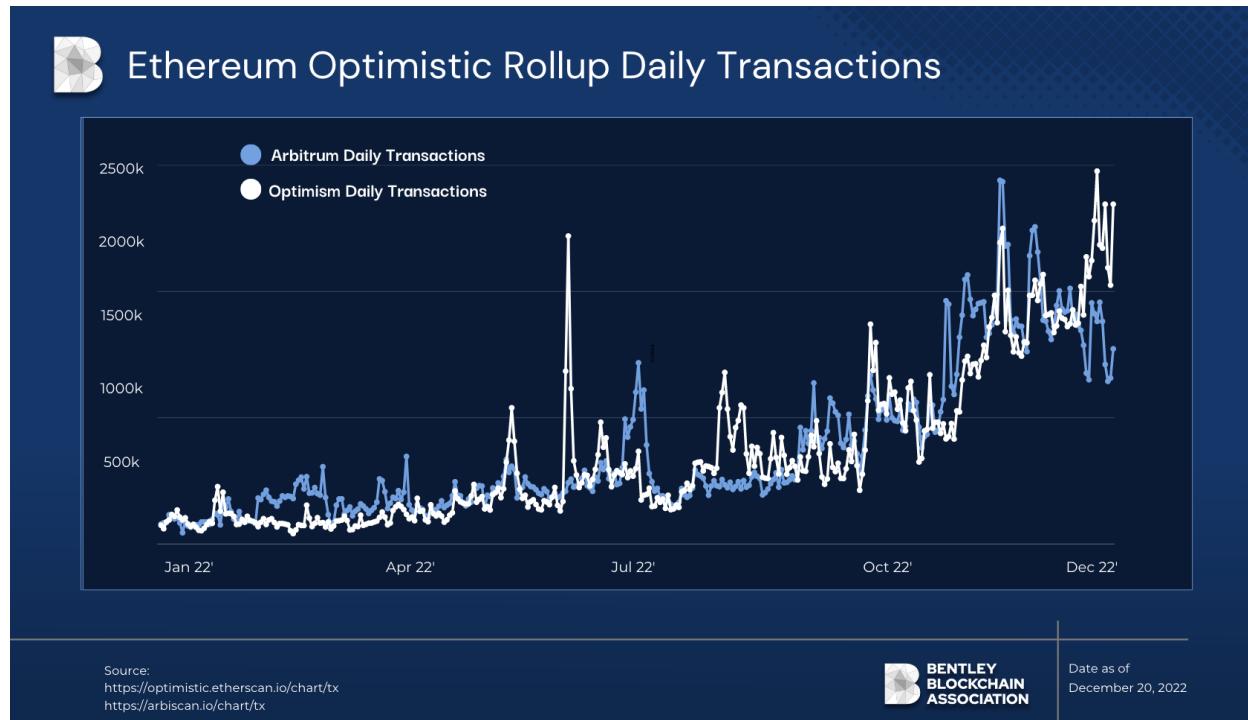
Source: The Block



Data as of
December 20, 2022

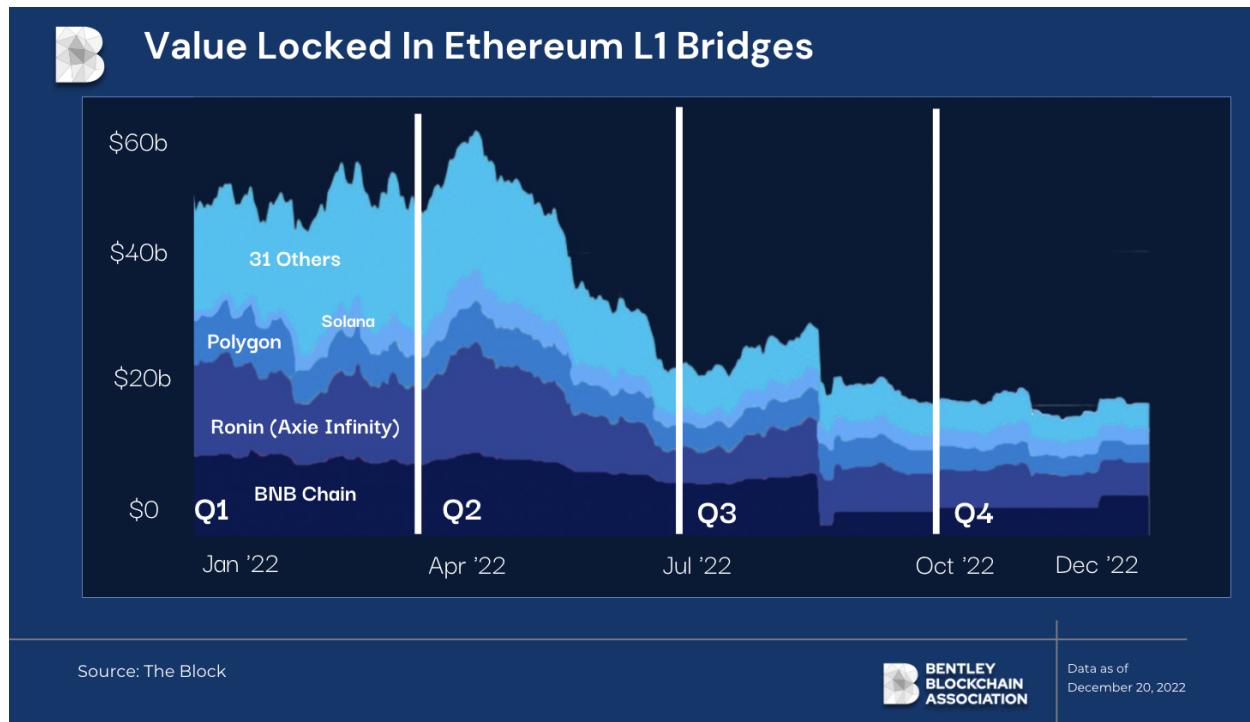
TVL in Optimistic Rollup Protocols. Arbitrum (Dark Blue) and Optimism (Light Blue) dominate in comparison to others.

More on Arbitrum and Optimism specifically, Q4 saw a massive spike in transactions on their networks as Arbitrum grew ~155% and Optimism ~123% QoQ. Optimistic rollups with the Optimism and Arbitrum protocols have grown immensely in popularity among users which will be an important datapoint to watch going forward as Ethereum looks to improve its scalability to further grow the ecosystem.



Transaction activity on Arbitrum (Blue) and Optimism (White). Q4 saw explosive growth. Chart as of 12/19/22.

Moving into interoperability features of the Ethereum network, Total Value Locked (TVL) within other layer 1 bridge protocols continued their declining trend in Q4 since high in Q1 and 2 2022. As the Ethereum's ecosystem develops, there is less need for bridges connecting foreign ecosystems as everything users may need can be found domestically. This is a datapoint to monitor going forward as the decline of bridges could potentially result in ETH emerging as the dominant industry standard among decentralized PoS layer 1 protocols.



TVL on Layer 1 bridge activity has declined significantly Since The Merge. Chart as of 12/20/22.

Qualitative Analysis

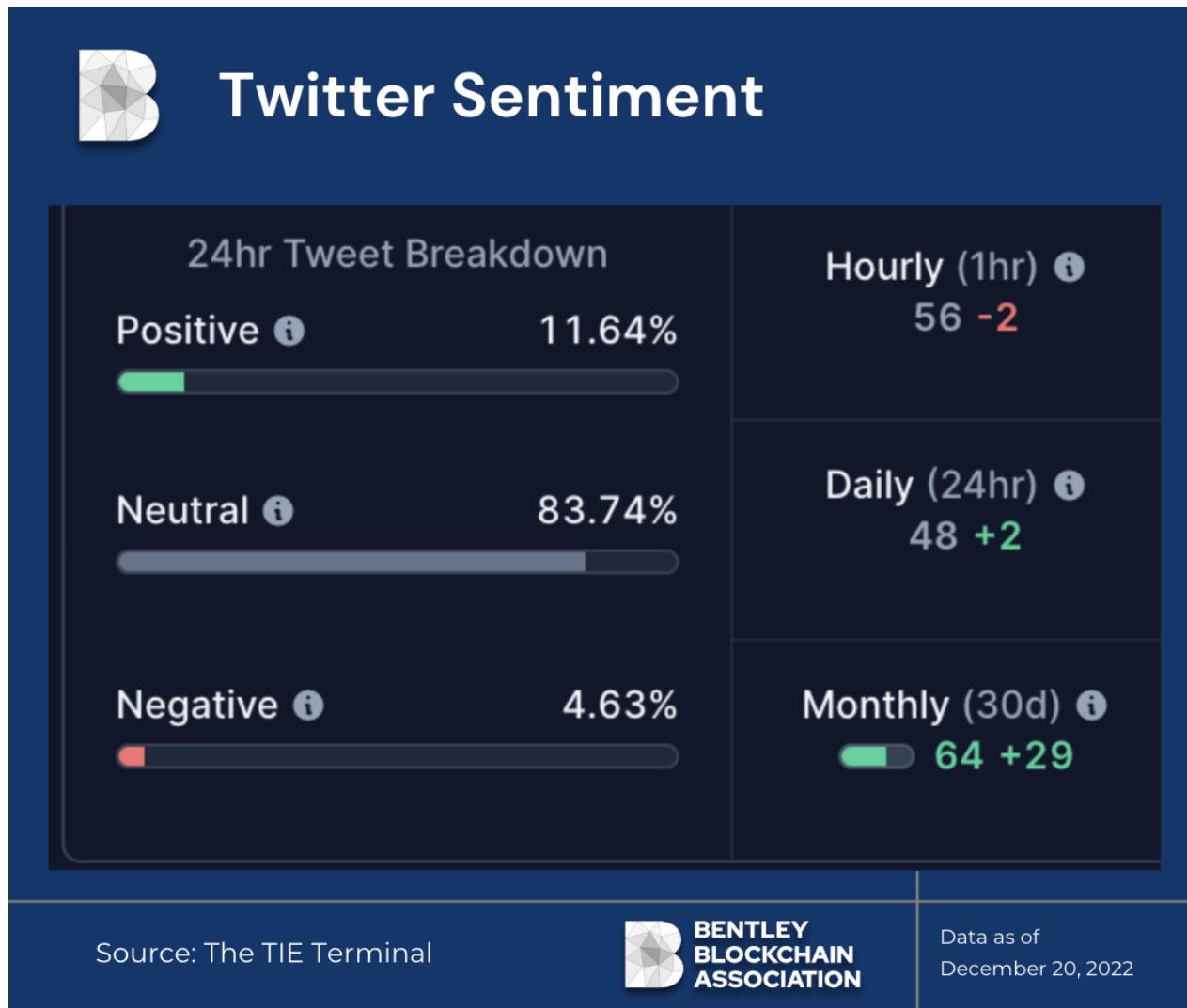
Sentiment

Over the past 6 months, despite 'The Merge' to PoS, Ethereum has stayed out of mass media spotlights as Q4 tweet volume has declined slightly QoQ (aside from a spike during the FTX chaos). Looking at Q4 sentiment data points from The TIE Terminal, Ethereum's Q4 "NVTweet Ratio" and "Hype-to-Activity Ratio" began to decrease and increase respectively. Ethereum's current NVTweet Ratio of 3.4 means there are 3.4 tweets occurring per \$1 million in market cap while its current Hype-to-Activity Ratio value of 6.18 means there are 6.18 tweets per \$1 million in trading volume.



NVTweet Ratio (top) and Hype-to-Activity Ratio are two key, innovative data points from The TIE Terminal used to measure sentiment. Chart as of 12/20/20.

Digging more into these tweets, The TIE defines each one as positive, neutral, and negative while Ethereum's tweet volume is 11.62% positive, 83.76% neutral and 4.63% negative. Furthermore, The TIE Terminal "Long Term sentiment" measures how positive or negative conversations on Twitter have been about a particular coin over the last 50 days vs. the previous 200 days has Ethereum at a score of 64 out of 100 and +29 points in the last 30 days. Another thing worth noting is that Q4 saw a sharp increase in views of YouTube videos with Ethereum content. This spike is most likely caused by the increased media attention the space has gotten over the past 6 months which has social media algorithms pushing its content and causing curious individuals to learn about the space.



The TIE Terminal's tweet sentiment percentage breakdown and trend. Chart as of 20/20/22.

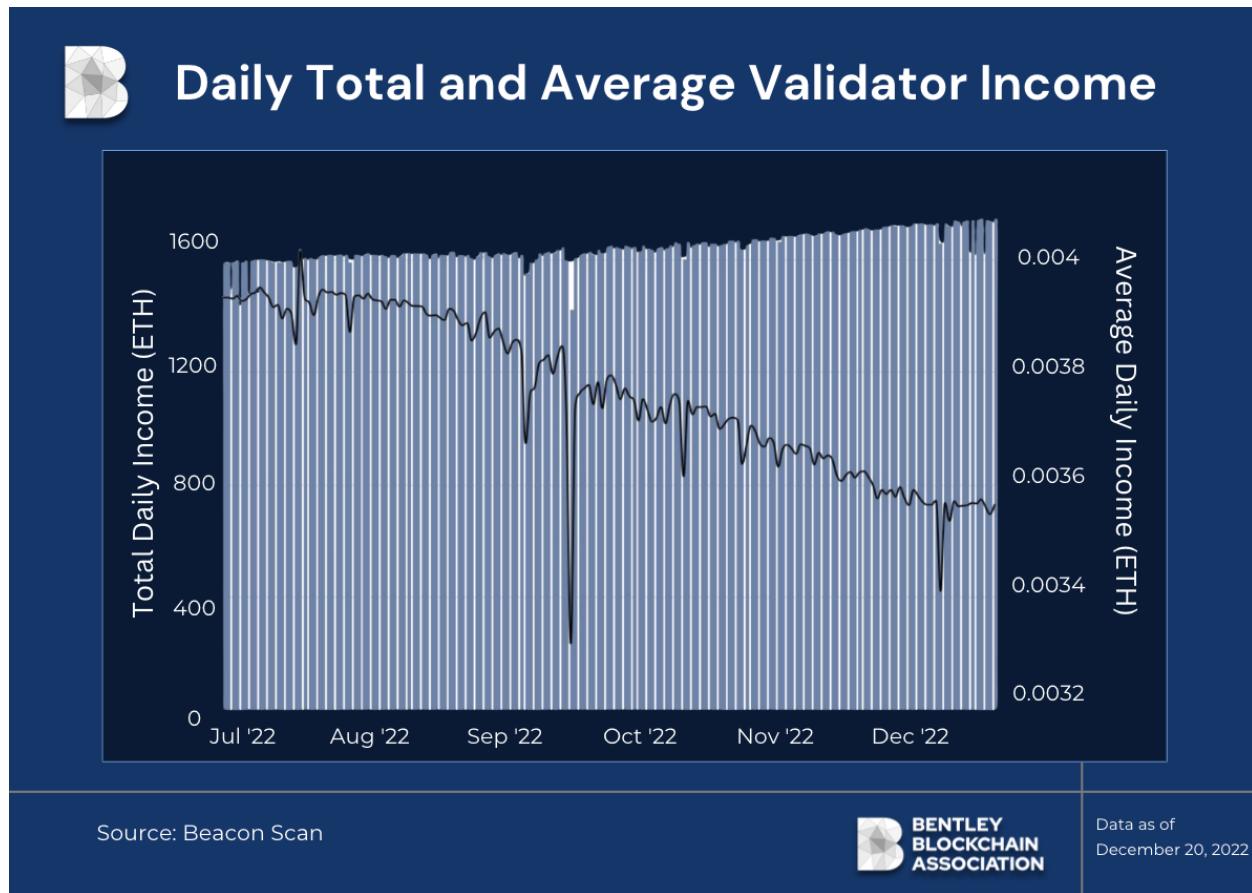
Geography

With Ethereum's large market cap and developed ecosystem, its reach is much more worldwide than many competitors but the network's anonymity makes accurate measurements of its geographic diversity difficult. With that, IP addresses of users can solve this problem so looking at metamask.io—the most popular self-custodial wallet and first step into the Ethereum ecosystem, an analysis of user geographic breakdown can be assessed. The top 5 countries by web traffic combine for roughly 34% with the top being the U.S at 13.38%. With the 5th most active country being

responsible for 4.83% of web traffic, the remaining ~65% of web traffic is distributed among countries individually responsible for no more than that amount. This demonstrates Ethereum's international exposure and footprint. Furthermore, this data shows us that individuals aged 25-34 have the highest representation with 36.93% of traffic and the gender breakdown is roughly a 3:1 men-to-female ratio.

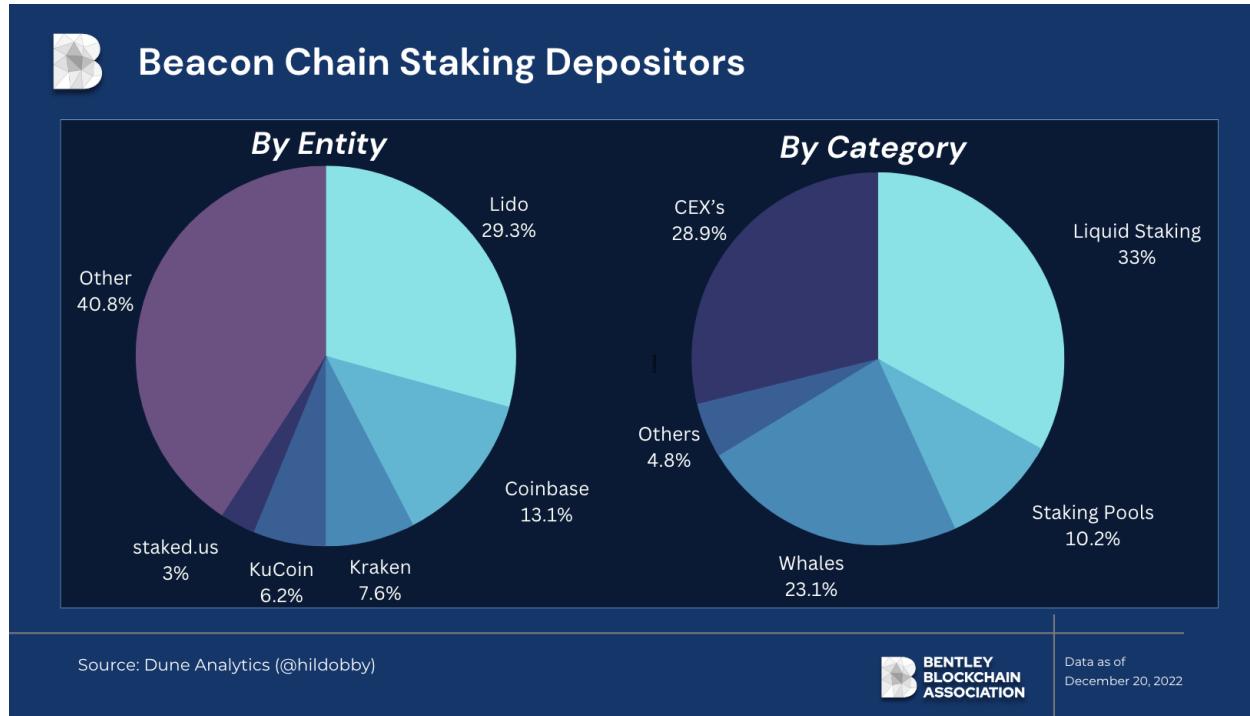
Decentralization

In addition to difficulties determining geographic breakdown of Ethereum users, the anonymity aspect of a very large Ethereum network makes an accurate analysis of its decentralization very challenging. Also, since the network just changed from PoW to PoS, there is a lot of volatility in the number of validators and the pools they are using. With this, there are a few data points to look at like the percentage of tokens staked, the number of validators and the distribution of tokens across these validators. As analyzed in the ecosystem section, over 13% of the total ETH supply is being staked at over 68% of this amount is locked away in illiquid staking pools or smart contracts. Also, there are over 491,000 individual validators with an average participation rate of roughly 99% in Q4. Taking a look at validator income in Q4, we see a gradual increase in total rewards, but a sharp decline in average rewards per validator. This is a good sign for decentralization as the more validators on a network, the more the rewards have to be split and shared among them.



Daily Total Validator Income is slightly increasing (blue bars) while Average Daily Income per validator decreases. More validators sharing the rewards indicates an increasingly decentralized network. Chart is of 12/20/22.

One thing to monitor going forward is the growing popularity and allocations of staking pools and centralized exchanges (CEX's) which currently combine to be responsible for almost 40% of the entire staked ETH. While the concept of pooled staking may seem to encourage decentralization as it lowers financial barriers (minimum stake amount is 32 ETH individually), it does the opposite as it aggregates many user wallets into a single wallet. The larger a pool, the more times it is selected to validate and the larger contribution that single wallet has to the ledger. If a large wallet turns malicious or gets hacked, the entire network can be compromised and exploited. For example, the largest individual pooled staking entities are Lido and Coinbase who represent 29.3% and 13.11% of the total staked ETH. If the pool grows to represent >50% of the total value staked, the system's integrity becomes compromised as a single wallet would then have a majority.



Largest depositors to the Beacon Chain by entity (Left) and general category (Right). Charts as of 12/20/22.

dApps

What makes Ethereum so unique is its vast, developed ecosystem. As of December 17th according to Dappradar.com, there are 3609 dApps on the Ethereum network. This does not include those that sit on side chains like Polygon or EVM compatible protocols like BNB chain. The top 5 dApps in terms of total value in the dApps' smart contracts were Ethereums staking dApp (DeFi), Polygon POS Bridge (DeFi), Uniswap v3 (Exchange), Curve (DeFi), and Pirates of Arrland (game). The top 5 dApps in terms of daily active users are OpenSea (marketplace), Uniswap v3 (marketplace), Uniswap v2 (marketplace), Metamask Swap (DeFi), SimpleFX (marketplace). The most popular categories of dApps are Decentralized Finance (DeFi), Marketplaces, and games (Play-2-Earn). The most common categories of dApps are DeFi, Marketplace, and Games.

Conclusion

While Q4 brought Ethereum's native ETH token lower on negative macro news and external events as the bear market continues, the quarter wasn't all bad news. The transition to PoS was a success as transaction fees dropped significantly and ETH experienced almost no inflation—and even times of deflation for the first time ever. TVL also increased drastically as more validators staked ETH to further secure the network. Also, Developer activity remained steady while smart contracts increased which means the ecosystem's key assets are continuing to build through the bear market. As for milestones, Q4 saw a new daily record in transactions (despite falling slightly QoQ) and active users (remained steady QoQ). Related to these transactions, Q4 saw a massive spike in activity on layer-2 scaling solutions like Arbitrum and Optimism which a continued trend may solve ETH's main problem: scalability.

Looking forward to next quarter, which will be the second full quarter of Ethereum 2.0 (PoS), it will be interesting to see if any of the observed data points influenced by The Merge like transaction fees, inflation, staked ETH, etc. will develop into more conclusive trends or patterns. In addition to PoS specific data points, monitoring the number of transactions, both directly on ETH and its L2 scaling solutions may hint at Ethereum's future role as a frontend software or backend infrastructure. Also, looking into 2023, developer activity will be a key datapoint to watch for Ethereum's long-term success and post-bear market performance. Regarding public sentiment, Ethereum's growing Hype-to-Activity Ratio and a sinking NVTweet Ratio may indicate ETH token price may begin to trade more on momentum not fundamentals. Finally, and related to sentiment is Ethereum token price. Sometime in Q1 2023, ETH will approach a potential key convergence point between a long-term resistance line traced from its ATH in 2021 and a strong support line held through most of the bear market. At this time, a combination of public sentiment, economic conditions, external factors, and fundamental data may dictate the direction of ETH's price in Q1 and beyond.

Solana (SOL)

Key Takeaways

- The foundation of Solana's network, such as low transaction costs and high speed interactions, drove network value in 2022.
- Solana's ties to FTX/Alameda Research through its ICO in 2020 have raised uncertainty for investors after the collapse of the quantitative trading firm and centralized exchange.
- The DeFi application Serum had ties to FTX, and its fall has played a role in the recent drawdown for Solana's network value.
- Solana Mobile was introduced as a premium mobile experience that enables users to trade tokens, mint NFTs, and have instant access to dApps on a Solana-backed smartphone.
- Solana's GameFi applications have driven a significant portion of network usage. The most popular options are Star Atlas, Aurory, and other games.
- Solana's NFT volume is currently the second largest behind Ethereum. Magic Eden is the most popular NFT marketplace on the platform.

Blockchain Overview:

Solana is a layer-one, public blockchain network using open-source code to deliver scalability and support smart contracts. Solana uses a hybrid consensus mechanism that combines both Proof-of-History (PoH) and Proof of Stake (PoS). PoH allows the Solana network to batch transactions, while PoS validates each sequence of blocks produced by the network. This concept allows for greater usability, in terms of low-cost, fast transactions, which makes Solana a phenomenon in the blockchain industry. Solana has design goals that include sub-second settlement times, low transaction costs, and support for all LLVM-compatible smart contract languages, including Rust, C, C++, and eventually Move as of Q4 2022.

The Solana Fourth Quarter Narrative:

In wake of the collapse of FTX/Alameda Research, Solana has been under scrutiny by both users and the crypto industry as a whole. Solana had been involved with FTX/Alameda Research through its ICO in 2020. Since the CEO of FTX and Alameda were the same person – Sam Bankman-Fried (SBF) – the project was inherently backed by the once-billionaire entrepreneur. After FTX filed for Chapter 11 bankruptcy in November, there are many questions related to the ripple effects on Solana's network and its governing body – The Solana Foundation.

State of the Network

During the bankruptcy event, the Solana network did not experience any notable performance or uptime issues. The security of the Solana network was not negatively impacted by the collapse of FTX, even with the volatility in the price of underlying assets on the network. As for the price of SOL, it quickly plummeted to a low of around \$12, which happened not long after it peaked at a three-month high of \$38 following the announcement of Google Cloud's support of the Solana ecosystem.

Most of the DeFi projects on Solana had limited or no exposure to FTX, based on a recent assessment by Solana Foundation. Given the bear market implications, the DeFi environment for Solana has been challenging in 2022, but the ecosystem continues to evolve and innovate. There are multiple market makers still providing liquidity for DeFi applications on Solana.

Solana's Exposure to FTX/Alameda

One DeFi application, Serum, did have close ties to the FTX fallout. Serum is a popular decentralized exchange (DEX) protocol built on Solana acting as a liquidity matcher to other DEX or trading protocols. Following the collapse of FTX, the company's wallet private keys were compromised, which resulted in a \$600 million hack on the network. The Serum program update key was not controlled by the SRM DAO, but by a private key connected to FTX. Speculators believe that the FTX group

may have been involved in running Serum's "decentralized" protocol. The Solana Foundation said that it held 134.54 million SRM on FTX, which is now essentially worthless. With this uncertainty, Binance recently delisted SRM from its exchange. Many actors in the Solana ecosystem have decreased their exposure to Serum, and developers have already created a new version of Serum, managed by multi-signature wallets and open-source code.

The Solana Foundation had ~\$1M in cash or cash equivalents on FTX as of 11/6/22 when FTX ceased to process withdrawals. This is less than 1% of Solana Foundation's cash or cash equivalents, so the impact on Solana Foundation operations is negligible. The Solana Foundation had no SOL in custody on FTX.

Most importantly, there are concerns over FTX/Alameda's SOL holdings.

FTX/Alameda first purchased SOL from Solana Foundation in August 2020, six months after Mainnet Beta launched. Below is a summary of Solana Foundation and Solana Labs, the development wing of the Solana Foundation, SOL sales to FTX/Alameda



Solana Unlock Schedule

Entity	Counterparty	Effective Date	# of SOL	Unlock Schedule
Solana Foundation	Alameda Research Ltd.	August 31, 2020	4,000,000	N/A
Solana Foundation	Alameda Research Ltd.	September 11, 2020	12,000,000	Linear monthly unlock from September 2021 to September 2027
Solana Foundation	Alameda Research Ltd & FTX Trading Ltd	January 7, 2021	34,524,833	Linear monthly unlock from January 2022 to January 2028
Solana Labs, Inc.	Alameda Research Ventures Ltd.	February 17. 2021	7,500,000	Full balance unlocks on March 1, 2025
Solana Labs, Inc.	Alameda Research Ventures Ltd.	May 17, 2021	61,853	Full balance unlocks on May 17, 2025

Solana does have exposure to FTX/Alameda. Roughly 58 million SOL was sold to the FTX/Alameda and will be unlocked by 2028. However, the Chapter 11 bankruptcy results in the future of these unlocks being unknown.

Despite Solana's exposure to FTX/Alameda and the pressures on its network from the bear market, Solana's blockchain network is still up and running. This report will dive into Solana's quantitative performance over the fourth quarter and the qualitative evidence that Solana is continuing to overcome challenges and progress through adverse market conditions.

Performance Analysis

B State of Solana Q4 2022				
Quarterly Metrics	Q1 2022	Q2 2022	Q3 2022	Q4 2022
Network Usage				
Average Daily Transaction ⁴	205,465 <i>28.4 %</i>	324,943 <i>58%</i>	223,015 <i>(31%)</i>	103,690 <i>(53.5%)</i>
Average Daily Transactions (Vote) ⁵	158,871,141 <i>4%</i>	143,354,622 <i>(70%)</i>	187,170,176 <i>31%</i>	302,375,801 <i>61.5%</i>
Average Daily Transactions (Non-Vote) ⁵	38,536,508 <i>(14.6%)</i>	20,544,622 <i>(47%)</i>	34,883,511 <i>70%</i>	17,426,944.00 <i>(50%)</i>
Network Financials				
Price ²	\$125 <i>(36%)</i>	32 <i>(74%)</i>	34 <i>6%</i>	12 <i>(65%)</i>
Circulating Supply ¹	324,927,186 <i>5%</i>	342,577,058 <i>5%</i>	355,568,712 <i>4%</i>	366,823,967 <i>3%</i>
Circulating Market Supply ²	39,218,225,945 <i>(26.4%)</i>	11,618,504,834 <i>(70%)</i>	12,066,578,262 <i>4%</i>	4,510,000,000.00 <i>63%</i>
Quarterly Revenue ²	\$11,591,818.00 <i>(44.5%)</i>	6,450,265 <i>(44%)</i>	4,832,507 <i>(25%)</i>	1,888,801 <i>61%</i>
Circulating Supply (P/S) ²	991x <i>47%</i>	847x <i>(14.5%)</i>	657x <i>(22.5%)</i>	998x <i>52%</i>
Ecosystem				
Total Value Locked (TVL) ⁴	\$7,816,851,944 <i>(30%)</i>	\$2,450,340,111.00 <i>(69%)</i>	\$2,061,997,531.00 <i>(16%)</i>	\$255,036,000.00 <i>88%</i>
Quarterly Contracts Verified ¹	56,067 <i>102%</i>	89,660 <i>60%</i>	100,428 <i>72%</i>	97,740 <i>(3%)</i>
Sentiment				
NVTweet Ratio ⁴	16.99 <i>27%</i>	3.7 <i>(78%)</i>	4.28 <i>16%</i>	1.95 <i>(54%)</i>
Hype-to-Activity Ratio ²	1.04 <i>(45%)</i>	1.97 <i>89%</i>	2.95 <i>50%</i>	7.47 <i>153%</i>

Source: SolScan ¹, The Tie Terminal ², Token Terminal ³, DeFiLlama ⁴, Dune ⁵
 Footnotes: The percentage values in italics are quarterly changes

Solana's price is currently ~\$12.25 and its market cap is ~\$4.5 billion. It ranks #16 in market capitalization for all cryptocurrencies, falling out of the top 10. See the custom table below, comparing the most important metrics for valuing the Solana ecosystem accompanied by supporting descriptions below:

Network Usage

Total active accounts unique fee payers:

The daily Unique Fee Payers metric consists of the number of unique accounts that pay for at least one transaction per day. In past quarters, unique fee payers were relatively stable, resulting in a foundational user base. In Q4, the stability of unique fee payers dropped off significantly (-53%), signaling a true representation of Solana's bear market.

Transactions on Solana can be divided into consensus and non-consensus (token transfers and smart contract logic) transactions. Solana's PoS mechanism is unlike other smart contract platforms because its consensus votes are registered as on-chain events.. The sum of consensus and non-consensus transactions is considered total transactions.

Average Daily Transactions (Vote/Consensus)

Voting transactions refer to transactions that involve a voting account (which is owned by a validator node). Vote transactions involve configuration, registration, vote collection and new vote signing. Consensus transactions were up 62% in Q4, meaning there is a push for activity within the ecosystem but not through the purchase or staking of SOL-backed assets.

Average Daily Transactions (Non-Vote/ Non-Consensus):

Non-vote transactions are analogous to EVM transaction counts. These transactions represent the actual economic activity on the network._Non vote transactions are

down -50% in Q4, which means the economic activity on the network (buying, staking, swapping) has been essentially cut in half.

Network Financials

Circulating supply and market cap:

Circulating supply has grown QoQ for Solana, while its circulating market cap has decreased significantly (-63%). Growing supply and falling market cap is an alarming combination for the network, especially with the market cap dropping 89% in 2022.

Quarterly revenue:

Quarterly revenue has also declined significantly in Q4, dropping 61%. The revenue has been in decline all of 2022, and is currently down 84% year-to-date.

Circulating supply P/S:

The circulating price-to-sales ratio has increased in Q4, which is another negative for the Solana network financials. The goal for the network is to have a lower P/S ratio, meaning that it is undervalued relative to its revenue. Since Solana's quarterly revenue decreased 61% and price decreased by 65%, the P/S has increased by 52%. Even with Solana decreasing in price, it is still overvalued relative to its revenue.

Ecosystem

Total Value Locked (TVL) measures the total value of all assets locked into DeFi protocols, including staking, lending, and liquidity pools.

TVL on Solana has been decimated in Q4 2022, declining 88%. This drawdown was fueled by the hack of Serum protocol, which was one of the largest DeFi protocols on Solana. Despite the significant decline in TVL, several projects including Ellipsis

Labs, Drift, Friktion, and others are creating new models in the DEX space, which have the potential to re-catalyze on-chain growth.

Active Programs:

The number of active programs is an important metric for tracking the growth and development of the Solana ecosystem. An active program is defined as an application with at least one successful daily instruction based on a single program address. Q4 was the only quarter in 2022 where active programs decreased. The rate of increase had been significantly slowing down throughout 2022, so Q4 was finally the time where users have started to migrate from the ecosystem relative to other quarters.

Sentiment Overview

NVTweet Ratio:

Per the Tie, The NVTweet Ratio compares a cryptocurrency's social conversation to its Market Cap. The NVTweet Ratio looks at how many tweets a particular coin has per \$1M in Market Cap. The lower a coin's NVTweet Ratio, the more tweet volume it has per \$1M in Market Cap. The NVTweet Ratio for Solana has decreased significantly in Q4, down 54%. The tweet volume per \$1M in market cap has rapidly slowed down.

Hype-to-activity ratio:

Per the Tie, Hype-To-Activity ratio measures the number of tweets a particular coin has per each \$1M in reported trading volume of that coin. High Hype-to-Activity™ Ratios suggest that a particular cryptocurrency is overhyped in social conversations relative to the amount of trading activity that it has. That being said, Solana's ratio has increased a whopping 153% in Q4. Solana may be overhyped, based on the Hype-to-Activity Ratio

Qualitative Analysis

Solana broke into the cryptocurrency industry as a layer-one solution with low transaction costs and fast transaction speed. Some users call the venture-backed network the “Ethereum Killer”. In line with the current trends in 2022, Solana has implemented three innovations that are setting it apart from other layer-one solutions: Solana Gaming, Solana Mobile, and Solana NFT

Solana Gaming

Solana’s blockchain-based gaming platform has been a driving factor in Q4 2022. Star Atlas remains the most popular game on Solana. Players in this game can explore the metaverse, collect resources, build their own space station, and compete against other players in missions and challenges. They can also trade resources and build fleets of ships to further customize their experience. Other popular games include Aurory, MonkeyLeague, and Nyan Heroes.

Solana Mobile

The open-sourcing of the Solana Mobile Stack (SMS) for Android is still underway. The SMS will enable native Android Web3 applications on Solana. In addition, Saga, the first Solana Mobile Android phone, will begin shipping with the SMS by Q1 2023. These developments aim to bridge smartphones and bring unique functionality and features that will tightly integrate with the Solana blockchain. Its features will include the open-source messaging application that Dialect and Solana Mobile are building. For Saga and SMS to succeed, more partnerships like the one with Dialect should be sought out.

The short-term roadmap for Solana Mobile consists of three initiatives:

1. Saga dev kits are scheduled to start shipping in mid December 2022.
2. Solana Mobile dapp store applications open in January 2023.
3. Saga phones will be available to the public in early 2023.

Solana NFT

Magic Eden remains a popular NFT marketplace on Solana. The marketplace takes a 0% listing fee and 2% transaction fee. Magic Eden takes pride in being the most liquid NFT marketplace on Solana with the most popular creators in the community. It has approximately 18 million daily active users (DAU).

Decentralization and Geographic Distribution

While Solana has all the components to create a smart contract based platform for NFT's, gaming, and even for smartphones, there are other ways to evaluate how valuable the chain is for users across the world.

The Solana Foundation has verified 2,379 consensus-producing validators, as of December 20, 2022 – with a total stake of approximately 365 million SOL.

On Solana, the Nakamoto Coefficient is 30. This means the lowest number of validators that would have to collude to censor the network is 30, which is down slightly from 31 in Q3 2022. However, this number has grown steadily since the chain's launch in March 2020, and its growth is a key indicator of the health of the network.

The decentralization of Solana also stems from the geographic distribution of its validators. Currently, validators are distributed across more than 35 geographic locations. Approximately 45% of Solana validators and 40% of the total stake are located in the U.S. and Germany. The "other" locations make up just under 30% of total stake but consist of more than 25 different countries. Solana aims to address the issue of geographical concentration, which is a common problem for Layer-1 networks. Having too many validators in the same location can pose risks to the network's health, including geopolitical risks, regulatory concerns, and natural disasters. By addressing this issue, Solana aims to ensure the stability and reliability of its network.

Conclusion

The current drawdown for Solana is inherently fueled by the FTX saga and the broader bear market in general. As a result, many of the most important statistics for the growth of the ecosystem are down significantly in Q4 of 2022. While network use and finances are down, the health of the network is still intact with Solana's industry leading Nakamoto Coefficient of 30 and its continued reliance on having an innovative rate of transactions per second of about 50,000 TPS. With its decentralization being one of the highest out of all layer-one coins and validators still playing a role in the ecosystem, Solana's network is still up and running successfully and open for development.

The Solana Foundation and SolanaLabs have huge goals for creating Solana Mobile as well as build out Solana's GameFi ecosystem and its NFT marketplaces. As Q4 comes to a close, the BBA Research Team suggests that 2023 will be a decisive year for both traditional markets and cryptocurrencies. Under control of macroeconomic factors, the future value of the Solana network is constrained by international monetary policy. However, it will be important to track network financials, such as quarterly revenue, and network usage, such as average daily non-consensus transactions. With the value of Solana's price dropping so drastically by over 95% from Q4 2021 to Q4 2022, investor sentiment is at an all time low as the FTX scandal and broader deleveraging is being completely flushed out of the cryptocurrency ecosystem.

Solana has the potential to take back its place as a top-10 cryptocurrency. If not, Solana could drop much lower. Solana's TVL has dropped over 90%, as developers and network users are becoming increasingly aware of the potential contagion within the network and cryptocurrency industry as a whole. All of these factors lead to the ultimate question for 2023:

Is the Solana network undervalued, or is there more to be uncovered as regulation looms over the cryptocurrency market after a groundbreaking, controversial year in 2022?

Avalanche (AVAX)

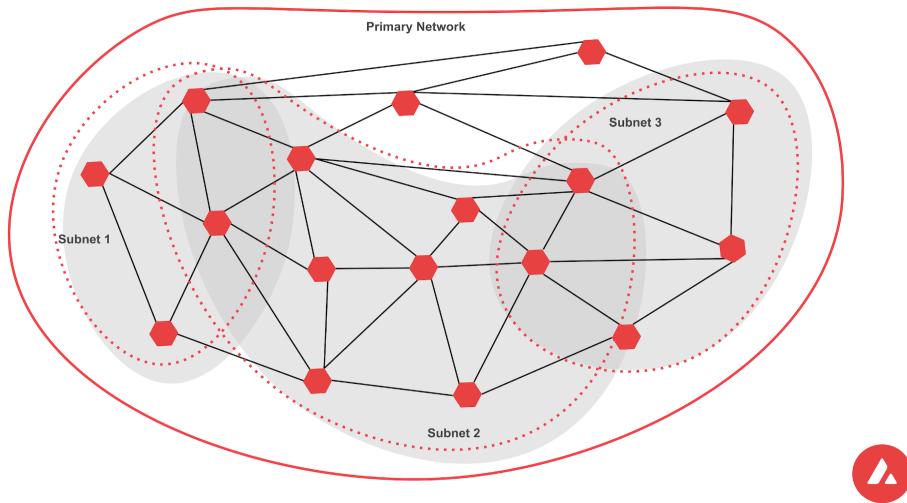
Key Insights:

- Q4 saw financial struggles continue as the value of the AVAX token returned below market average. However, Ava Labs continues to focus on infrastructure building with the release of new development software and incentive programs.
- Avalanche surpassed 500 million total transactions.
- Avalanche launched natively on OpenSea.
- Banff, the latest version of Avalanche Go, went live. This completed the launch of Elastic Validation and allows for builders to have more options when customizing their subnets.
- Ava Labs partners with GREE to accelerate the growth of Web3 gaming through ecosystem investments and subnet development.
- Release of the Rust software development kit (SDK) allows developers to build custom virtual machines on Avalanche making it easier for devs to build their own blockchain on Avalanche.

Chain Overview:

Avalanche is a proof-of-stake (POS) smart contract platform for launching decentralized applications and enterprise blockchain deployments. It is a highly scalable and interoperable network with near-instant transaction finality that was created and operated by Ava Labs. It differentiates itself from other decentralized networks by utilizing a unique consensus protocol made up of a multichain framework. This framework utilizes three chains: the Platform Chain (P-Chain), the Contact Chain (C-Chain), and Exchange Chain (X-Chain). Each chain has a unique role and they are validated and secured by all the Avalanche validators. These validators compose a special subnet referred to as the Primary Network that, by definition, validates Avalanche's three built in blockchains. And the use of Subnets is crucial to how Avalanche operates. Subnets are subclasses of Primary Network validators that function as sovereign networks with their own rules regarding membership and tokenomics. These subnets run on the same VMs as the Primary

Network, and can enable different properties of reliability, efficiency, and data sovereignty while providing the ability to create custom blockchains for different use-cases. Additionally, developers can program smart-contracts using Solidity, a programming language influenced mainly by C++ as well as Python and JavaScript.



Visualization of Avalanche's Subnets Operating Within the Primary Network (Avalanche: Subnets Overview)

Q4 Narrative:

As the cryptocurrency market continued to struggle, AVAX (Avalanche's native token) fought to keep up with other top coins. The collapse of FTX wiped billions of dollars in market cap from many of the top cryptocurrencies, and AVAX was not an exception. The value of AVAX dropped 30.78% quarter to date whereas Bitcoin and Ethereum only fell 20.53% and 24.89% respectively. Although this seems discouraging, Avalanche has focused their efforts on creating a strong network infrastructure through the release of new development software kits and developer incentive programs.



State of the Network

Despite the falling value of the AVAX token, transaction volume has grown over the last quarter. In fact, Avalanche surpassed 500 million total transactions as total transactions increased by 1,507% from November 2021 to November 2022. When looking at Q4 specifically, there has been a 1.97% growth in average daily transactions. This demonstrates that network usage is still fairly high among the active developers and users of the network. Given the macro-conditions of the crypto market, it is encouraging to see that activity on the Avalanche blockchain is still holding steady.

Effect of Macro-Conditions on Avalanche

The macro-environment has taken its toll on Avalanche over the past year. AVAX got off to a strong start heading into 2022. AVAX was trading around \$110 a coin at the start of the year and reached a market cap of over \$28B. Then, in April and May, equity markets around the world started to lose value as a result of the

Russia-Ukraine conflict and global supply chain issues. Supply and demand along with investor sentiment and economic policy changes affect both equity markets and cryptocurrencies. Hence, the value of AVAX started to fall as global economic conditions worsened.

Then, when Terra Luna collapsed in mid-May, the value of AVAX tanked. At the time, the Luna Foundation Guard held 1.97 million AVAX tokens (worth \$53.89 M at the time), however they did not sell any AVAX to shore up UST's value following the depeg. Rather they sold a lot of their Bitcoin, Binance coin, and Luna holdings. Despite not selling any of their AVAX holdings, the panic around the collapse of Terra caused the value of the AVAX token to fall from around \$78 a coin to around \$30 a coin from 4/21/22 to 5/21/22. This wiped out over \$13B dollars in market cap and knocked AVAX out of the top 10 cryptocurrencies by market cap.

AVAX continued to lose value heading towards the end of the second quarter. This was followed by a rally that regained almost \$4.5B in market cap. The rest of Q3 saw a steady decline in the value of AVAX leading up to the collapse of FTX. Luckily, FTX did not hold any AVAX on their balance sheet. As a result, the price of AVAX fell approximately 27%; this was pretty consistent among other leading cryptocurrencies not held by FTX. The rest of Q4 has been very stable for AVAX with the price sitting around \$13 a coin. The crypto market has been searching for direction following the collapse of FTX. Therefore, AVAX will most likely remain steady unless there is market divergence. This allows for Ava Labs to further build out Avalanche's infrastructure and focus on development during this crypto market lull.

Performance Analysis:

State of AVAX Q4 2022

Quarterly Metrics	Q1 2022	Q2 2022	Q3 2022	Q4 2022
Network Usage¹				
Average Active Daily Addresses	94,082 <i>32.80%</i>	63,327 <i>(32.70%)</i>	38,553 <i>(39.10%)</i>	29,708 <i>(22.94%)</i>
Average Daily Transactions	864,446 <i>84.20%</i>	538,351 <i>(37.70%)</i>	1,878,2369 <i>248.89%</i>	1,915,265 <i>1.97%</i>
Network Financials²				
Circulating Market Cap	\$25,725,736,661.00 <i>4.3%</i>	\$4,967,701,617.00 <i>(80.70%)</i>	\$5,129,624,506.00 <i>3.30%</i>	\$3,721,420,775.00 <i>(27.45%)</i>
Quarterly Revenue	\$52,286,902.00 <i>72.70%</i>	\$39,226,599.00\$ <i>(25%)</i>	\$2,311,908.00 <i>(94.10%)</i>	\$1,342,279.00 <i>(41.94%)</i>
Circulating P/S Ratio	92.49x <i>(42.50%)</i>	381.86x <i>312.87%</i>	669.53x <i>75.33%</i>	863.6x <i>28.99%</i>
Ecosystem³				
Total Value Locked (TVL)	\$11,098,770,502.00 <i>(5.90%)</i>	\$2,673,176,222.00 <i>(75.90%)</i>	\$1,938,092,895.00 <i>(27.50%)</i>	\$802,110,000.00 <i>(58.61%)</i>
Quarterly Contracts Created	7,750 <i>154.52%</i>	23,480 <i>202.97%</i>	61,730 <i>162.90%</i>	63,460 <i>2.80%</i>
Sentiment⁴				
NVTweet Ratio	33.36 <i>45.93%</i>	7.88 <i>(76.88%)</i>	12.31 <i>56.22%</i>	10.61 <i>(13.81%)</i>
Hype-to-Activity Ratio	0.54 <i>(53.33%)</i>	1 <i>85.79%</i>	1.21 <i>21.00%</i>	2.24 <i>85.12%</i>

Sources: Avalanche Explorer¹, Token Terminal², DeFi Llama and the Dune³, The Tie Terminal⁴
 Footnotes: The percentage values in italics are quarterly changes

Data as of December 20, 2022

AVAX is currently trading around \$11.80 a coin, and has a market cap of \$3.67B. It ranks number 19 by market cap across all cryptocurrencies which makes Avalanche one of the leading smart contract blockchains by market-cap. However, following the Luna de-peg and FTX collapse, Avalanche has struggled to reclaim the relative position they were in at the end of 2021 where it ranked 10th by market cap. Despite the falling value of AVAX, activity on the chain has grown during Q3 and Q4.

Network Usage:

When looking at Avalanche's active daily addresses, there has been a continuing decline over the last three quarters, with Q4 seeing a 22.94% loss in active daily addresses. This means that less and less users are active on Avalanche's blockchain. However, when looking at Avalanche's average daily transactions, there has actually been strong growth over the last two quarters. Q3 saw a 248.89% increase in average daily transactions. This means that despite the declining amount of users on the Avalanche blockchain, those that are active are generating really strong

transaction volume. This transaction volume can most likely be accredited to voting/consensus transactions considering economic activity and trading volume on the chain was relatively low compared to Q1 and Q2. With Q4 seeing slowed continued transaction volume growth, it can be determined that there is currently a strong community of committed developers and users that are working on building out the infrastructure of the network as many users are leaving due to the falling economic value of AVAX.

Network Financials:

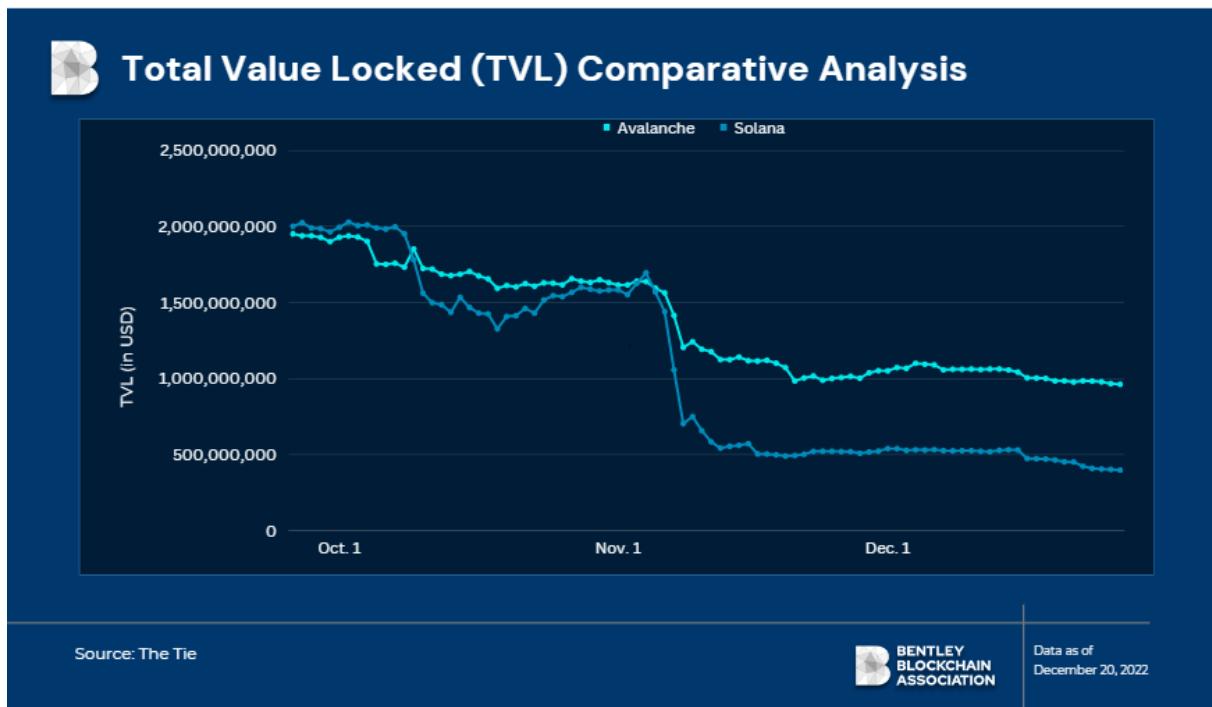
Following the Luna de-peg, AVAX lost more than 80% of its market cap over the course of Q2. After regaining some of its market cap in Q3, AVAX lost 27.45% of its market cap in Q4. A loss of this size was pretty consistent with other top cryptocurrencies following the FTX collapse. Quarterly network revenue on the Avalanche chain also saw a large loss over the last two quarters. Network revenue is the fees paid by users to the network for transactions, and strong revenue can help support a healthy and growing network. In Q3 and Q4, Avalanche's quarterly revenue dropped 94.1% and 41.9% respectively. This loss put a lot of downward pressure on the price of AVAX. However, the lower transaction fees may have helped promote more on-chain development since it costs less to generate transactions. When looking at AVAX's circulating P/S ratio, it appears that the token is becoming increasingly overvalued. The circulating P/S ratio has grown quarter over quarter, and despite the falling value of AVAX, the P/S ratio still signifies that the token is overvalued.

Ecosystem:

Total Value Locked (TVL) on the Avalanche chain has fallen every quarter this year. Although, TVL has fallen across all chains this year as DeFi protocols have struggled to grow due to macro-conditions. Avalanche specifically has five leading DeFi protocols that hold the majority of its TVL. These protocols are AAVE, Benqi, Stargate, Trader Joe, and GMX. AAVE holds the majority of Avalanche's TVL at 37.65% or \$292.1M in assets. However, Stargate, a cross chain protocol, has seen significant

growth over the last quarter whereas the majority of DeFi protocols have seen contraction.

When comparing Avalanche's TVL to Solana, it is comparatively strong. Before the collapse of FTX, Solana had a market cap that was more than double Avalanche's. Yet, Avalanche's TVL was very similar to Solana's. This indicates a strong TVL to market cap ratio and a healthy network ecosystem. The collapse of FTX affected the TVL of Solana and Avalanche differently. Since FTX was a majority stakeholder of Solana, Solana's TVL tanked along with its market cap. With the economic value of both Solana and Avalanche remaining relatively steady over the last month, the TVL of each of these chains will most likely remain steady as well until there is a change in market direction.

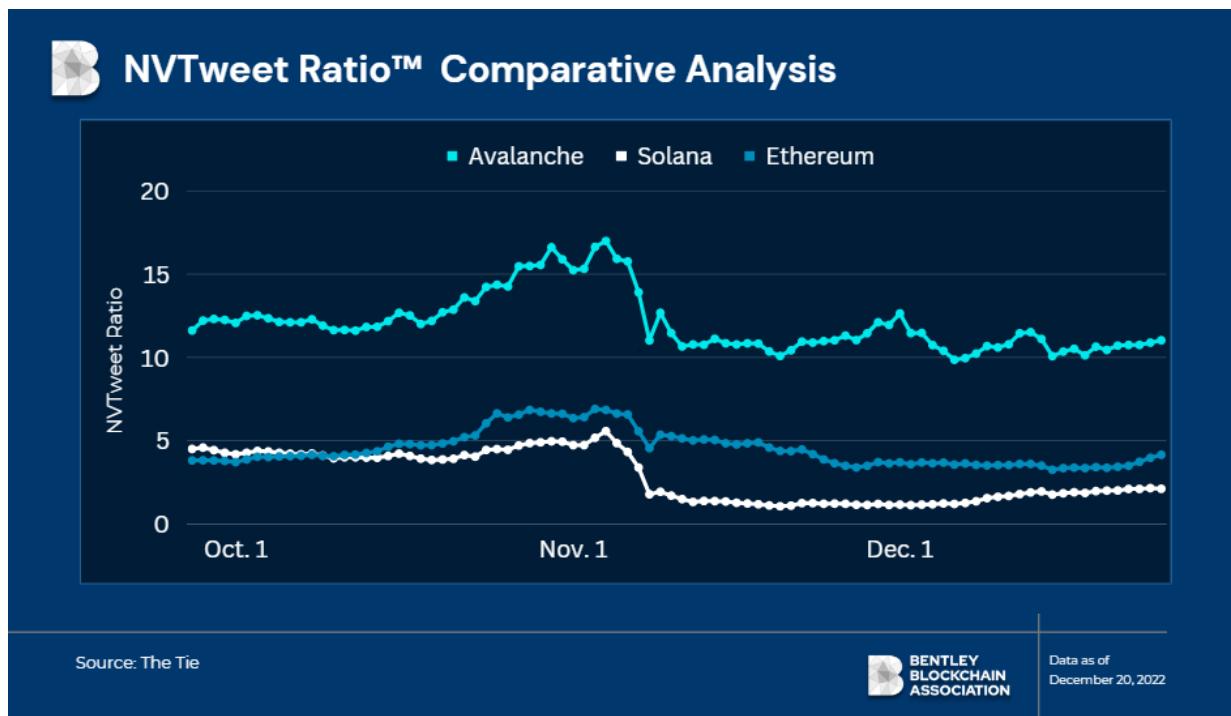


Avalanche's most promising metric is its quarterly contract creation. Over the course of 2022, contract creation has grown quarter after quarter with Q2 and Q3 seeing significant growth rates at 202.97% and 162.90% respectively. Contract creation remains high in Q4 but the growth rate has slowed down to 2.80%.

Increasing contract creation indicates heavy network development and growth. With Ava Labs focusing on network infrastructure and development, it is promising to see their efforts are paying off despite poor market conditions.

Sentiment:

Avalanche's sentiment relative to its market cap could be a lot better. The Tie developed a NVTweet Ratio™ that compares a cryptocurrency's social conversation to its market cap. It is measured by examining how many tweets a coin has per \$1M in market cap. A lower NVTweet Ratio™ means that there are more tweets per \$1M in market cap. As seen in the graph below, Avalanche has a relatively poor NVTweet Ratio™ as its ratio is a lot higher than that of Ethereum and Solana. To compete with other Layer-1 blockchains and grow as a leading smart-contract platform, Avalanche needs more social conversation. Ethereum and Solana are both large names in the crypto space and there has recently been a lot of buzz around Solana following the collapse of FTX. However, Solana's sentiment has been mostly negative over the last quarter and a low NVTweet Ratio™ may not necessarily be a good thing. Going forward, Avalanche should look to generate more positive sentiment around the network to attract more users and developers.



Qualitative Analysis:

Avalanche Decentralization

Avalanche has a very healthy ecosystem that is primed for scalability and growth. One metric that aids in understanding ecosystem health is the Nakamoto coefficient. This is defined as the minimum number of nodes that must be compromised to alter block production in a network. Avalanche has a fairly strong Nakamoto coefficient of 26. This means that the Avalanche network is very censorship-resistant, and any user can be confident that their usage of the network won't be disrupted.

Comparatively, Avalanche also has a lot of validators staking on the network. Avalanche has over 1,100 validators while other popular Layer-1 networks like Solana and Polygon have 1,911 & 100 respectively. Each network can determine how many validators it has and Polygon decided to cap its validator count at 100. This gives the network more control over a smaller number of trusted validators. However, this also makes Polygon more vulnerable in terms of decentralization. Decentralization is crucial to supporting a healthy ecosystem. The more validators a network has, the more secure the network is in retaining data storage and network function in the event of a system failure or breach. This is because each validator represents a separate copy of the current network state, and many validators would have to become compromised for the network to fail.

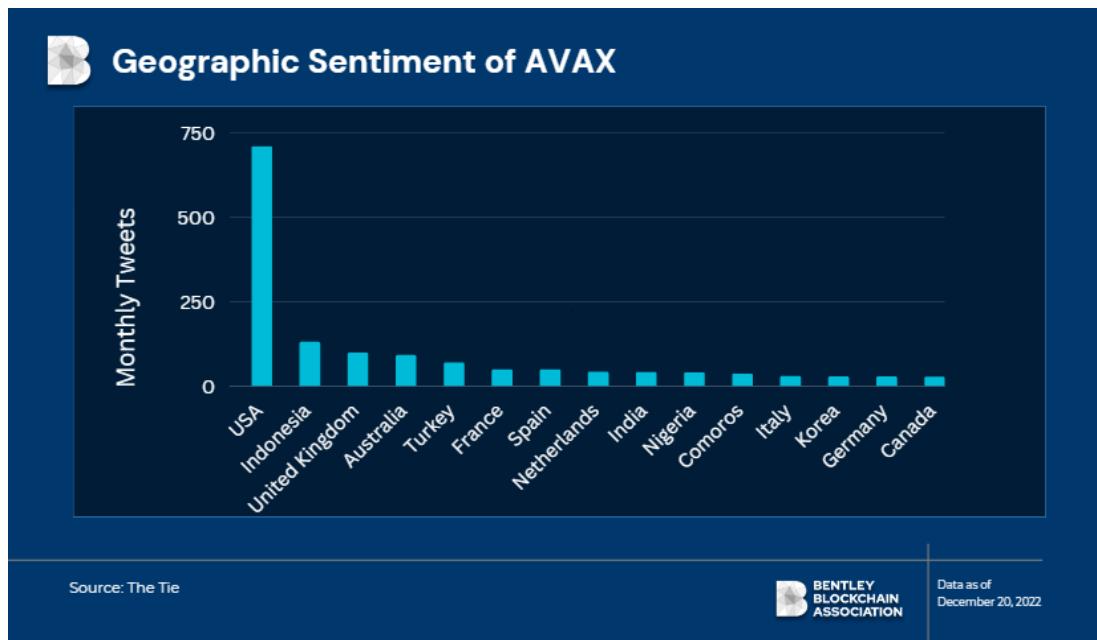
Q4 Developments

Earlier in the quarter, Banff, the latest version of Avalanche Go, went live. This completed the launch of Elastic Validation and allows for builders to have more options when customizing their subnets. To further enhance development opportunities on Avalanche, the Avalanche team launched the Rust software development kit which allows developers to build custom virtual machines on Avalanche making it easier for devs to build their own blockchain on Avalanche. Then to incentivize development, StackUp (a learn-and-earn platform) launched an

Avalanche developer course with a prize pool. Avalanche also took steps to enhance user knowledge by partnering with Robinhood to create a learn and earn program to educate users about the network. And most recently, Ava Labs released Avalanche Warp Messaging (AWM) to allow for native communications to all Subnets. This will allow developers to build their own VM and interoperate with other Subnets without the reliance on bridges as well as additional communication capabilities.

Additionally in Q4, Ava Labs branched further into the Web3 gaming environment as they partnered with Japanese gaming giant GREE to accelerate Web3 gaming growth through ecosystem investments and subnet development. Additionally, Avalanche launched natively on OpenSea (the largest NFT marketplace) which will allow for higher trade volume of NFTs on the Avalanche network.

Geographic Diversity



Avalanche is a globally diverse protocol with users and developers from all over the world. Avalanche's largest markets by trading volume/wallet activity are located in the U.S. and Asia. And although trading volume is a very strong indication of market size, consumer sentiment in these markets is also crucial to the development and

success of growing protocols. The U.S. tweets by far the most about Avalanche with Indonesia and the U.K. following behind. Having strong consumer sentiment in the U.S. is important as it has a large crypto market and it is an innovative leader in the space. When looking at wallet activity on global exchanges, Binance has recently seen the most 24 hr trading volume with \$9.81M. Coinbase (a U.S. exchange) and HitBTC (a Chinese exchange) also have considerable 24 hr trading volume with \$3.34M and \$2.67M respectively. This statistic conveys Avalanche's global presence as it is traded on exchanges all over the world. As Avalanche continues to grow as a leading smart-contract protocol, it will branch into new markets as well as further penetrate markets where it is already located.

Conclusion

The crypto bear market has been exacerbated by the collapse of FTX and all Layer-1 blockchains have seen large financial losses as a result. And although Avalanche saw decreasing users and poor financial performance in Q4, Ava Labs took many initiatives to grow the network through the release of development software and learn and earn programs. Ava Labs took advantage of the crypto market lull to build out the infrastructure of their network and create a developer friendly environment. This can be seen through their rising contract creation and daily transaction rate. Creating a strong network infrastructure now will provide benefits in the long run and allow Ava Labs to focus on scalability and network maintenance as economic activity picks up again.

Ava Labs also made huge strides in user awareness with their partnership with Robinhood. Educating users about their network can generate a lot of value creation as more informed users can become more invested in the network, and provide more valuable feedback. Their investments in Web3 gaming will also provide valuable returns. Ava Labs' partnership with GREE will allow BLRD (a GREE subsidiary) to break into the blockchain gaming space. Avalanche will gain ecosystem development and strong credibility if the launch of BLRD's first Web3 game in 2023 goes smoothly. 2023 will be an exciting year for Avalanche as they will continue to venture into new spaces and develop a secure and scalable network infrastructure that will be primed to reclaim its position as a leading Layer-1 blockchain.

Q1 2023 & Beyond

As we begin 2023, the global economy is in a very vulnerable spot with elevated inflation, geopolitical tensions, energy crisis, and more, as macroeconomics around the world feel the effects of Covid-19 lockdowns and stimulus injections. In efforts to control these variables federal banks and governments around the world have stepped in to help, control, and mend macroeconomic conditions.

To tame inflation we are seeing federal banks around the world hike rates at faster paced than ever seen before. For example, the US Federal Reserve has raised interest rates 7 times to its current level of 4.25–4.5% to tame inflation. Also, the Bank of Japan, who is often considered the most resistant to interest rate changes, just moved their risk free rate off of 0% for the first time. This indicates the rate increases are well justified and no joke.

Moving into 2023, it seems as if the extreme efforts of Federal Banks is working as global inflation is falling and will continue to do so. With this data, interest rate hikes by Federal Banks will most likely see a pause in Q1 2023 as per the BBA Research Team. At this moment is when equity, bond and crypto markets should have bottomed and a recovery is within reach. While a pause in interest rates hikes would indicate a market bottom, it is important to remember markets think ahead and the overall economy may still fall into recession which the BBA team is confident will happen in Q2 or Q3 2023. From here, equity earnings may be re-priced into their market values, consumer data may worsen, and interest rates may stay elevated. The depth and severity of the recession, would indicate how quickly crypto, equity, and bond prices would recover.

While a market bottom is indicated by the pausing of interest rate hikes most likely in Q1 2023, the recovery will be interrupted and prolonged as the economy then falls into a mild recession the BBA Research Team believes will last until 2024. No 'V' shape recovery this time around and all time highs in equity and crypto markets will most likely hold off until 2024.

Also, governments around the world are on high alert. Many at-risk nations, stakeholders in geo-political events, or their alliances are frantically meeting with each other to resolve disputes and prevent another world war type of conflict. For example, Joe Biden recently visited the Middle East to discuss oil prices with OPEC, President Zelensky visited the white House to discuss the U.S's position in the Russian invasion of Ukraine, and Europe is actively seeking potential partners and alliances to help replace their oil supplies.

In Q1 2023, these geopolitical meetings and events will continue and may even intensify, especially as winter deepens in Europe and North America increasing the demand for energy. As 2023 progresses, keeping eyes on Russia and China will be increasingly important as the Russian invasion of Ukraine lengthens and the Taiwan situation matures. These two countries are the largest and most influential countries not a part of or involved in alliances with NATO and a disagreement or dispute between these two parties would be detrimental to the global efforts to repair the world's macroeconomics.

These estimations are barring an unforeseen circumstance and are based on current data. Unforeseen circumstances like a surge in inflation data or increased geopolitical conflicts regarding Russia, China, or the Middle East would negatively impact these estimations.

Bitcoin Cycle:

The Bitcoin cycle is based on mining and the new supply entering circulation from it. Currently, there are 1,923,819 million BTC in circulation and every time a block (a number of transactions fitting into it) is mined, 6.25 new BTC are added to circulation as miner rewards. Every 210,000 blocks mined, the production or new supply of bitcoin gets cut in half and the time it takes to mine 210,000 blocks is dependent on transaction frequency, sizes, and overall storage capacity of the block (which is commonly accepted to take just over 4 years). These halving events drive Bitcoin cycles as the market price in lower supply growth and inflation. After a halving event, the markets typically rally as scarcity becomes real and the current supply of BTC increases the value. For this cycle starting May 11th, 2022, we experienced a bull run

after this last halving until the end of 2021 when the bear market took over bringing the market to its current state.

Currently, the Bitcoin network has a block height (total number of blocks mined) of 768,373. This includes 210,000 blocks mined for the first cycle, 210,000 blocks for the second cycle, 210,000 blocks during the third cycle, and 138,373 blocks in the current cycle. With that, the cycle is 65.9% complete and has 71,627 blocks left until 210,000. Comparing this BTC cycle with prior cycles, it is clear that the 60%-70% completion range is a very important, established, and consistent pattern as the bull market has come and gone and the bear market seems to be on its last legs.

The following 35% of the cycle is a consolidation period and moves off of cycle lows as we prepare for the next halving event and thus, bull market. Also, the last 3 cycles have seen peak to trough declines of 94%, 84%, and 83% respectively. This cycle we saw peaks of \$68,789 and lows of ~\$15,500 for roughly ~77% declines. Considering cycle peak to trough declines have trended upward slightly, with the last one being an 84% decline, the current cycle down 77% indicates most of the damage seems to be done. Analyzing the status of the current cycle compared to the past three cycles at 65% completion, and the current peak to trough declines vs prior declines, the BBA Research Team predicts Q1 2023 to be the last quarter to test or make cycle lows which then should concede to a period consolidation off lows for the remaining 30-35% of the cycle as we prepare for the next halving event in April, 2024. This estimation from the BBA Research teams is barring any large external influence like, but not limited to, an overly hawkish FED or additional bankruptcies/collapses in the cryptocurrency landscape.

Bitcoin Price (Black) and supply growth (yellow). An analysis of prior cycle statuses (blue) and peak to trough declines (red) are compared to the current cycle data.

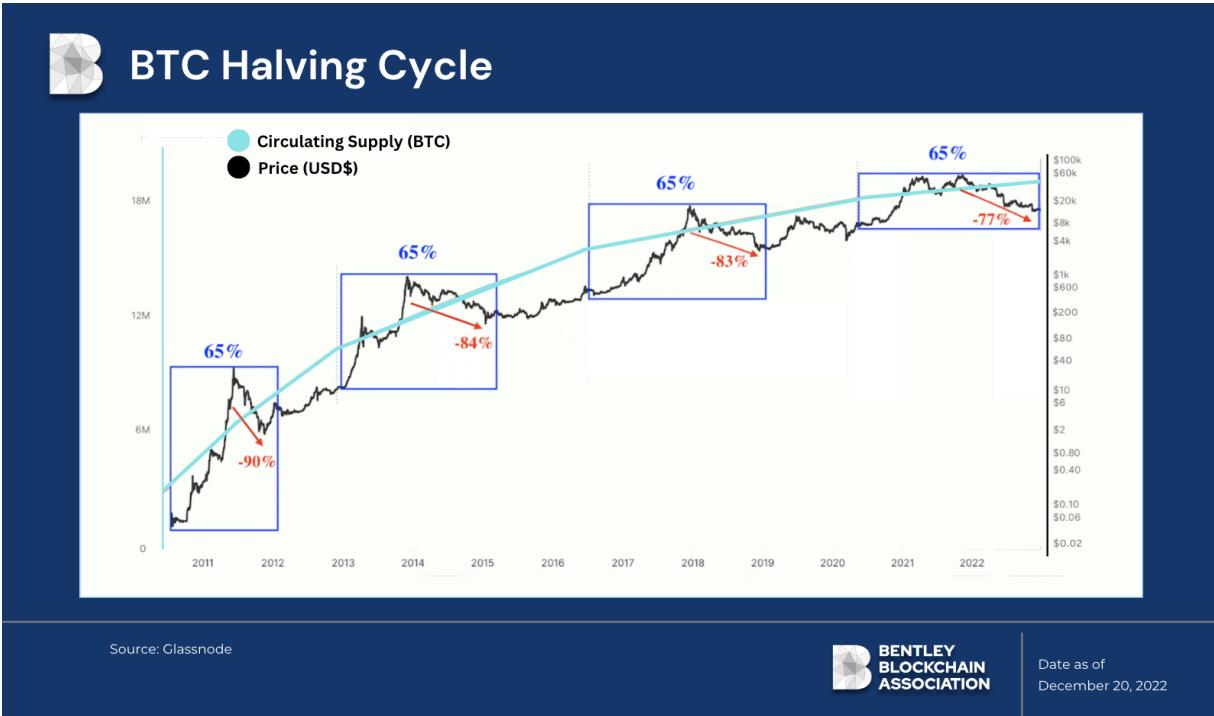


Chart visualizes Bitcoin circulating supply (light blue), Bitcoin price (black), 65% complete halving time frame (dark blue), and peak to trough drawdown during cycle (red). Chart as of 12/20/22.

U.S. CBDC Development

CBDC Overview

Currently, there are a handful of programs working to develop a secure and scalable U.S. CBDC. Not only are institutions looking to conduct research and development for a U.S. CBDC, the U.S. government is prioritizing development as well with Executive Order 14067. A well-structured CBDC system could safely offer the general public digital money that is free of credit risk and liquidity risk. It would also allow for firms to innovate financial services to meet the rapidly evolving digital economy. On the consumer level, a U.S. CBDC could promote financial inclusion by offering a cost-effective and efficient way to pay taxes, receive wages, access credit, and more. Lower transaction costs could greatly benefit lower-income households who feel the burden of high fees and long transaction processing time. These goals are set in mind for those developing hypothetical architectures.

Project Hamilton & The NYIC Pilot Program

One of the leading CBDC development programs is Project Hamilton. MIT's Digital Currency Initiative has partnered with the Federal Reserve Bank of Boston to explore technical design considerations for a possible U.S. CBDC. They have gotten to experiment hands-on with different architectures to learn more about the efficiency, security, scalability, and more of a potential CBDC infrastructure. In Phase 1 of the project, they put forth two possible architectures, the atomizer, and a 2PC design. Looking ahead to 2023, Project Hamilton aims to explore further possibilities and security measures that can be implemented to create the most efficient and secure CBDC infrastructure possible. This includes quantum resistance and utilizing cryptographic primitives that are resistant to classical, quantum, and hybrid attacks. They also want to investigate the plausibility of offline payments.

The Federal Reserve Bank of New York and New York Innovation Center (NYIC) have also recently taken a huge step in CBDC development as they have launched a proof-of-concept project to explore the feasibility of an interoperable network of CBDCs and commercial bank digital money. To achieve this, they utilized distributed ledgers to enable a common source of truth for asset exchange. The goal of this project is to determine the feasibility of distributed ledger technology in an interoperable CBDC infrastructure as well as to discover design considerations for the concept.

What's Next?

Looking ahead, there is still more research to be done before the U.S. is ready to launch a full-scale CBDC. Project Hamilton and the NYIC pilot program are two of the leading CBDC projects. The research findings from these projects will help build the foundation for further research and development of a U.S. CBDC infrastructure. There has been a lot of progress over that last year, and it is up to the Biden Administration to help guide the next steps. Given that the Biden Administration is strongly encouraging the development of a CBDC, it is possible that in 2023, we could see another executive order similar to Executive Order #14067 with more direct guidance to ensure a U.S. CBDC launches sometime in the near future.

Correlation of Equity Markets and the Crypto Market

COVID-19 Pandemic Effect on Market Correlation

Cryptocurrencies used to be an obscure form of digital money that acted as a hedge against swings in other markets. Before the pandemic, there was little sign of any correlation between large crypto assets like Bitcoin and Ethereum with major stock indices. Things have since changed. The market value of these novel assets rose to nearly \$3 trillion in November 2021 from \$620 billion in 2017 and since then, the industry staple, Bitcoin, is no longer considered to be on the fringe of the financial system. Ever since the powerful central bank crisis response of 2020, both crypto and equities have surged. When looking at recent data, Bitcoin has behaved more like the S&P 500 than an asset thought to have been built to be unrelated to it. For example, the correlation coefficient of both assets daily moves used to be just 0.01, but that number has jumped to 0.36 since 2020–22.

What Variables Cause Market Correlation?

Investor sentiment and income are two factors that played a large role in the correlation between Bitcoin and the equity market. When we acknowledge the central bank crisis response in 2020 for COVID, we can understand that stimulus checks and lack of consumer spending would have contributed to households having a higher income level. To add, Bitcoin is quickly becoming a mainstream, innovative asset class that provides unique use cases. It is possible that the new correlation between these asset classes now exists because people have more money to invest into assets, and digital assets could be considered a new investment strategy. The hype around that concept has driven everyone to dabble in the market, ultimately making the market just as, if not more volatile than the equity market. With this, we can assume that there is a correlation because there has been a significant influx of naive crypto market participants who are acting, as they also would in the equities market, principally because of the fear of missing out (FOMO/hype) and artificially well-endowed wallets.

FTX and Luna's Effect on Investor Sentiment

The Luna de-peg was a monumental moment for the crypto industry. Do Kwon, the founder of Luna, was seen as competent and trustworthy before his project collapsed overnight. While billions were lost, the more piercing impact of this event was that it tainted the narrative of crypto in people's minds. The recent FTX collapse is another example of this, but on a significantly larger scale. Well known, sophisticated investors like Sequoia Capital, SoftBank and Kevin O'Leary invested into FTX with 'confidence' and that made retail investors confident in doing so as well. When FTX collapsed, also overnight, this had rippling effects throughout the industry that severely damaged the narrative behind crypto. People have lost faith in the asset class and only those truly understanding the underlying technology and its use cases know that it will take time for a new, more positive narrative to take hold. The development and progress that will come along with this next narrative will mark an inflection point in the maturity of crypto as a whole.

Looking Ahead

Once the idea of crypto matures as an assets class, when regulation protects the players, when people no longer feel FOMO over every little announcement, when people start to reach a common belief about which assets are purposed for what, that's when we'll see Bitcoin lose it's correlation to the S&P. Being said, other digital assets might just as well follow the equity market indefinitely because it makes sense. Bitcoin was meant to be a store of wealth, like the US dollar, and it could act like that when it matures as mentioned above. As for the other digital assets, they were not necessarily built to act like digital gold, so it's reasonable to assume that they will likely be correlated with equities, and will be influenced by similar factors such as sentiment, income, and market conditions. There is positive correlation between the crypto market downturn following FTX collapse and the S&P. Why? Crypto has gotten so large that it's intricately associated with other markets now, and that means when it's affected in some way, so are other markets.

What to Expect in 2023

2023 looks to further enhance blockchain technology to become more secure, scalable, and applicable. *Digital identity* will be revolutionized through projects such as POAP, ENS, and SBTs. These seemingly futuristic concepts will help develop a more 4-dimensional digital identity that interweaves our physical and virtual lives. It will also help create better governance and proof-of-personhood online. As we move into 2023, developers are expected to continue building out these programs and look to attract users.

2023 may also be an exciting time for *infrastructure building* as developers on Ethereum aim to move forward with creating more scalable and efficient networks. With improvements in zk systems, zk-zk rollups, and other innovations in scalable privacy, Ethereum is expected to be able to process tens of thousands of transactions per second in a way that is both scalable and confidential. Advancements in fully-programmable, private smart contracts, private NFTs, identity tokens, and programmability to unlock public DeFi protocols that interact with anonymized holdings will be further realized in 2023. This will also bring opportunity to bridge fragmentation between zk languages and smart contracts.

Institutional adoption is imperative for the growth of blockchain networks. Following the collapse of FTX, there has been a lot of hesitation from institutions to invest in blockchain. However, with time, the demand for crypto-related services and products will continue to surge, and more companies will be investing in blockchain technology and engaging in crypto-related activities. It is expected that companies will also be launching their own tokens, as well as building blockchain-based platforms and applications. This will lead to more mainstream adoption of crypto, and the industry will continue to expand.

Finally, *social applications* powered by blockchain will continue to gain traction in the coming year. These applications will leverage blockchain technology to enable users to securely store and transfer data, including messages, pictures, and even money. They will also provide a more secure and transparent platform for users to conduct commerce and create new business opportunities. The blockchain will also

enable users to access social networks, allowing them to interact with others in a more secure and private manner. This technology will revolutionize the way people interact and transact with each other, creating a more secure and efficient global economy.

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