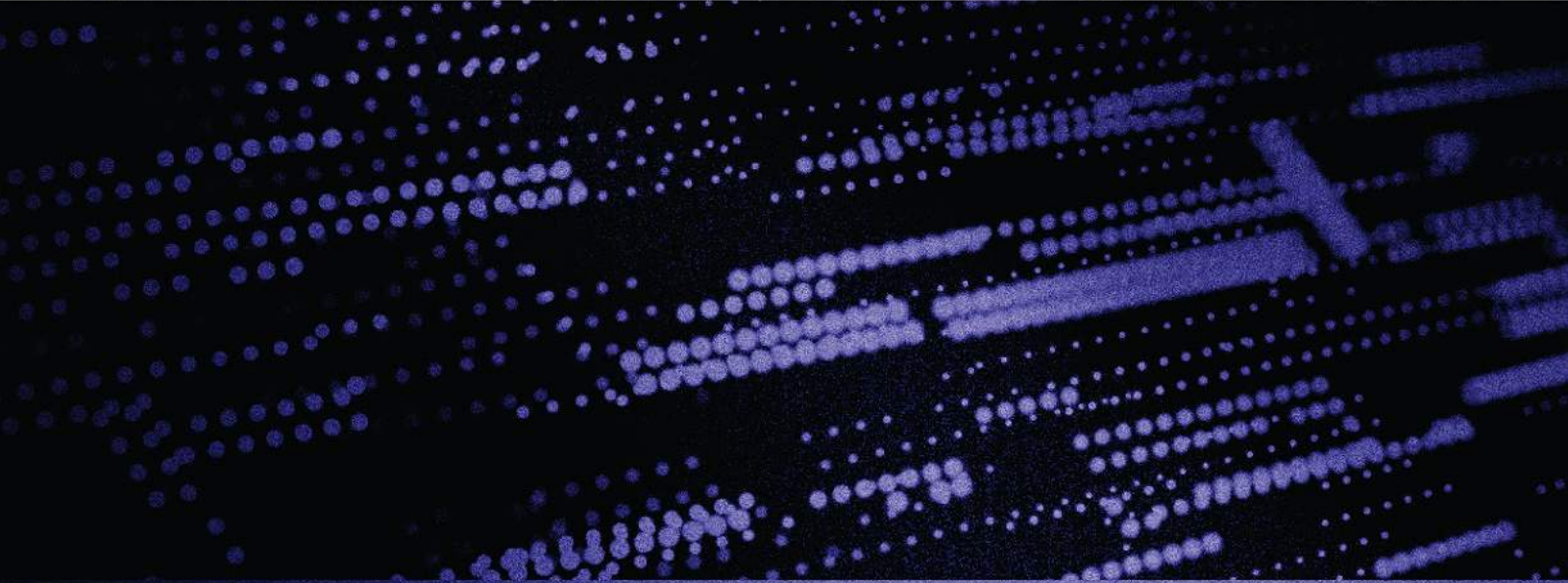




2023

 **THE BLOCK** · Research

Digital Asset Outlook



About



The Block Research delivers industry-leading research and analysis produced on a daily basis, covering an array of topics within the digital asset space.

Our research and insights are trusted by institutional investors, traders, financial service professionals, digital asset and blockchain infrastructure service providers, regulators, policymakers, and crypto enthusiasts, to help them remain the most knowledgeable in the market.

[Click here](#) to learn more.

Forward

In 2022, The Block Research produced more than 420 unique pieces of research for our research members.

The 2023 Digital Asset Outlook Report looks at the most important cryptocurrency developments in 2022 and looks ahead to the future of the space in the coming years.

The report covers the state of the market, investment trends, decentralized finance, blockchain gaming, and other cryptocurrency sectors to watch for in 2023.

DISCLAIMER

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Table of Contents

About	2
Forward	3
The Block Research Team	4
Table of Contents	5
Executive Summary	8
State of the Market	13
A Look Back at 2022 by the Numbers	13
Market Performance	13
Adjusted On-chain Volume	14
Stablecoins	15
Spot Volumes	16
Grayscale	17
Bitcoin Derivatives	18
Ethereum Derivatives	19
Mining Market: 2022 Overview	22
Public Bitcoin Mining Firms	24
Miner Revenue	25
Digital Asset Investment: 2022 Overview	28
Historical Background of Venture Funding	28
State of Venture Funding in 2022	34
Crypto Financial Services	34
Infrastructure	35
NFTs/Gaming	36
Trading/Brokerage	38
Web3	38
Data/Analytics/Information	39
Future is Multi-chain	39
Overview of the Largest Raises	40
Assessment of Crypto Unicorns	41
Most Active Investors	43
Mergers & Acquisitions	45
Historical Overview	45
M&A Activity by Firm	47
M&A Landscape in 2022	47
State of Employment in 2022	49
Employment	49

Layoffs	52	DeFi-optimized Blockchains	119
Layer-1 Networks: 2022 Overview	56	Liquidity Bootstrapping Structured Products	120
State of Layer-1s in 2022	56	Asset Tokenization	120
Dynamics of Layer-1 Consensus	57	Non-dollar Stablecoins	121
Proof-of-stake Consensus Dominance	57	Institutional DeFi	122
Layer-1 Valuations & Ecosystem Health	58	Web3: 2022 Overview, 2023 Outlook	124
Security Through Social Consensus	61	State of Web3 in 2022	124
Security & Decentralization	62	The Web3 Economy	124
Economics of Cross-chain Value Capture	65	General Overview	125
Scalability & Execution Environments	67	NFTs	125
Cross-chain Communication in Scaling Solutions	68	Metaverse	126
The EVM Dominance	70	Decentralized Autonomous Organizations	126
Optimizations Beyond the EVM	71	The DAPP Framework	126
Blockchain Scaling Solutions & Bridges: 2022 Overview	76	Protocols	128
State of Blockchain Scaling Solutions in 2022	76	Primitives	130
Ethereum-based Scaling Solutions	76	Applications	132
Optimistic Rollups	76	Doors	136
Zero-knowledge Rollups & Validiums	79	Hardware Centralization Issues	138
Outlook on Rollups	87	Outlook on Web3 in 2023	139
Data Availability Solutions	88	NFTs: 2022 Overview, 2023 Outlook	142
Outlook on Blockchain Scaling	92	State of NFTs in 2022	142
Blockchain Interoperability Solutions	96	General Market Overview	142
Cross-chain Activity	96	NFT Marketplace Landscape	145
Multi-chain Bridges	96	Summary of Core Themes in 2022	146
Two-chain Bridges	99	Creator Royalties in Jeopardy	146
Decentralized Finance: 2022 Overview, 2023 Outlook	102	Consolidation of Market Power	148
State of DeFi in 2022	102	Golden Goose	148
Decentralized Exchanges	104	Uncoupling of Generative Art	149
Lending	106	Storytelling NFTs	150
Crypto-backed Stablecoins	108	War on IP Rights	151
Algorithmic Stablecoins	109	Free Mint Mania	152
Liquid Staking	111	Mechanism Design	153
Derivatives	112	Outlook on NFTs in 2023	154
Structured Products	114	The Great Filter	154
Privacy	115	Only the Paranoid Survive	155
Insurance Coverage	116	Rebranding Attracts Big Brands	155
DeFi Exploits in 2022	116	Appendix: Timeline Event Related to NFTs in 2022	156
Outlook on DeFi in 2023	119	Gaming & Metaverse: 2022 Overview, 2023 Outlook	158

State of Crypto Gaming in 2022	158
Types of Crypto Games	158
GameFi Market Overview	161
Token Sustainability	162
Other Web3 Gaming Trends in 2022	164
Pivot of GameFi Guilds	164
X-to-earn	166
Free-to-play Web3 Games	166
On-chain Games	166
Metaverse	167
Market Overview	168
Are We Too Early?	170
Outlook on Gaming & Metaverse in 2023	172
Web3 Gaming SuperApp for Mass Adoption	172
Metaverse Development Remains Slow	173
Appendix: Timeline Event Related to Gaming & Metaverse in 2022	174
Macro Perspectives: 2022 Overview	176
Weathering Macro Uncertainty	176
2022 Economic Data Summary	177
Centralized Finance Blowups	180
Rise & Collapse of Terra	181
Initial Unraveling of Lenders	184
Collapse of FTX & Alameda Research	191
Unpacking the Fallout of the FTX Collapse	195
Conclusion	199

Executive Summary

State of the Market

2022 has been a tumultuous year for cryptocurrencies.

The total crypto market capitalization in 2022 opened the year at \$2.2 trillion in January and subsequently hit an annual low of \$1 trillion in November. ([pg 13](#))

Bitcoin's price fell below its 2017-cycle high in June for the first time since January 2021. Although bitcoin's price dropped 64.1% year-to-date, its dominance remains stable at 40% of total digital asset market capitalization. ([pg 13](#))

All of the top ten cryptocurrencies by market capitalization experienced negative price returns as low as 81%. Nevertheless, exchange-associated tokens such as BNB and OKB and memecoins like DOGE performed better than BTC and other layer-1 protocols. ([pg 13](#))

As the market experienced a steep downturn, stablecoins became the exit gateway. The annual stablecoin adjusted transaction volume crossed \$7.2 trillion in 2022, a 19% year-on-year growth, yet the aggregate stablecoin supply contracted 2.4% to \$140 billion year-to-date. The discrepancy between high transaction volume and shrinking supply suggests that crypto market participants may have cashed out to fiat. ([pg 15](#))

Binance stablecoin BUSD challenged Tether's USDT on centralized exchanges. Although Tether remains the most popular trading pair denomination for centralized exchange trading, its volume dominance fell from 64% in January to 59% in November. In contrast, BUSD is the only pair to have increased its market share this year, from 8% to 15%, as it accounted for 75% of all legitimate spot volume at the end of November 2022. ([pg 15](#))

The year began with monthly cryptocurrency spot volumes breaking below the \$1 trillion mark, a mark that was surpassed nine times in 2021. According to The Block's

legitimate volume index, volume dropped 20% from \$841 billion in January to \$673 billion in November. Yet, Binance managed to consolidate its market share from 60% to 75% over the same time period. ([pg 16](#))

The digital asset derivatives market primarily declined over the past year. Last-twelve-months, Bitcoin futures volume decreased by 52%, more than Ethereum futures' 28% decline. For the first time, Ethereum futures exceeded Bitcoin futures volume in August 2022 with a 7% margin, before contracting in the subsequent months. ([pg 18](#))

Mining Market: 2022 Overview

As bitcoin's price more than halved throughout the year, many miners faced increasing financial distress. Many miners kept a portion of their mined bitcoins in their respective treasuries. 15 publicly-traded bitcoin firms tracked by The Block mined a total of 33,800 bitcoins worth over \$550 million. ([pg 24](#))

Uproar amidst the increasing Flashbots dominance in relaying Ethereum blocks. Flashbots recently introduced "MEV-Boost" to provide validators access to an off-chain marketplace for block-building. Flashbots MEV-Boost currently proposes 62% market share of blocks proposed. This poses a problem as Flashbots' software was confirmed to be OFAC-compliant, rejecting any transactions that engaged with Tornado Cash and other sanctioned addresses. ([pg 24](#))

Digital Asset Investment: 2022 Overview

Number of funding deals increased 18% year-on-year to 2,201 deals. However, its 2022 growth decelerated compared to that of 2021, which increased by 150% in a single year. The amount raised in 2022 saw a 7% increase year-on-year to \$30.9 billion. ([pg 28](#))

North America, Asia, and Europe were the continents where crypto activity was most concentrated in the past 6

years. 95% of the total amount raised at \$75.9 billion is attributable to deals in these continents. ([pg 29](#))

NFTs/Gaming vertical attracted the most funding this

year. The vertical raised \$8.3 billion in 2022, a 51% year-on-year increase. Half of these investments were in VR/metaverse, blockchain-based gaming, and game studio subcategories. Most of the deals reflected seed and pre-series A stages. ([pg 36](#))

75% of the total amount transacted in M&A in the last two years reflects pre-existing crypto native players.

This suggests changing operational dynamics for category-leading players as they acquired smaller players in the market to weed out competition and diversify into an entity providing a full range of product/service suites. Coinbase and Animoca Brands led the race with 30 and 22 acquisitions, respectively. ([pg 45](#))

Number of employment in the digital asset industry has jumped over 351% since 2019.

Based on The Block Research's database, 421 firms employ 82,248 people within the industry, compared to only 18,200 from 158 companies in 2019. Half of the 2022's employment are within the Trading/Brokerage category. ([pg 49](#))

The number of layoffs in 2022 was the highest at 9,564.

Volatility in the crypto market was widely felt within its job market as Crypto.com contributed 2,260, or 24%, to total attrition. Meanwhile, Coinbase, Kraken, and Bybit each laid off ~1,000 employees. ([pg 52](#))

Layer-1 Networks: 2022 Overview

Ether daily net issuance turned negative a month after

The Merge. However, the transition to proof-of-stake made former Ethereum miners irrelevant and Ethereum security is now dependent on ether price. Ether supply stood at 120 million as of end November. ([pg 57](#))

Layer-1 token valuations fell sharply in 2022 alongside the broader drawdown in crypto and traditional equities

markets. The drawdown directly impacted value locked in DeFi across Layer-1 ecosystems, contributing to diminished growth and yield opportunities. Value locked in Layer-1 DeFi peaked at ~\$228 billion in December 2021, declining ~72% to around \$58 billion as of end November. ([pg 58](#))

Emergence of application-focused chains. Although EVM continued to dominate among smart contract platforms, there is a high demand in abstracting away blockchain complexities, as reflected in Cosmos ecosystem, Avalanche subnets, and Polkadots's parachains. ([pg 62](#))

Blockchain Scaling Solutions & Bridges: 2022 Overview

Adoption of Ethereum-based rollups is currently

dominated by Optimistic rollups. The success of Arbitrum and Optimism were primarily contributed by GMX and the launch of OP token, respectively. ([pg 76](#))

Arbitrum, Optimism, and dYdX largely dominate the overall landscape for Ethereum-based scaling solutions.

That said, value locked across all scaling solutions declined 24% throughout 2022, from \$6 billion to \$4.5 billion at the end of November. ([pg 76](#))

Developments of various solutions to improve

blockchains' throughput. There were many scaling solutions that have seen significant development, from data availability solutions like Celestia, to zkEVM efforts like zkSync, Scroll, and Polygon Hermez. The current scaling efforts are predominantly Ethereum-based or data availability-based. ([pg 79](#))

Adoption of validity proof Layer-2s is currently limited to the Validium approach.

Validium utilizes off-chain data availability and has been popularized by StarkWare by facilitating the launch of several application-specific Layer-2s such as dYdX, ImmutableX and Sorare. Generalizable zero-knowledge rollups are awaiting the mainnet launch of zkSync 2.0, StarkNet, and several zero-knowledge rollup solutions from Polygon. ([pg 79](#))

Value locked in cross-chain bridges has fallen

significantly in 2022. The metric peaked at over \$58 billion in January, declining by ~90% to \$6 billion as of end November. The decline was primarily because the value of assets held in bridges fell in prices, and numerous bridge exploits happened throughout 2022, including the \$600 million Ronin hack, the \$323 million Portal exploit, and the \$100 million Horizon bridge attack. ([pg 96](#))

Decentralized Finance: 2022 Overview, 2023 Outlook

DeFi space experienced a contraction in 2022. Value locked in DeFi decreased 74.6% from \$166 billion to \$42.1 billion. Terra's ecosystem collapse in May marked the most drastic crash in value locked. ([pg 102](#))

DeFi activities slowed down as reflected by less active users throughout 2022. Using decentralized exchange trading activities as a proxy for DeFi activities, 8.9% of Ethereum transactions were decentralized exchange trades in November, up from 5.6% in July but down from 11.5% in January. ([pg 102](#))

Revenue generated by DeFi protocols took a massive hit amid a more challenging economic environment. While Uniswap remained the leading protocol by revenue, with an annual revenue of \$792 million in 2022, its monthly revenue sank from \$134 million in January to \$53.3 million in November. ([pg 103](#))

2022 was a terrible year for algorithmic stablecoins.

Although algorithmic stablecoins experienced rapid growth at the start of 2022, mid 2022's catastrophic destruction halted this momentum, with contagion still rippling through every corner of the crypto space. UST, now known as USTC, was the largest algorithmic stablecoin before its collapse, with a market cap of \$10.1 billion in January and \$18.8 billion at its peak in May. ([pg 109](#))

Liquid staking ramped up as Ethereum's successful transition to proof-of-Stake during The Merge.

Year-to-date, Lido is the largest liquid staking protocol on Ethereum, almost tripled its TVL to 4.77 million ETH, with a market share of 76.1%. ([pg 111](#))

Advancement of decentralized derivative protocols. 2022 saw several developments of various derivatives products and there are two popular products this year. First, GMX, an Arbitrum- and Avalanch-based decentralized perpetual exchange, with a TVL of \$445 million, surpassing dYdX and Synthetix. Second, an exotic derivative Oryn Squeeth, a power perpetual indexed to the price of ETH raised to the second power, amassed \$447 million volume since its inception in January. ([pg 112](#))

2022 was a critical juncture for privacy protocols. OFAC sanctioned cryptocurrency mixers such as Bitcoin-based Blender.io and Ethereum-based Tornado Cash for their roles in allegedly facilitating money laundering for North Korean-linked Lazarus Group. The sanction led many Tornado Cash depositors to flee. Value locked in Tornado Cash reflects ~\$111 million, a whopping 78% decrease year-on-year. ([pg 115](#))

Web3: 2022 Overview, 2023 Outlook

Although the public interest with "Web3" had been decreasing in 2022, it remained more popular than a year ago. The same can be said for the number of active addresses on Ethereum, which decreased by 20% to fewer than 420,000 since the beginning of the year. ([pg 125](#))

The DAPP framework can be used to analyze the evolution of Web3 infrastructures (Door, Application, Primitive, and Protocol). Each layer helps identify the blockchain usage journey, beginning with accessing Web3 (door), connecting and interacting with blockchain via user-friendly interfaces (application), tools that facilitate a specific task behind the scenes (primitive), and finally, the blockchain architecture where applications are built (protocols). ([pg 126](#))

NFTs: 2022 Overview, 2023 Outlook

Monthly NFT trading volume on Ethereum hit a new all-time high in January of \$5.6 billion, breaking its previous record in 2021. However, in June, it registered the biggest month-on-month decline and continues sliding. ([pg 142](#))

Solana contended Ethereum as a new home to NFTs. Solana NFTs experienced a renaissance that underscored their relative strength, resulting in a temporary market share of 46.2% in terms of NFT trading volume. Nevertheless, Ethereum defended its lion's share position at 72.5% at November end. ([pg 143](#))

Battle of creator royalties. NFT marketplaces had been fiercely competing for liquidity by circumventing creator royalties, allowing competitors to siphon liquidity from OpenSea and spawning zero-fee marketplaces such as Sudoswap, X2Y2, and Magic Eden. Zero-royalty trading volume jumped from 2.8% of total trading volume in January to 30% at November end. ([pg 146](#))

Yuga Labs Empire. BAYC creator Yuga Labs went on an acquisition spree in 2022. In March, it acquired the intellectual properties of CryptoPunks and Meebits. Subsequently, it acquired Wenew, a startup founded by Beeple and the company behind 10KTF. Yuga Labs also launched Otherdeeds, its metaverse project, and airdropped ApeCoin to BAYC and MAYC holders. As a result, Yuga Labs boosted its volume dominance from 33.3% at the beginning of the year to a peak of 69.6% in early May. ([pg 148](#))

2022 had been a seminal year for NFTs. There had been a myriad of developments throughout the year besides zero-creator royalty, such as an emergence of storytelling NFT, war on intellectual property rights, and new mechanism design spurred such as an on-chain game with an art factory. ([pg 150](#))

Gaming & Metaverse: 2022 Overview, 2023 Outlook

The delay of AAA games. Although the number of Web3 games increased by 34% to 1,873 as of end November, many of the 2022-promised AAA-games have yet to be released, including Illuvium, Mirandus, and Star Atlas. ([pg 159](#))

Diminishing play-to-earn games. Play-to-earn games demonstrated through Axie Infinity, StepN, Thetan Arena, and many others that they were neither sustainable nor market-proof, as GameFi experienced a 79% decline in 2022, worse than the overall market's 64.1% decline. ([pg 161](#))

Proliferation of X-to-earn. As Web3 gaming evolves from Axie Infinity's play-to-earn model, developers create novel gameplay mechanics in an effort to attract diverse audiences. Various "X-to-earn" spawned, such as move-to-earn, sleep-to-earn, and learn-to-earn. ([pg 166](#))

Development of on-chain gaming. As a result of the infrastructure growth like Layer-2s, several new gaming primitives launched in 2022. We identified 40 on-chain games, primarily on StarkNet. This marks a staggering increase from the initial ~5 identified at the start of the year. ([pg 166](#))

Macro Perspectives: 2022 Overview

Prices of cryptocurrencies and digital assets have been primarily impacted with macroeconomic conditions and various market crises. These two market drivers are not independent. Rather, due to the Fed's pivot into a tightening stance, external market pressures reversed last year's "everything rally," brutally punishing overexposure to risky strategies and their related counterparties. ([pg 176](#))

The fall of Terra triggered the collapse of several powerful centralized crypto players. Six major players, Three Arrows Capital, Voyager, Celsius, FTX & Alameda Research, and BlockFi, who were intricately intertwined and (in some cases, appeared to) earn enormous returns during the bull cycle, were wiped out spectacularly as the market turned bearish. The reverberation continues to impact other players such as Gemini and Digital Currency Group. ([pg 180](#))

1

State of the Market

Lars Hoffmann



State of the Market

Lars Hoffmann

A look at measures of market health, including: asset performance metrics, on-chain data, exchange volumes, and more.

For real-time data on the metrics featured in this section, please see [The Block Data Dashboard](#).

A Look Back at 2022 by the Numbers

Disclaimer: Q4 numbers include data until November 30, 2022. Price performance measures data up until November 30, 2022.

Market Performance

After hitting many new all-time highs (ATHs) across the market in November 2021, the start of the year was much more subdued. 2022 saw prices decline across the cryptocurrency market, with many, including bitcoin (BTC) and ether (ETH), retesting and breaking below their 2017 cycle highs. The total crypto market capitalization in 2022 opened the year at \$2.2 trillion in January and subsequently hit a yearly low of \$1 trillion in November.

Bitcoin remains the clear market leader in terms of total market capitalization, but fell below its 2017-high in June for the first time since January 2021 and extended its drawdown to -64.1% year-to-date (YTD) – versus Gold: -3.3%, S&P500: -14.6%, and Nasdaq: -26.6% in the same time period.

Notably, all top ten cryptocurrencies by market capitalization, excluding stablecoins, generated negative returns. Macro headwinds such as elevated

inflation, aggressive central bank rate hikes, the war in Ukraine, as well as the continued closure of China, added constant negative pressure. However, the relative performance of cryptocurrencies in the top ten against BTC showed significant variance.

Exchange-associated tokens such as BNB and OKB, as well as memecoins such as DOGE fared relatively better than BTC and other Layer-1 (L1) tokens in 2022.

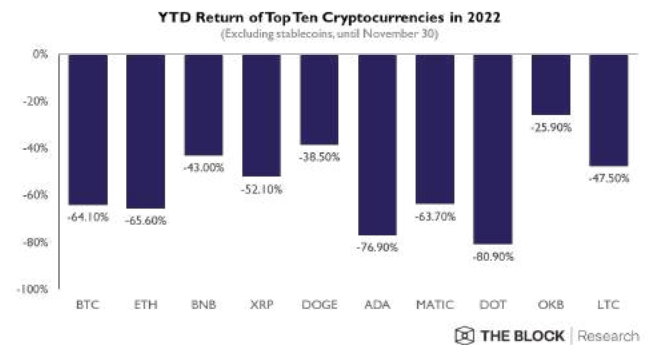


Figure 1: Year-to-date return of top ten cryptocurrencies in 2022
Source: TradingView

Except for XRP, DOGE, and ADA, none of the cryptocurrencies in the top ten had any days with noteworthy (>2%) YTD positive returns. Events surrounding Terra, LUNA, and UST in May, as well as subsequently Three Arrows Capital (3AC) in June, resulted in further market downside. Following these, a low volatility month for most cryptocurrencies ensued. However, starting in the middle of July, the anticipation of the Ethereum Merge, which was successfully completed on September 15, 2022, resulted in a temporary recovery led by ETH. Comments by Tesla CEO Elon Musk on Twitter led to a temporary recovery for DOGE at the end of October. Finally, the collapse of FTX and Alameda Research in early November resulted in a retest of the June lows for many cryptocurrencies in the top ten, notably, with BTC breaking below its June low.



Figure 2: Return of top ten cryptocurrencies in 2022
Source: TradingView

YTD, Bitcoin's dominance (ratio of bitcoin market cap to total digital asset market cap) remained stable around 40% as of the end of November — with a temporary high of 48% in June, and a temporary low of 39% in September around the Ethereum Merge date.

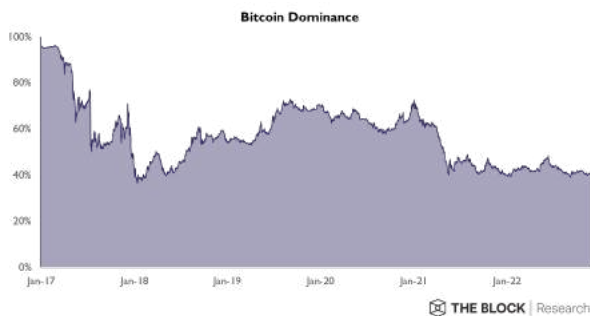


Figure 3: Bitcoin market dominance 2017 - 2022
Source: TradingView

Overall, Bitcoin's on-chain volume decreased by 14.9% year-on-year (YoY), from \$4.7 trillion in 2021 to \$4 trillion in 2022. Meanwhile, Ethereum's on-chain volume decreased 55.6% YoY, from \$3.6 trillion to \$1.6 trillion.

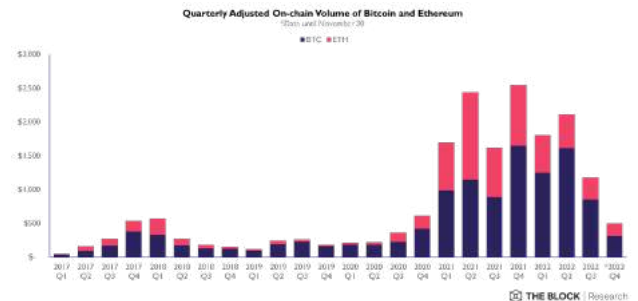


Figure 4: Quarterly adjusted on-chain volume of Bitcoin and Ethereum 2017 - 2022
Source: Coin Metrics

Adjusted On-chain Volume

Total adjusted on-chain volume on a public blockchain, which is a proxy for economic throughput, reached \$5.6 trillion between Bitcoin and Ethereum in 2022, a 32.5% decrease from the previous year.

Throughout 2022, on aggregate, Bitcoin's on-chain volume exceeded Ethereum's by ~2.6x. In comparison, Bitcoin's adjusted on-chain volume was 1.3x the size of Ethereum's in 2021, showing that Ethereum's economic

activity slowed at a significantly faster pace relative to Bitcoin's.

As of the end of November, Bitcoin's on-chain transaction count of ~263,000 remains, 30.6% below its December 2017 high of ~379,000 (30DMA). In comparison, Ethereum's on-chain transaction count of ~1.04 million at the end of November remains 31.6% below its May 2021 high of ~1.52 million (30DMA).

Stablecoins

In 2022, stablecoins continued to be one of the growing handful of cryptocurrencies that found product-market fit and broader institutional acceptance. Since the beginning of the year, and despite a substantial decline in overall market capitalization for the broader industry, the aggregate stablecoin supply only contracted by 2.4% – from \$143 billion to \$140 billion.

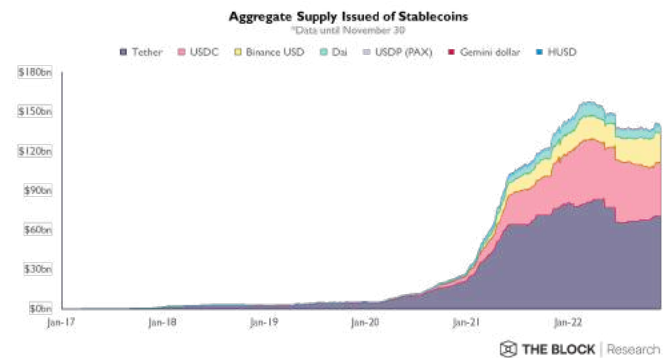


Figure 5: Quarterly adjusted on-chain volume of Bitcoin and Ethereum 2017 - 2022

Source: The Block Research

Moreover, stablecoin usage saw new records in 2022. Annual stablecoin adjusted transaction volume (i.e., a payment flow from one address to another on a public blockchain) crossed \$7.2 trillion in 2022, 19% YoY volume growth.

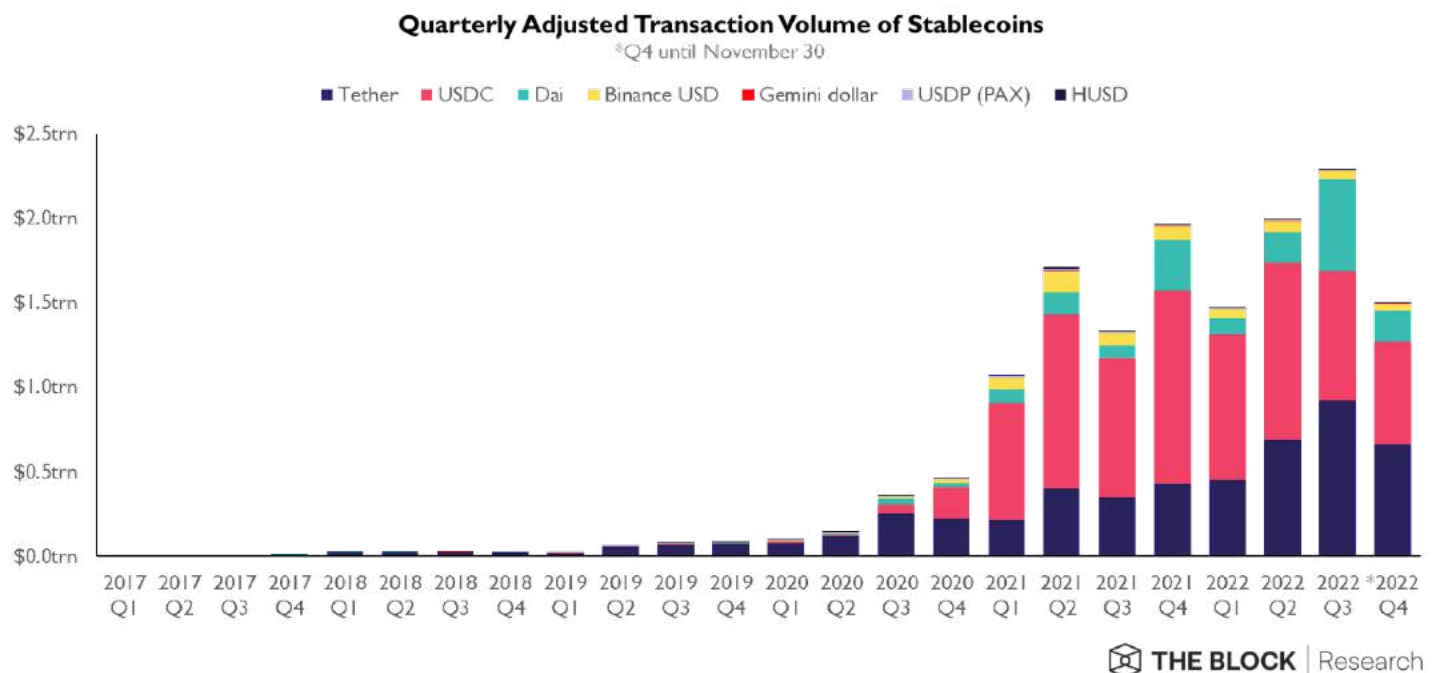


Figure 6: Quarterly adjusted transaction volume of stablecoins

Source: Coin Metrics

Spot Volumes

2022 began with monthly cryptocurrency spot volumes falling below \$1 trillion, a benchmark surpassed nine times in 2021 and in December 2021. According to The Block's Legitimate Volume Index, from December 2021 to January 2022, volumes fell 19% to \$841 billion. January to April saw volumes stabilize around the \$650 billion to \$800 billion range, before the Terra LUNA collapse in May as well as the 3AC collapse in July which further suppressed both prices and volumes. The latter half of the year traded flat until further macro headwinds post-Merge in October as well as the FTX and Alameda Research collapse in November.

Binance remains dominant with 67% of spot trading volume occurring on their exchange in 2022. Their spot trading market share continues to grow, increasing

from 60% to 75% YTD. This trend was especially pronounced in November after the collapse of FTX.

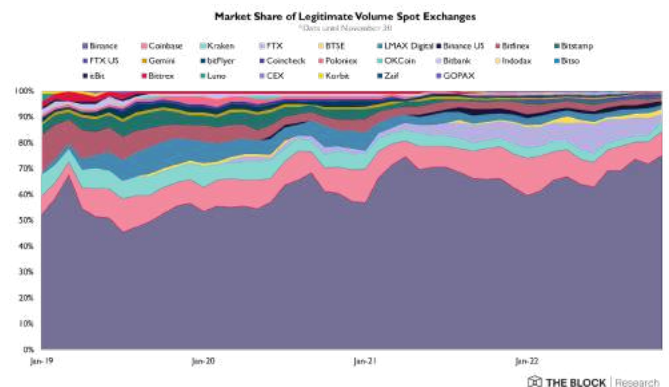


Figure 7: Legitimate volume share on spot exchange 2019 - 2022
Source: CryptoCompare, The Block Research

As of November, Binance's (75%) main competitors are Coinbase (9.2%), Kraken (3.6%), BTSE (1.8%), and LMAX Digital (1.7%).

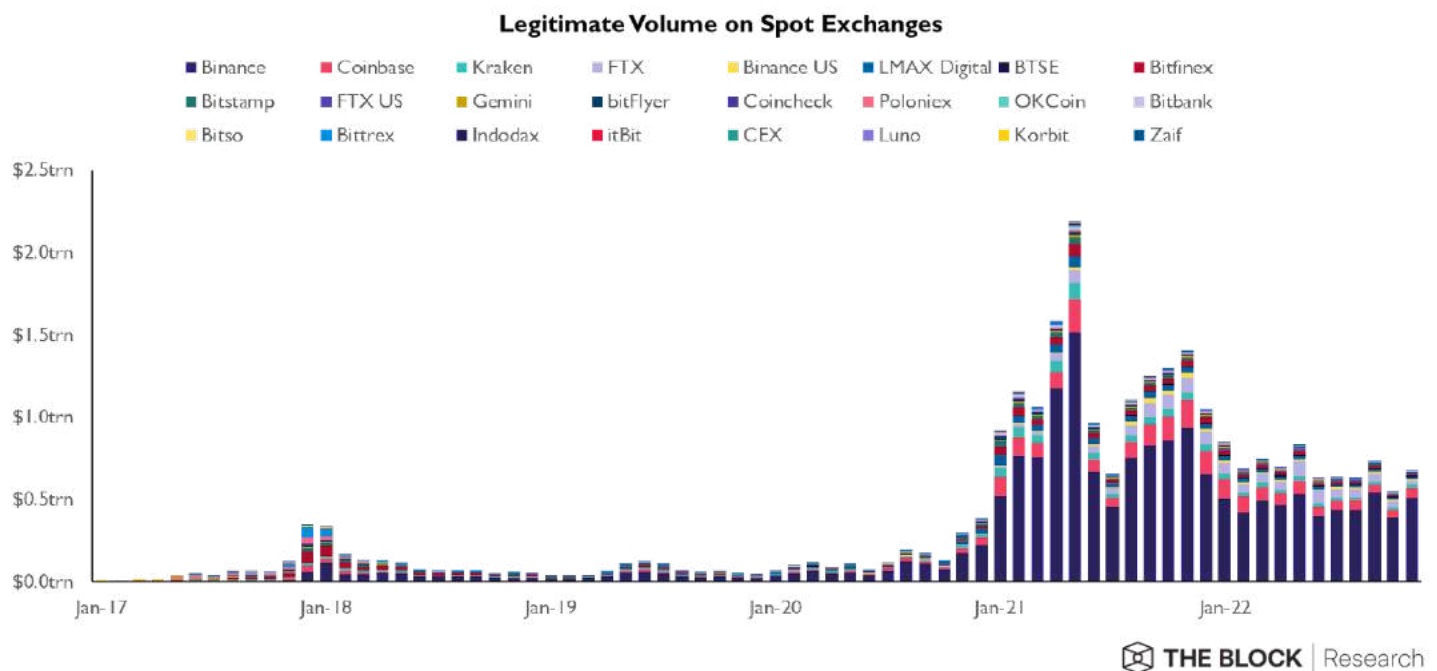


Figure 8: Legitimate volume on spot exchange 2017 - 2022
Source: CryptoCompare, The Block Research

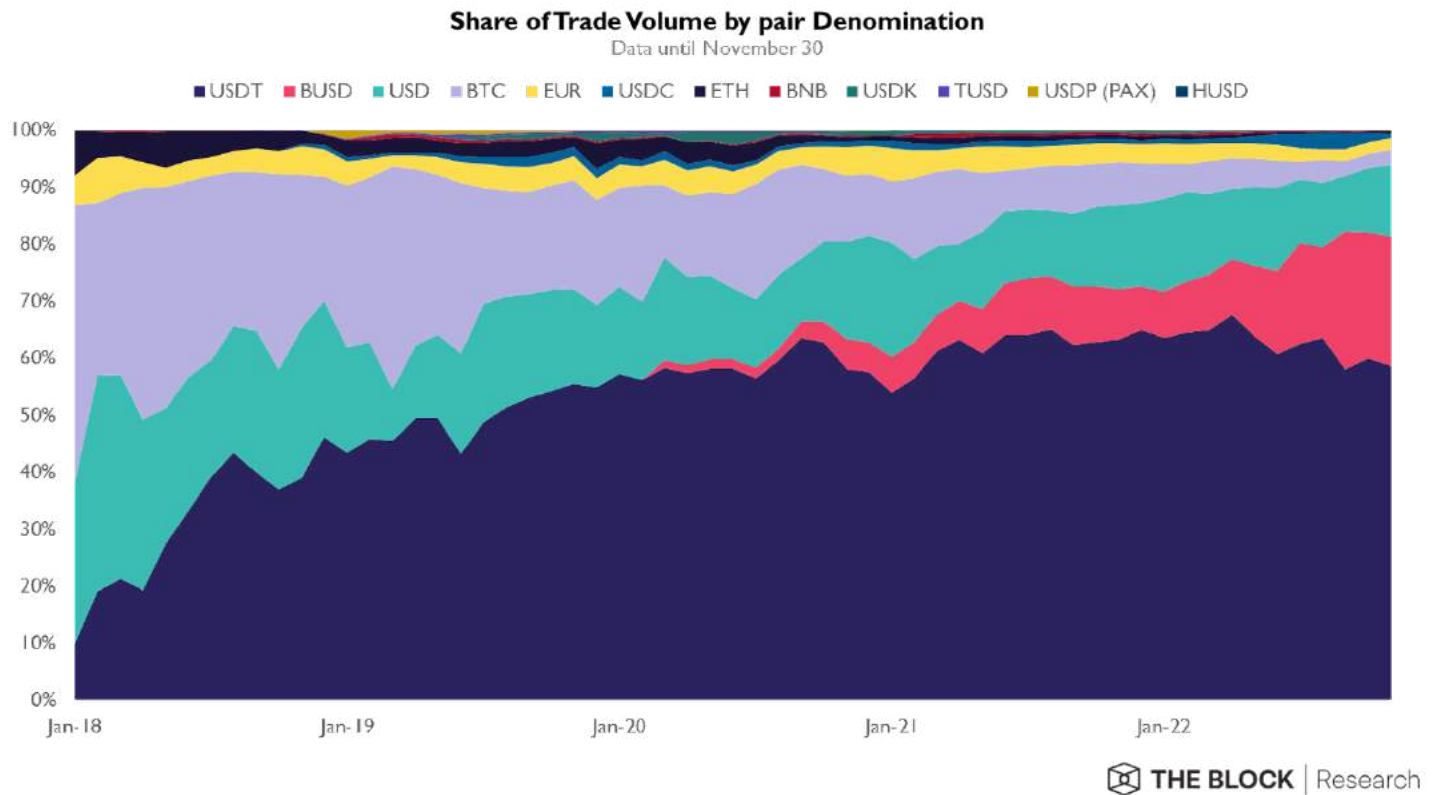


Figure 9: Volume share on spot exchange by pair denomination 2018 - 2022

Source: CryptoCompare, The Block Research

As with the previous year, Tether continues to maintain its dominance as the most popular trading pair denomination for centralized exchange (CEX) trading. However, YTD, USDT's share of trade volumes fell from 65% in December 2021 to 59% at the end of November 2022. This means that around 59% of spot trading volumes were denominated in, at times, the controversial stablecoin. In November, BUSD and USD pairs were the second and third largest pairs at 22.6% and 12.7% respectively. With Binance heavily pushing its stablecoin BUSD on its exchange, which accounted for ~75% of all legitimate spot volume at the end of November 2022, BUSD gained the largest share against any other pair this year.

Grayscale

Grayscale's Bitcoin Investment Trust (GBTC) continues to be the largest Bitcoin fund in existence, owning over 633,200 BTC (~3.3% of Bitcoin's total supply) as of the end of November 2022. Worse than bitcoin's 62.9% price decline YTD, the market price of GBTC declined 74.4% since January. Average daily trading volumes reached lows of \$55 million in Q4.

On February 23, 2021, GBTC began trading consistently at a discount for the first time in its history. This trend reversal can be attributed to a wider offering of Bitcoin ETFs becoming available, such as spot products in Canada. At the end of November 2022, GBTC trades at an ~42% discount to its net asset value (NAV).

A few companies were hit especially hard by this unexpected change. In particular, BlockFi's core revenue stream relied on arbitrage strategies based on GBTC continuing to trade at a premium. When GBTC started trading at a discount, BlockFi found themselves locked into a soured trade that worsened with the widening spread. Similar events impacted 3AC.

On October 19, 2021, Grayscale filed with the Security Exchange Commission (SEC) to convert GBTC to an exchange-traded fund (ETF). This filing hoped to further legitimize GBTC, increase access to the product, and most importantly, force it to trade closer to its NAV. However, on June 29, 2022, the SEC rejected Grayscale's bid to convert GBTC to a Bitcoin ETF. The same day, Grayscale filed a suit against the SEC regarding its rejection of the GBTC conversion bid.

Since late February 2021, Grayscale's Ethereum Investment Trust (ETHE) also trades at a discount. However, the spread increased substantially in 2022. At November 2022 end, ETHE trades at an ~45.2% discount to its NAV. In a similar vein, daily average trading volumes also saw significant and continued declines.

YTD Grayscale ETHE declined ~79.5% in market price compared to Ethereum's ~64.8% decline. This discrepancy is due to discount deepening, going from -13.6% on December 31, 2021, to -45.2% as of November 30, 2022. Average trading volume decreased with lows of \$31.4 million in Q4 2022, last seen in Q3 2020.

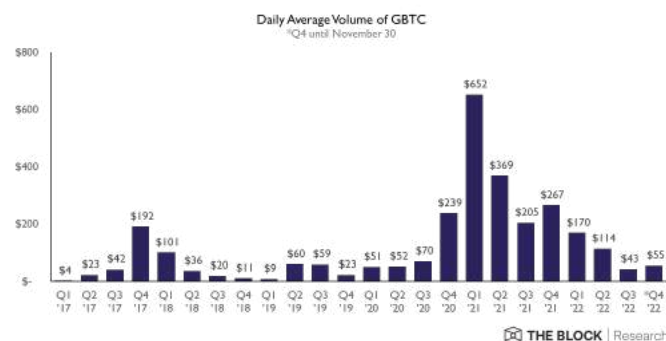


Figure 10: Daily average volume of GBTC 2017 - 2022

Source: FactSet, The Block Research

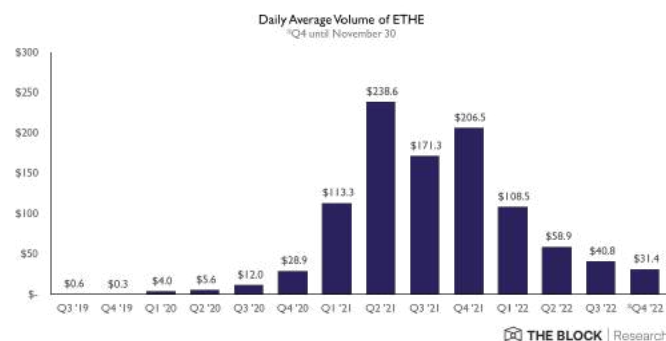


Figure 11: Daily average volume of ETHE 2019 - 2022

Source: FactSet, The Block Research

Bitcoin Derivatives

The digital asset derivatives market mostly declined over the past year. December 2021 Bitcoin futures volumes were \$1.3 trillion when aggregated across all major exchanges. Since then, average monthly volumes have not surpassed this threshold and were \$622 billion in November 2022.

While off-shore exchanges continue to dominate the majority of trading, futures markets on traditional US-based exchanges remain a reliable metric for gauging “institutional” interest in the digital asset market. Usually, large players prefer to trade via established exchanges that have the infrastructure, regulatory benchmarks, and trade execution familiar to these institutional traders. This trend will only intensify

over the next few years after FTX's collapse in November 2022.

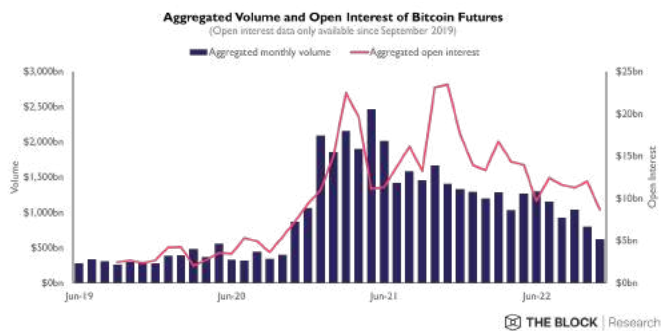


Figure 12: Aggregated volume and open interest of Bitcoin Futures 2019 - 2022

Source: skew, The Block Research

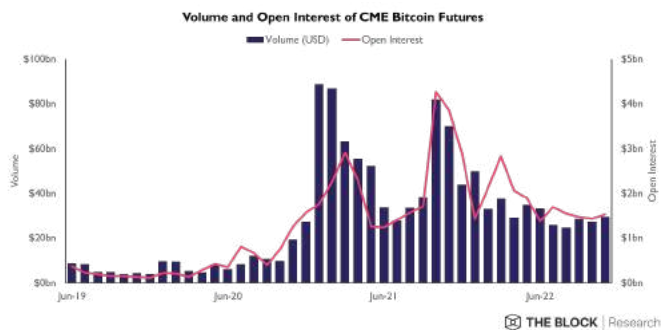


Figure 13: Volume and open interest of CME Bitcoin Futures 2019 - 2022

Source: skew, The Block Research

CME remains a reliable metric for “institutional” trading activity in both BTC and ETH derivatives. For institutional traders, traditional hedge funds, and large asset managers, CME remains one of the most native products for gaining exposure to bitcoin. In addition, high capital requirements drive away retail flow. However, in March 2022, CME launched both BTC and ETH micro options to build on its previous attempts to attract smaller traders.

YTD, CME BTC Futures open interest declined 50%, from \$2.9 billion to \$1.45 billion. Simultaneously, monthly volume fell 38%, from \$43.9 billion to \$27.2 billion.

Despite the sharp price decrease, traded volumes and liquidity remain high.

Deribit continues to dominate the options market. Their share of Bitcoin options trade volume stabilized around the 92% mark over this year. As of November 2022, Deribit reflects ~\$4.1 billion of BTC options open interest, which comprises ~86.2% of total open interest.

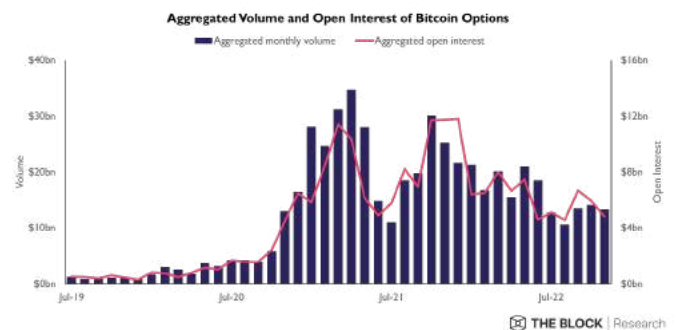


Figure 14: Aggregated volume and open interest of Bitcoin options 2019 - 2022

Source: skew, The Block Research

Despite renewed filing attempts for BTC spot ETFs in the US, the SEC continued to reject every filing.

Vehicle Name (Ticker)	Filing	Inception	Deadline	Date of Rejection (If Rejected)	Country
ARK 21Shares' Bitcoin ETF	5/13/2022	-	1/27/2023	-	United States
21Shares Bitcoin ETF (EBTC)	na	5/9/2022	-	-	Australia
Simplify Bitcoin Strategy PLUS Income ETF (MAXI)	4/22/2022	9/29/2022	-	-	United States
ProShares Short Bitcoin Strategy ETF (BITI)	4/5/2022	6/21/2022	-	-	United States
VanEck Bitcoin Strategy ETF (XBTF)	1/18/2022	4/3/2022	-	-	United States
AdvisorShares Managed Bitcoin Strategy ETF (CRYP)	8/21/2021	4/27/2022	-	-	United States
Hashdex Bitcoin Futures ETF (DEFI)	4/18/2021	9/15/2022	-	-	United States
IT Now Bloomberg Galaxy Bitcoin ETF (BITI1)	na	11/10/2022	-	-	Brazil
Valkyrie XBTO Bitcoin Futures Fund	8/23/2021	5/5/2022	-	-	United States
Teucrium Bitcoin Futures ETF	7/23/2021	4/6/2022	-	-	United States
Global X Bitcoin Trust	7/21/2021	-	-	3/10/2022	United States
Wise Origin Bitcoin Trust	3/24/2021	-	-	1/27/2022	United States
WisdomTree Bitcoin Trust	3/11/2021	-	-	3/15/2022	United States

Legend: Pending (blue), Approved (green), Rejected (orange)

Figure 15: Bitcoin ETF application status in 2022

Source: The Block Research

Ethereum Derivatives

Ethereum aggregate monthly futures volumes saw a decline of 28% from December 2021 to November 2022. Volumes saw a low of \$572 billion in April, before rising

sharply in anticipation of The Merge, to an annual high of \$985 billion in August. YTD, open interest declined by 51%, with a yearly low in June of \$4.4 billion.

CME became the first traditional US-regulated exchange to launch both micro Ethereum options in March 2022, and Ethereum options in September 2022. While CME accounts for 17.7% of Bitcoin futures open interest at the end of November 2022, its impact on the Ethereum derivatives market remains subdued, with only 8.7% of futures open interest. As for the Ethereum options market, the share of CME both for volume and open interest is negligible.

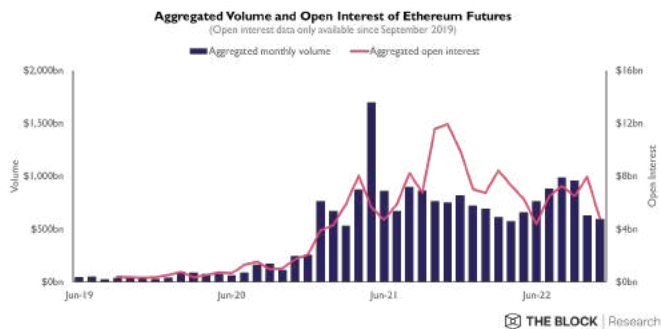


Figure 16: Aggregated volume and open interest of Ethereum futures
2019 - 2022

Source: skew, The Block Research

Ethereum options growth was overall strong in 2022, but did not reach 2021 highs. YTD, aggregate monthly open interest declined by 35.5%, and aggregate monthly volumes fell by 36.2%. Like the futures market, Ethereum options consolidated at elevated levels. Open interest recovered sharply after June and in

anticipation of The Merge. Open interest growth continued beyond The Merge.

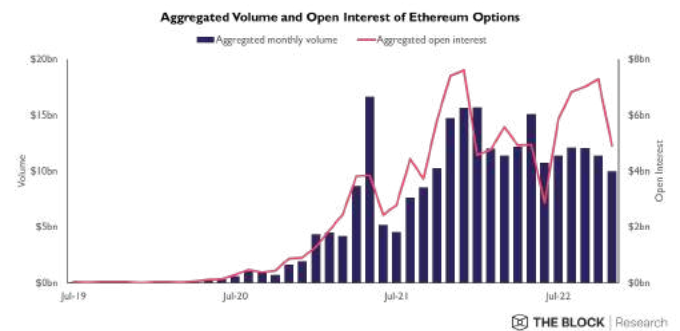


Figure 17: Aggregated volume and open interest of Ethereum options
2019 - 2022

Source: skew, The Block Research

Similarly to Bitcoin options, Deribit holds almost all of the market share, accounting for 96.6% of trade volume in 2022 and for 96.7% of open interest at the end of November 2022.

Like US BTC spot ETFs, the SEC continues to reject US ETH spot ETF filings.

Vehicle Name (Ticker)	Filing	Inception	Deadline	Date of Rejection (If Rejected)	Country
Global X Ethereum ETP (ETOX)	na	3/8/2022	-	-	Netherlands
Bitpanda Ether ETC (KETH)	na	4/21/2022	-	-	Netherlands
Fidelity Advantage Ether ETF (FETH)	7/27/2022	9/26/2022	-	-	Canada
BTG Pactual Hashdex Nasdaq Crypto Index Fund	na	8/31/2022	-	-	Chile
Short Ethereum ETP (SHETH)	na	9/29/2022	-	-	Switzerland
Ethereum Core ETP (CETH)	na	9/29/2022	-	-	Switzerland
21Shares Ethereum ETP (EETH)	na	5/9/2022	-	-	Australia

Legend: Pending (blue), Approved (green), Rejected (orange)

THE BLOCK | Research

Figure 18: Bitcoin ETF application status in 2022

Source: The Block Research

2

Mining Market: 2022 Overview

Steven Zheng



Mining Market: 2022 Overview

Steven Zheng

A look at the mining market for the two largest cryptocurrencies in the space and new mining trends.

Quick Take

- Impacted by a mix of the market collapse and major protocol changes, Bitcoin and Ethereum miners experienced a troubling 2022.
- Bitcoin and Ethereum miners and stakers generated over \$18 billion revenue in 2022, a 40% decline YoY.
- Ethereum's Merge upgrade completely decimated the Ethereum mining sector.

2022 started off as a fruitful year for Bitcoin and Ethereum miners, as prices for bitcoin and ether were just slightly below their ATH mania in 2021. However, as the year progressed, many miners soon ran into trouble as global macro and crypto markets collapsed from central bankers' desperate attempts to maintain control of runaway inflation through various monetary policies and a major escalation in the Russo-Ukrainian war.

Against the backdrop of concurrently occurring major macro events, Ethereum miners also faced an

existential crisis when the Ethereum community executed their move to Proof-of-Stake (PoS) via The Merge. As a result, many old Ethereum Proof-of-Work (PoW) mining machines were rendered nearly worthless.

Despite rapidly declining bitcoin prices nearing the end of 2022, Bitcoin's hash rate actually hit an ATH this year, growing from 168 exahash per second (EH/s) in January to 273 EH/s in November on a 7DMA basis.

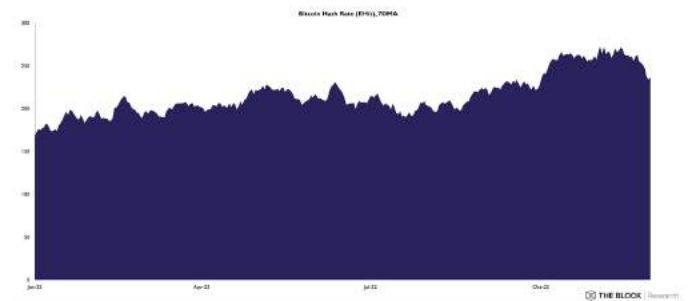


Figure 19: Bitcoin's hash rate (7DMA) in 2022

Source: The Block Data Dashboard

Leading the charge in this growing hash rate is Foundry USA, a barely two-year-old bitcoin mining subsidiary for a crypto conglomerate, Digital Currency Group (DCG). Foundry USA benefited from 2021's Chinese cryptocurrency mining ban, forcing many miners to relocate to other parts of the world, with the United States benefiting most from the policy. Foundry USA started the year with a 17% share amongst major bitcoin mining pools and is currently sitting at 28%, contributing 45 EH/s of hashpower.

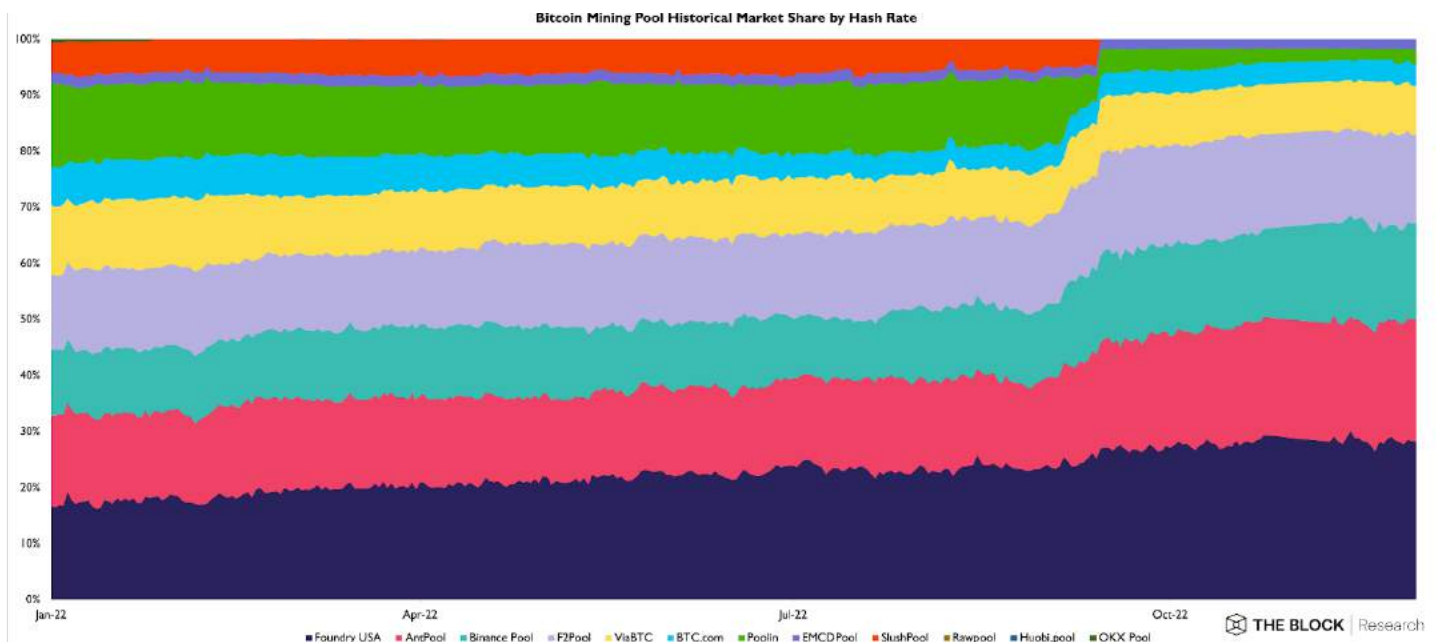


Figure 20: Bitcoin mining pool market share by hash rate in 2022

Source: The Block Data Dashboard

Similar to Bitcoin, Ethereum's hash rate also reached ATHs in 2022, as miners joined in their last attempts to generate as much revenue as possible before Ethereum's September Merge activation. The hash rate on Ethereum started the year at 883 terahash per second (TH/s) to 1,039 TH/s in May, on a 7DMA basis. On September 15, 2022, Ethereum hash rate dropped to 0, as Ethereum moved to PoS, leaving mining operators rushing to mine compatible chains like Ethereum Classic or ending their operations entirely.

With Ethereum's transition to PoS, a new market leader emerged for PoS validators, who perform similar roles to original PoW miners. Flashbots, a research organization established in 2020 to create a "permissionless, transparent, and fair ecosystem" for maximal extractable value (MEV) introduced "MEV-Boost" shortly after The Merge to provide validators access to an off-chain marketplace for block-building. As a result of being a market leader and a trusted brand, Flashbots saw nearly 450,000 validators sign up for MEV-Boost within two months of introducing the software.

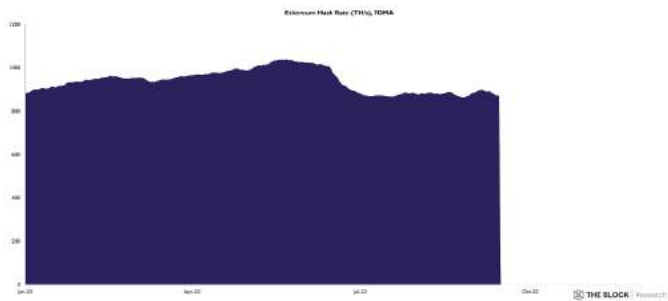


Figure 21: Ethereum's hash rate (7DMA) in 2022

Source: SEC filings compiled by The Block Research

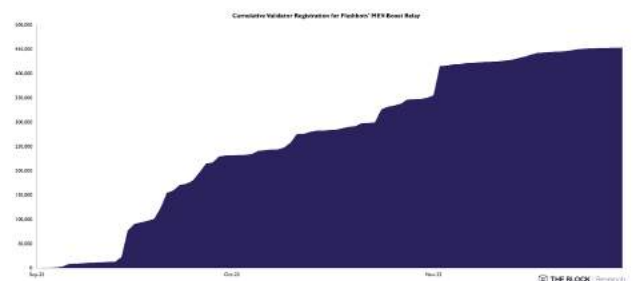


Figure 22: Cumulative registered validators on Flashbots MEV-Boost

Source: The Block Data Dashboard

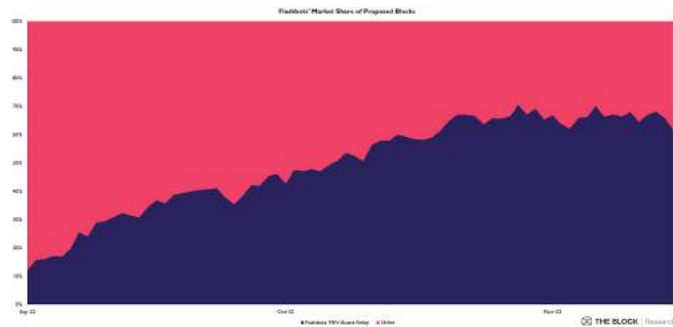


Figure 23: Flashbots' market share of proposed blocks
Source: The Block Data Dashboard

Nevertheless, Flashbots' popularity also gave it an almost monopolistic dominance in the block-building process on Ethereum. While Flashbots MEV-Boost only proposed 12% of blocks on Ethereum post-Merge, it currently holds a 62% market share of blocks proposed, reaching as high as 71% in November. More on MEV can be found in the [Layer-1 section](#).

The dominance of Flashbots led to outcries amongst Ethereum community members, as Flashbots' software was configured to be compliant with the Office of Foreign Assets Control (OFAC), blacklisting addresses associated with the privacy software, Tornado Cash,

after it was sanctioned by OFAC in August this year. This move meant that all blocks proposed through Flashbots' software automatically rejected any transactions that engaged with Tornado Cash, resulting in concerns about the censoring of transactions on a blockchain that is supposed to be neutral. As of the writing of this report, Flashbots continues to censor blocks proposed by validators using its software.

Public Bitcoin Mining Firms

Given the mania of 2021, a handful of bitcoin mining firms conducted initial public offerings to much fanfare. In 2022, publicly-traded bitcoin mining firms mined over 46,000 bitcoins collectively. The leading bitcoin miner this year was Core Scientific, the largest bitcoin mining firm in North America. Core Scientific itself mined over 11,000 bitcoins, or 25% of the bitcoins mined by the 15 publicly-traded miners tracked by The Block.

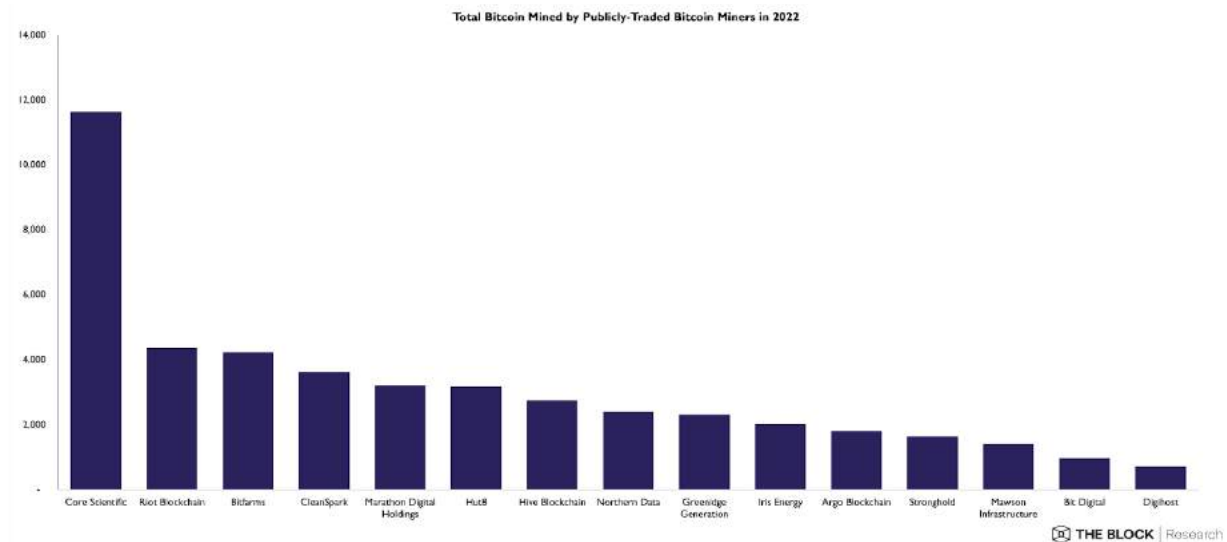


Figure 24: Total bitcoin mined by publicly-traded bitcoin miners in 2022
Source: Public filings and press release

As bitcoin's price slid from ~\$48,000 at the beginning of 2022 to ~\$16k, many public bitcoin miners faced increasing financial distress. In October, Core Scientific announced that it might have to explore bankruptcy if its financial situation did not improve. The firm cited "the prolonged decrease in the price of bitcoin" as one of the primary reasons for its situation. Additionally, firms like Argo Blockchain also continued to struggle to find financing deals to continue to maintain operations.

One of the many reasons why bitcoin mining firms struggled during a price downturn of bitcoin was because many miners held portions of their mined bitcoins in their treasuries, in part as a speculative bet on the future price of bitcoin. Using Core Scientific as an example, the mining giant sold zero bitcoins from January to May despite having mined over 5,000. The firm did not sell its bitcoin until June, following the Fed's first major rate hike and over 30% price drop in bitcoin.

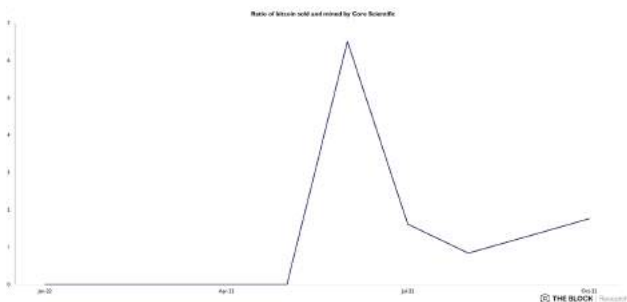


Figure 25: Ratio of bitcoin sold and mined by Core Scientific
Source: Public filings and press releases

In fact, some major bitcoin miners like Marathon Digital, continue to hold all the bitcoins they mined this year. At the time of writing, the 15 publicly-traded bitcoin mining firms tracked by The Block hold over 33,800 bitcoins in total, worth over \$550 million.

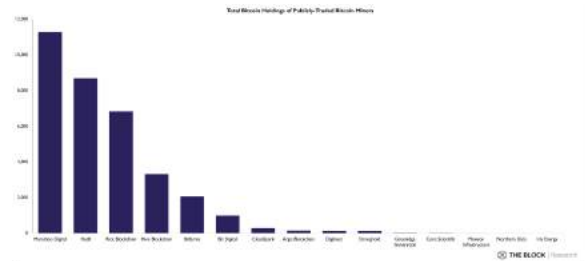


Figure 26: Total bitcoin holdings of publicly-traded bitcoin miners
Source: Public filings and press releases

Miner Revenue

After a record year of revenues in 2021, miners in 2022 saw significant drops to their bottom lines. YTD, Bitcoin miners generated a total of \$8.8 billion in revenue, representing a YoY decrease of 42%. The decrease can be attributed to the plummeting price of bitcoin in 2022, after reaching new highs in 2021.

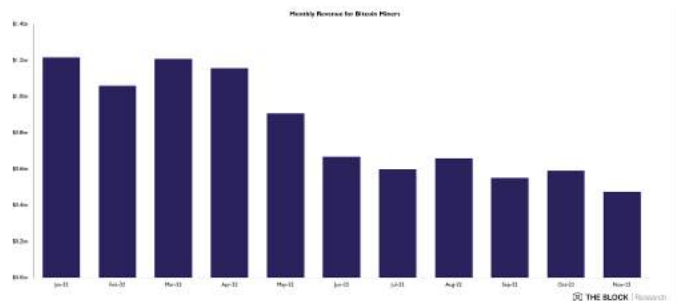


Figure 27: Monthly revenue for bitcoin miners
Source: The Block Data Dashboard

Following the popping of the non-fungible token (NFT) hype bubble, which drove a lot of fee revenue for miners, and the complete obliteration of Ethereum miner subsidies due to The Merge, total ETH issuance dropped 88%, Ethereum miners, and soon validators, saw a collapse in total revenue. Miners who previously made an average of 13,000 ETH a day from mining subsidies are no longer receiving them. Meanwhile, PoS validators continued to receive 1,700 ETH a day in staking subsidies.

YTD, Ethereum miners and validators generated a total of \$9.7 billion in revenue, representing a YoY decrease of 46%. The Merge in September may result in dramatically lower revenue for validators relative to pre-Merge in the foreseeable future, unless transaction

fees rapidly increase. With the ongoing bear market, many miners and mining operations will have to tighten their belts, revisit their finances, and prepare for a potentially prolonged winter.

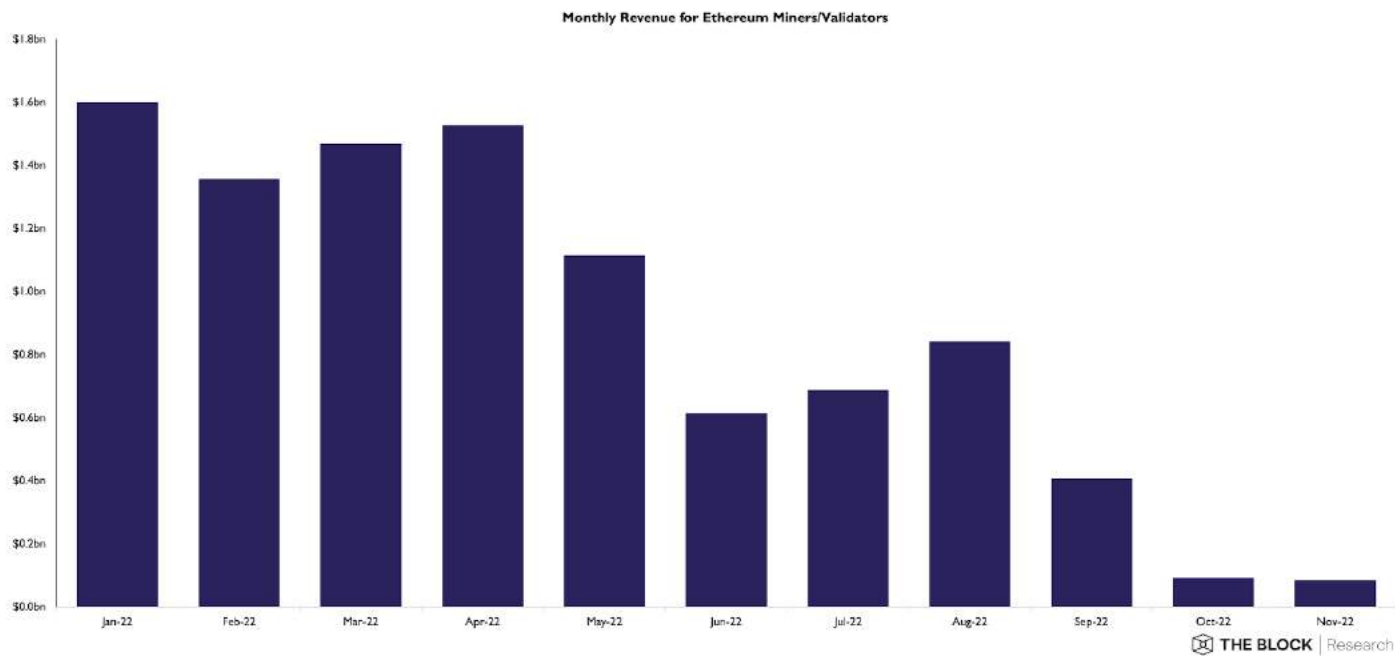


Figure 28: Monthly revenue for Ethereum miners and validators
Source: The Block Data Dashboard

3

Digital Asset Investment: 2022 Overview

Atharv Deshpande, Edvinas Rupkus, John Dantoni



Digital Asset Investment: 2022 Overview

Atharv Deshpande, Edvinas Rupkus, John Dantoni

A look at venture funding, M&A transactions, public market activity, and investor outlook survey results for the digital asset industry.

Quick Take

- Digital asset sector witnessed an allocation of \$30.95 billion across 2,201 funding deals in 2022.
- NFTs/Gaming category raised \$8.32 billion, the largest amount raised by any category in a year.
- Number of M&A deals dropped from 233 to 186 YoY, where firms providing trading services were most active.

more than 50% from its ATH. Within the same period, the sector raised 6,658 venture funding deals, corresponding to \$75.9 billion. 60% of the deals and 78% of the amount raised in the last two years.

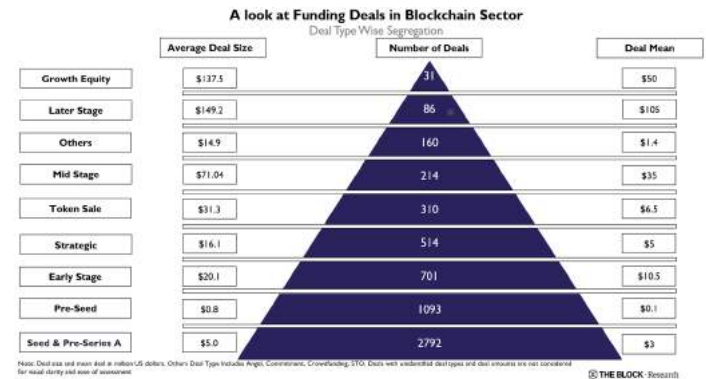


Figure 30: Funding deals in blockchain sector 2017 - 2022

Source: The Block Research



Figure 31: Funding raised relative to digital asset market capitalization 2017 - 2022

Source: The Block Research, CoinGecko

Historical Background of Venture Funding

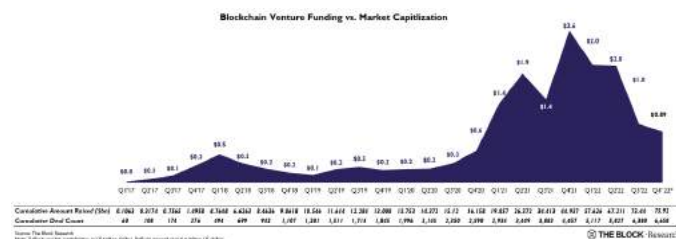


Figure 29: Blockchain venture funding vs. market capitalization 2017 - 2022

Source: The Block Research

The digital asset sector remains a wildly volatile landscape. Over the past six years, market capitalization increased more than 20 times and fell by

The total crypto market cap fell sharply to \$1 trillion, but money infused in the industry barely decreased YoY. It can be inferred henceforth that private funding is typically a lagging indicator of the sector's health and interest. Investment trends exhibit a delayed response to the overall macroeconomic volatility and crypto-specific events. On top of that, many deals are finalized earlier than when they are announced and made public.

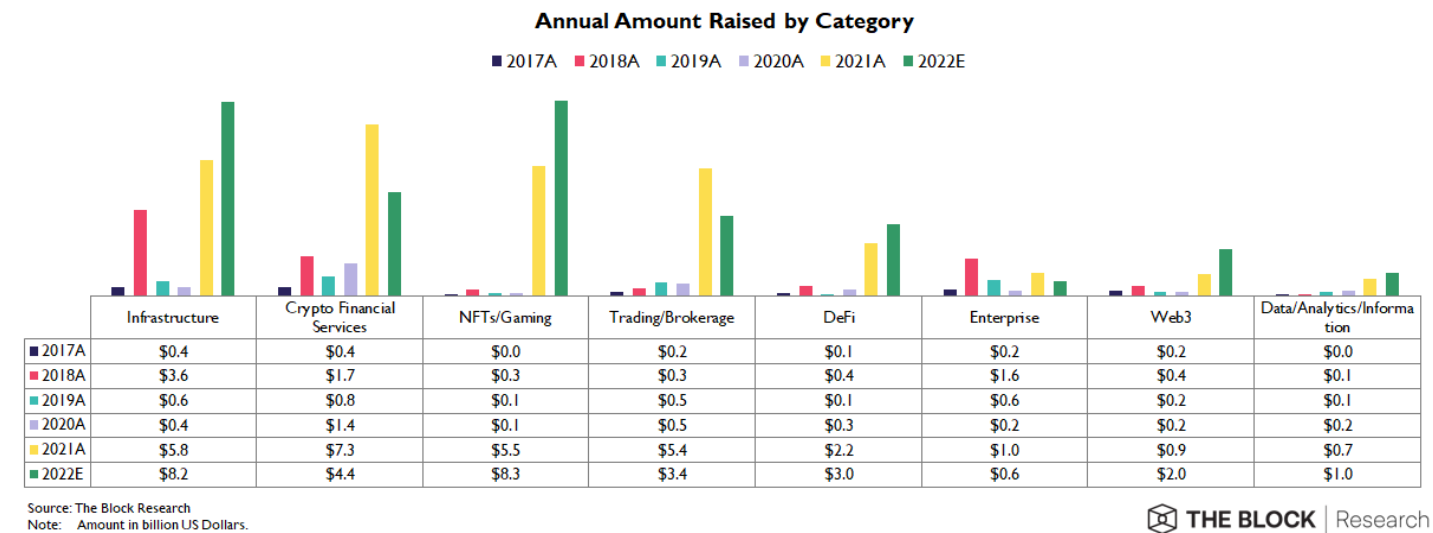


Figure 32: Amount raised by category and year 2017 - 2022
Source: The Block Research

In the last 6 years, projects in the Infrastructure and Crypto Financial Services (CFS) categories attracted the most investments, closely followed by NFTs/Gaming. Companies like Chainalysis, Nansen, and Dune Analytics dominate the Data/Analytics/Information (DAI) category investments, representing 34% of the total investments in that category.

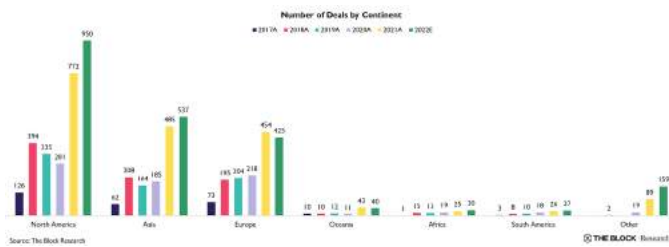


Figure 33: Number of deals by continent 2017 - 2022
Source: The Block Research

Crypto activity is more prominent in North America, Asia, and Europe than the other continents. Throughout this section, these continents are labeled as “Active Continents,” as 91% of the total deals recorded and 95% of the total amount raised are attributable to them. Oceania, Africa, and South America are labeled “Developing Continents.”

Since inception, North America mirrors its lion’s share in global venture investments. The United States consistently contributes to more than 50% of global venture investments since 2017.

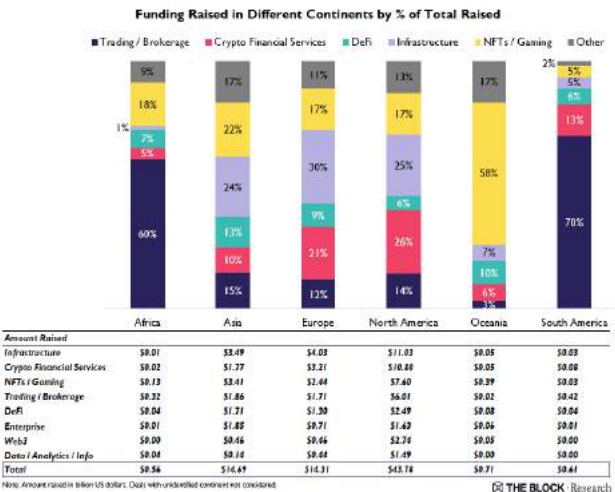


Figure 34: Funding raised in different continents by category 2017 - 2022
Source: The Block Research

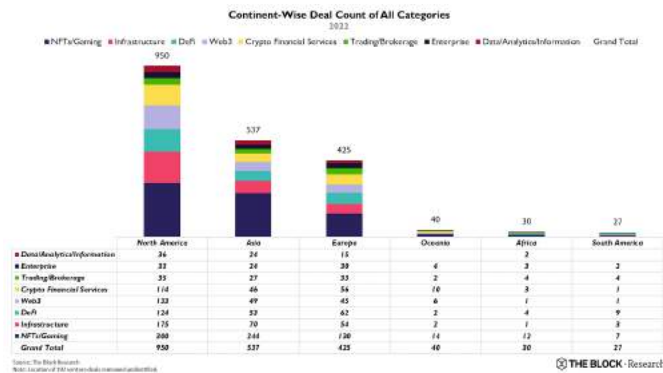


Figure 35: Funding raised in different continents in 2022

Source: The Block Research

CFS and Infrastructure projects account for more than 50% of the total amount raised in North America. Most early development in the industry during 2017-2018 occurred in North America, and the two categories mentioned above were more prevalent during that period.

In Asia, NFTs/Gaming leads the way by contributing 23% of the total amount raised. The increasing demand for alternative income sources, the borderless nature of blockchain games, the rise of Axie Infinity, and the development of Polygon as a scaling solution, along with Polygon's native NFT infrastructure projects, may have played some part in this growth.

As rationale might dictate, a jurisdiction will primarily attract investments into the CFS, Infrastructure, and Trading/Brokerage projects. However, Developing Continents exhibit a different trend.

The Developing Continents are taking noticeable strides in Trading/Brokerage to increase user adoption. Since 2017, South America and Africa have raised \$573 million and \$546 million, respectively. In contrast, the distribution of investments in the CFS and Infrastructure categories is more disproportionate and heavily skewed towards Active Continents, making

them location-agnostic categories as opposed to Trading/Brokerage.

The occurrence of variations in the investment trends for a category is often an indicator of a change in the category's development status or its perceived notion. The yearly trend of the average deal amount of a particular category can be a helpful metric for analyzing a category's development phase.

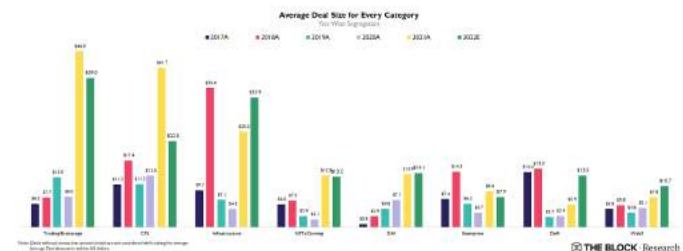


Figure 36: Deal size in different continents by category 2017 - 2022

Source: The Block Research

The average deal size of the blockchain sector is \$15.2 million. CFS, Infrastructure, and Trading/Brokerage record the average deal size above \$15.2 million, courtesy of the growth in Mid and Later Stage deals since 2021.

The average deal size of DAI between 2017 and 2019 was \$2.3 million. However, data analytics platforms caught the attention of venture firms over the last two years, as the average deal amount increased to ~\$14 million since 2021. As the number of users increases, so do market surveillance and compliance complexity. Thus, there would be greater demand for efficient data scraping, visualization, analysis, and surveillance, providing new opportunities in the DAI category.

Consequently, growing on-chain interaction can also be expected with the rise of L1s competing against Ethereum and Layer-2 (L2) solutions. On-chain compliance regulation and analytics firms also gained

more attention as the last twelve months saw a few of the largest investment rounds in DAI, led by companies like Chainalysis, Nansen, and Dune Analytics.

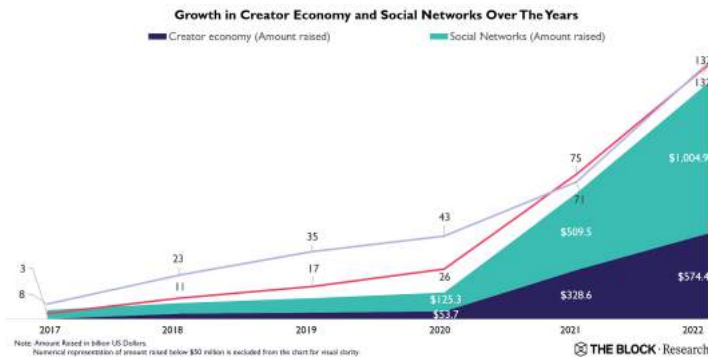


Figure 37: Growth in creator economy and social networks 2017 - 2022

Source: The Block Research

Per our category segregation, growth in decentralized creator economy would point to growth in subcategories hailing from NFTs/Gaming and Web3 like – “creator economy” and “social networks.”

The creator economy will be an exciting theme in the next few years. In the age of Web2, creators are usually at the mercy of traditional media platforms. More often than not, content creators' revenues and royalties are siphoned away from them by centralized multinational social media conglomerates, which could disincentivize many interested individuals from pursuing their passion as a full-time career.

The venture capitalists' investment trends in Figure 37 indicate a rising interest in the creator economy. DeSo, Nation, Farcaster, Lens Protocol, and Braintrust are decentralized alternatives for the social, professional, and talent acquisition networks, which raised upwards of \$100 million each. Royal, All Saints Music Group, One Of, are a few of the active creator economy platforms building music NFTs that raised upwards of \$50 million in investments.

Web3 and NFTs possess the capacity to unlock higher revenue potential and greater transparency for artists and creators. If the competitive multi-chain landscape improves user experience, investments into NFTs/Gaming and Web3 projects may see growth in the near future as more mainstream artists and content creators may embark upon their Web3 journey. More information on NFTs can be found in the [NFTs section](#), while Web3 gaming is covered in the [Gaming & Metaverse section](#).

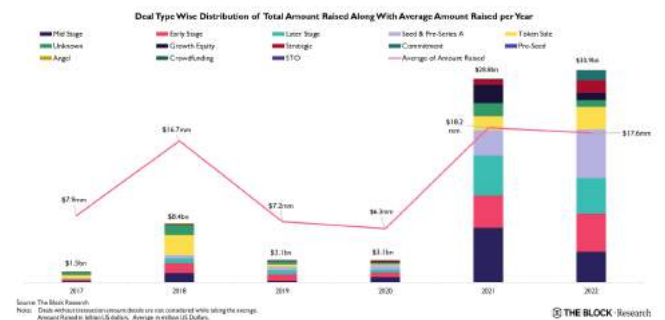


Figure 38: Total amount raised by deal type and the average amount raised per year 2017 - 2022

Source: The Block Research

Early, Mid, and Later Stage deals in the digital asset sector were relatively low until 2020 but were more prominent in 2021 and 2022. A rise in the deal count for these deal types increased the average deal size from \$6.3 million in 2020 to \$18.2 million in 2021 and further to \$17.6 million in 2022.

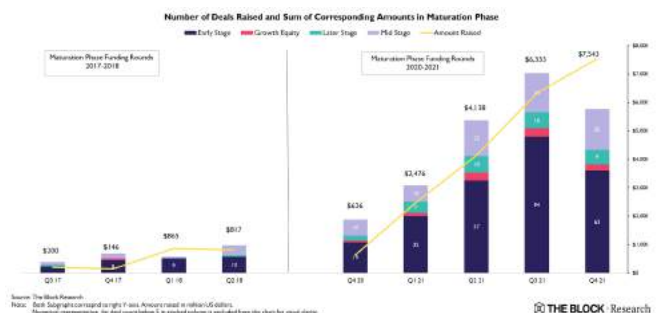


Figure 39: Number of deals raised by maturation phase

Source: The Block Research

The dynamics of the Maturation Phase funding rounds changed in the 2021 bull run. The Block recognizes the capital injection rounds of Growth Equity, Series A, Series B, and beyond as Maturation Phase funding rounds. During Q4 2021 alone, these deal types added a staggering \$7.5 billion.

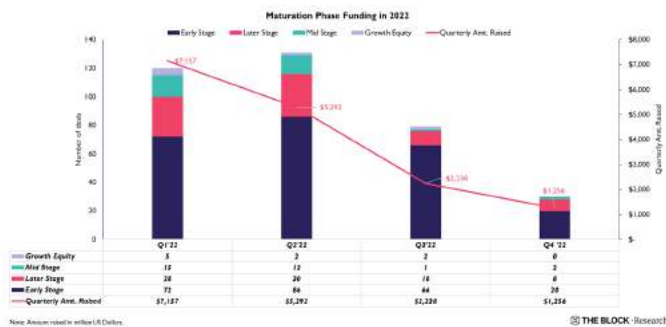


Figure 40: Maturation phase funding in 2022
Source: The Block Research

However, funding dried up in the last two quarters of 2022. Q1 2022 witnessed 120 maturation phase deals, whereas Q4 witnessed only 30 as of the end of November. The fall of FTX and other lenders in November 2022 will cause a further downturn in the investment sector. Going into 2023, we expect a noticeable pullback on venture funding in the digital asset space.

The United States is the torchbearer for the crypto industry. According to The Block Research's funding database, projects from the United States raised 2,526 deals. Furthermore, US-based projects received \$38.6 billion in the last six years.

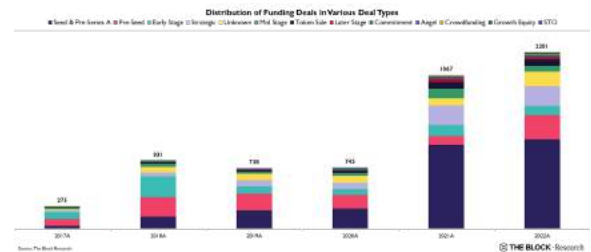


Figure 41: Distribution of funding deals by deal types 2017 - 2022
Source: The Block Research

Investment trends across all categories are cyclical. As discussed, funding deals are a lagging indicator of the sector's health. The 2017-2018 boom was followed by a 202% rise in deal count in 2018, whereas the 2020-2021 bull run was followed by a YoY increase of 150% in 2021 and 15% in 2022. The latter marks the highest deal amount in a calendar year, albeit at a decelerating rate.

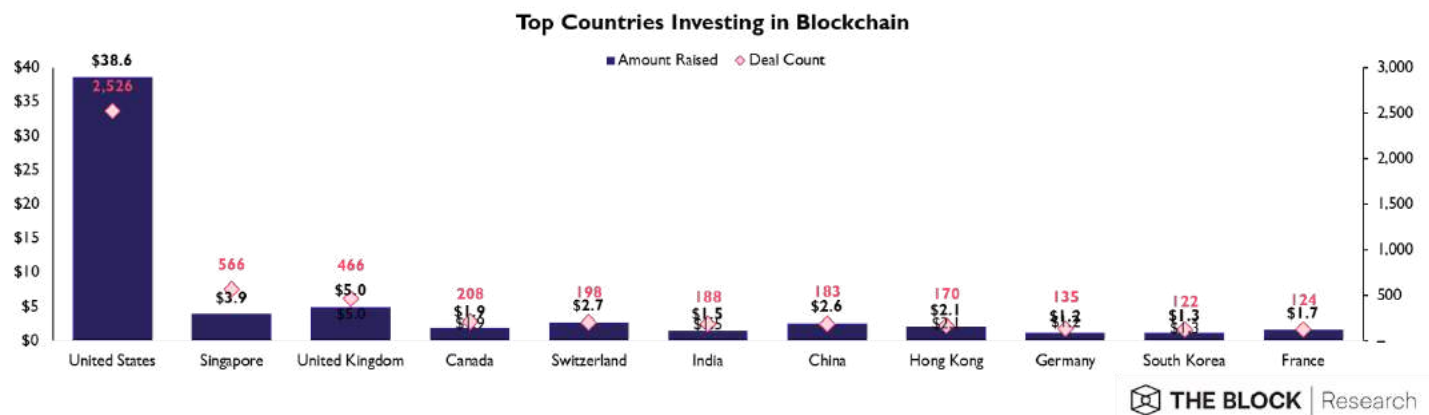


Figure 42: Top countries/regions investing in blockchain technology
Source: The Block Research

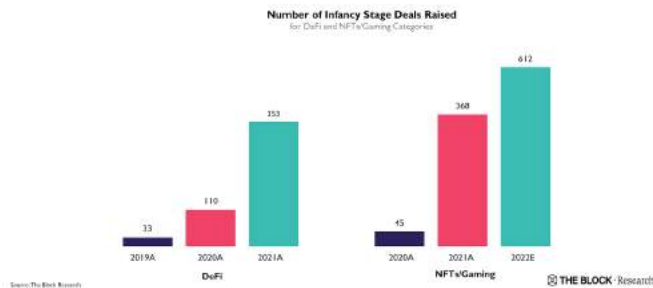


Figure 43: Number of infancy stage deals 2020 - 2022

Source: The Block Research

A growing interest in a particular market category leads to an increase in the number of projects entering that field, driving up the number of deals in the infancy stage. The infancy stage is characterized by Pre-Seed, Seed & Pre-Series A, and Strategic deals.

This trend can be observed in DeFi during 2019-2021 and NFTs/Gaming during 2020-2022. DeFi narrative picked up in 2020, and NFTs soared in 2021. The comparison above considers one year before and after the narrative development. The number of infancy-stage deals in DeFi increased 11-fold from 2020 to 2022 as the introduction of liquidity mining by Synthetix, the rise of Uniswap, the staggering growth of Yearn, etc., helped build the DeFi composability narrative.

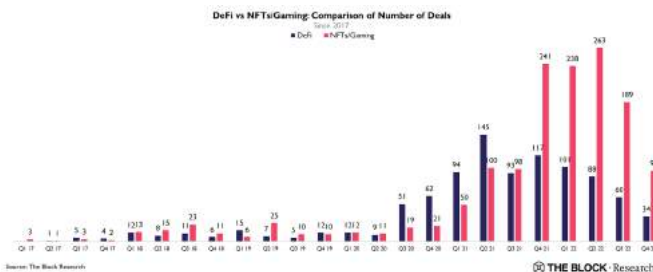


Figure 44: Quarterly number of deals raised by DeFi and NFT/Gaming verticals 2017 - 2022

Source: The Block Research

The rise of Axie Infinity, Facebook joining the metaverse bandwagon, and the cheaper L1 alternatives for high-volume in-game transactions led to a boom in new NFTs/Gaming projects during 2021-2022. During 2020-2022, yearly deals in the infancy stage for NFTs/Gaming rose from 45 to 612.

In the last six quarters, the exponential growth of deal count for DeFi was replaced by NFTs/Gaming.

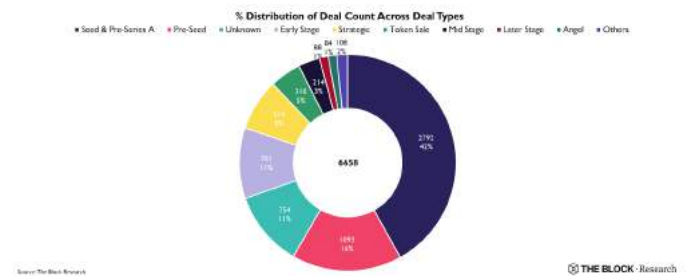


Figure 45: Share of deal count by deal types

Source: The Block Research

42% of the total deals in the sector recorded since 2017 are at the Seed level. 1,093 deals occurred in the Pre-Seed rounds. Early Stage deals rose in the last two years, as 69% of Early Stage deals occurred since 2021.

State of Venture Funding in 2022

Type	Transactions	Amount Raised
Venture Funding	2201	30.95 Billion
M&A	186	3.35 Billion

THE BLOCK · Research

Figure 46: Number of transactions and amount raised by investment activities in 2022

Source: The Block Research

Although the market capitalization of the digital asset sector plummeted, venture funding deals increased YoY by 17%, whereas the amount raised increased by 7%.



Figure 47: Venturing funding by category in 2022

Source: The Block Research

The NFTs/Gaming category raised the highest number of deals at 786, while DAI raised the lowest at 82 this year. One reason DAI reflects such a low deal count is that some data analytics firms focus on infrastructure development or developer toolings, which is included in the Infrastructure category and not in DAI.

Although Infrastructure and NFTs/Gaming raised similar amounts at \$8.2 billion and \$8.3 billion each, the latter accounted for more deals at 786 than the former at 334.



Figure 48: Amount Raised by deal types and stages in 2022

Source: The Block Research

NFTs/Gaming raised more in Seed rounds, whereas Infrastructure raised more in mid and later-stage rounds. Of the \$1.3 billion raised via token sales in the Infrastructure category, \$1 billion came from Luna Foundation Guard (LFG)'s raise from Jump Crypto and 3AC.

The average deal size for Infrastructure and NFTs/Gaming is \$30.5 million and \$12.7 million, respectively.

We will dive deeper into every category to inspect the available dataset through a category-specific lens.

Crypto Financial Services

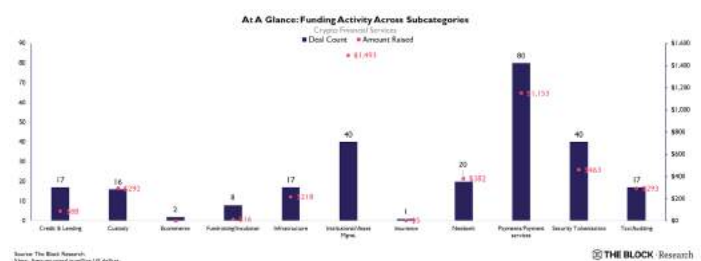


Figure 49: CFS funding activity by subcategory in 2022

Source: The Block Research

CFS projects raised \$4.4 billion across 258 deals. Institutional Asset Management and Payment/Payment Services subcategories contributed to ~60% of the amount raised. Fireblocks, a digital asset custodian,

raised \$550 million in a series E round. On the other hand, Circle, a payment services company that developed USDC raised \$400 million in a growth equity round at a valuation of \$9 billion.

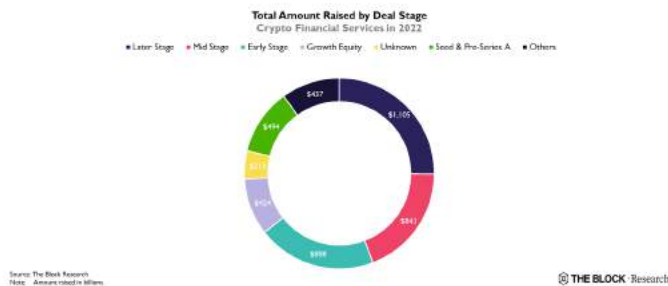


Figure 50: CFS total amount raised by deal stage in 2022
Source: The Block Research

We can infer that CFS as a category matured over the years, as 74% of the total investment in 2022 belongs to the Early, Mid, and Later Stage deals and Growth Equity.

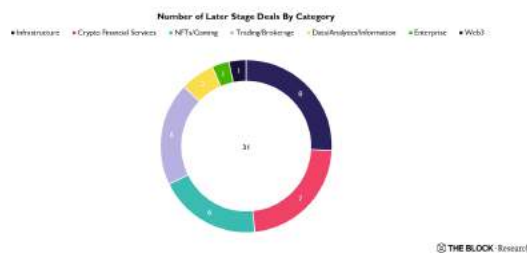


Figure 51: Number of later-stage deals by category in 2022
Source: The Block Research

Of the 31 Later Stage deals, 7 deals belong to the CFS category.

Infrastructure

Infrastructure raised \$8.2 billion in 2022. The category consistently increases the funds raised YoY, suggesting it is the least affected by bear markets. Although the rise and fall in engagement in the industry at times may be narrative-driven, be it the NFT mania of 2021 or the recent market crash of 2022, the need for infrastructure

development to increase user adoption and improve user experience, security, and scalability is constant. Despite potentially lower venture funding in the coming quarters, we expect infrastructure investments to weather the storm.



Figure 52: Infrastructure funding activity by subcategory in 2022
Source: The Block Research

Within Infrastructure subcategories, L1s and Mining/Staking Infrastructure projects consistently attracted investments. Whereas R&D investments are on the rise starting in 2021.

Rise of Scaling Solutions for Ethereum and other Layer-1s

Since its inception, Ethereum spearheaded the DeFi sector. As user adoption for Ethereum increased exponentially in 2020-2021, transaction costs skyrocketed. Ethereum's design limits the number of transactions it can process, averaging at 13 transactions per second (TPS), but the transactions submitted on the blockchain were oftentimes much higher. The average transaction cost for May 2021 was as high as \$70. This rendered retail market participants unfit to interact with Ethereum and gave rise to other L1 blockchains and L2 scaling solutions. Scaling solutions offer increased transaction speed and higher transaction throughput without sacrificing the decentralization or security of the Ethereum base layer. The exorbitant gas price of Ethereum led to a supply-demand gap that made retail investors exercise

other alternative blockchains. Until early 2020, 94% of the total value locked (TVL) was concentrated on Ethereum. As of this writing, the TVL is more distributed as 58% of the TVL belongs to the Ethereum blockchain, and the rest is divided amongst BNB Chain, Tron, Polygon, etc.



Figure 54: Number of mid-stage deals by category in 2022

Source: The Block Research

23% of total Mid-stage deals in 2022 belonged to the Infrastructure category.

NFTs/Gaming

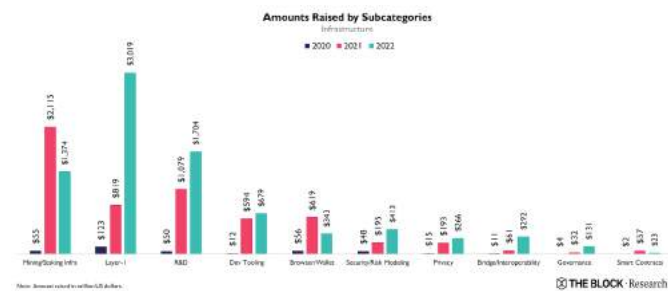


Figure 53: Infrastructure amount raised by subcategory 2020 - 2022

Source: The Block Research

Subcategories like L1s, R&D, and Bridge/Interoperability, which work towards developing a more frictionless end-user experience, garnering more interest YoY since 2020.

Capital injections in R&D steadily increased over the last three years. The amount raised by projects under the R&D subcategory grew from \$50 million to \$1.7 billion in the respective years of 2020 and 2022. Consensys, an R&D company that offers services ranging from consulting to developing turn-key blockchain-based projects, raised \$715 million since 2021.

Polygon Technology, OP Labs PBC, Offchain Labs, and StarkWare are some notable R&D companies building scaling solutions that raised ~\$1 billion dollars collectively. All these raises sprung up in the last two years to attract users and developers since the Ethereum base layer was unfit for daily transactions.

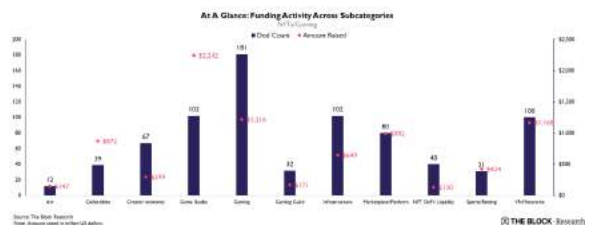


Figure 55: NFTs/Gaming funding activities by subcategory

Source: The Block Research

NFTs/Gaming category raised \$8.3 billion in 2022, which is a record amount raised by a category in a calendar year. Virtual reality (VR)/Metaverse and blockchain gaming are the preferred themes for investors, as around half of the investments correspond to Game Studio, Gaming, and VR/Metaverse subcategories.

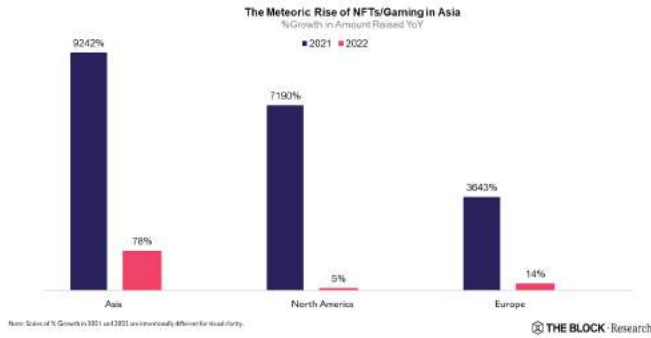


Figure 56: Growth in the amount raised in NFTs/Gaming category by active continent 2021 - 2022
Source: The Block Research

Asia witnessed a massive boom in NFTs/Gaming since 2021, as the number of new projects founded in 2021 increased by 400% YoY. The total amount raised YoY for the same year grew by an astonishing 9,242%, followed by a 78% growth in 2022. The rise of Axie Infinity, a play-to-earn (P2E) blockchain game, kickstarted the NFT Mania in Asia and the rest of the world as the AXS token price rose from \$0.25 to \$165 at the 2021 peak.

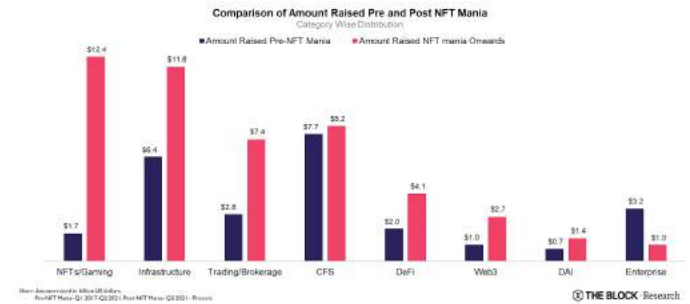


Figure 57: Amount raised pre- and post-NFT mania (Q3 2021) by category
Source: The Block Research

NFTs/Gaming attracted funds at an unprecedented rate since NFT mania began in Q3 2021. The category witnessed a 562% growth in the recent five quarters over the previous 16 quarters.

The NFTs/Gaming category raised the highest number of Pre-Seed, Seed & Pre-Series A, and Early Stage deals in 2022.

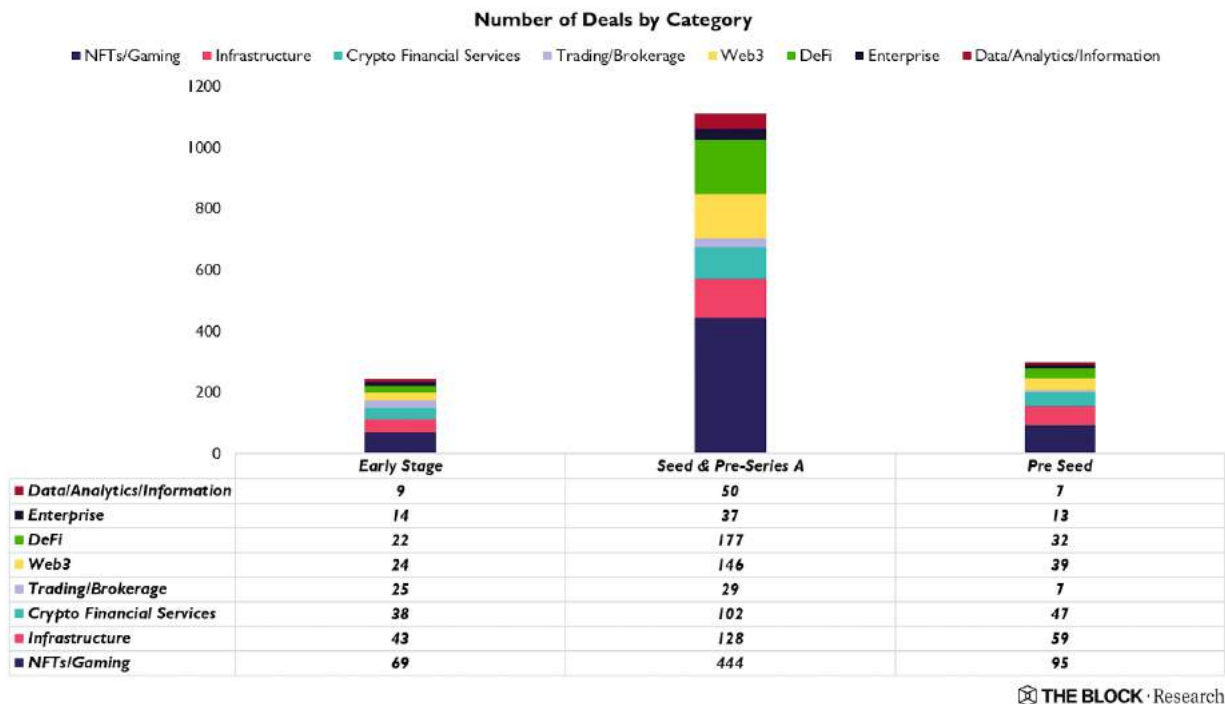


Figure 58: Number of deals by category and deal type in 2022
Source: The Block Research

Trading/Brokerage

Although Infrastructure and NFTs/Gaming investments raised 45% more YoY, Trading/Brokerage and CFS investments dropped by 40%. The drop in the funding for the latter two categories can be attributed to the maturation phase of each investment vertical. For instance, CFS and Trading/Brokerage raised over \$12 billion in funding in 2021 and thus achieved maturity within the scale of its operating market. Meanwhile, NFTs/Gaming was still in its nascent stage in 2021 and was able to attract more funding in 2022, unencumbered by the market downturn. Nonetheless, funding data is likely to be a lagging indicator and would only reflect the winter market in the subsequent years.



Figure 59: Trading/Brokerage funding activities by subcategory in 2022
Source: The Block Research

Before FTX went bust, the Sam Bankman-Fried-led organization raised \$800 million this year. FTX, a trading service platform more focused on derivatives products, had benefited the most from investors' insatiable appetites before they became insolvent. FTX acquired a total of \$1.8 billion of investments since its inception. FTX had expanded its global presence over the last three years. As of Q1 2022, the company was valued at \$32 billion. FTX and Alameda Research shutting down is arguably the black swan event that caused further negative consequences for the industry.

On the other hand, Binance.US, the American counterpart of Binance, raised \$200 million in a seed

round. In Asia, exchanges like Coinswitch Kuber and CoinDCX from India, Pintu from Indonesia, and Matrixport, a Singapore-based brokerage firm, raised Mid or Later stage deals. These exchanges developed consumer-centric products and services, creating a conducive environment for retail and institutional traders. Asian markets accounted for 43% of global cryptocurrency activity between June 2020 and June 2021.

Web3

The Web3 category saw a change in fortune in the last couple of years. It saw a 230% rise in 2018 during the ICO boom, only to plunge the following year by 59% in terms of the amount raised.

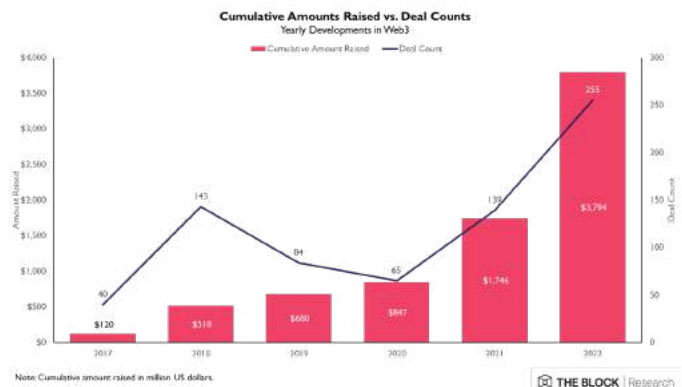


Figure 60: Web3 funding activity 2017 - 2022
Source: The Block Research

In the last three years, the dollars raised and deal count increased steadily every year.

Web3 will flourish in a developed infrastructure that allows a multi-chain presence of a protocol, interoperability of tokens across various blockchains, and cross-chain bridging of assets. Such infrastructure was relatively underdeveloped in 2018 and 2019. They are decentralized network and tool providers that help to connect decentralized application (dapp) builders

with multiple blockchain ecosystems, applications, and users for frictionless cross-chain communication.

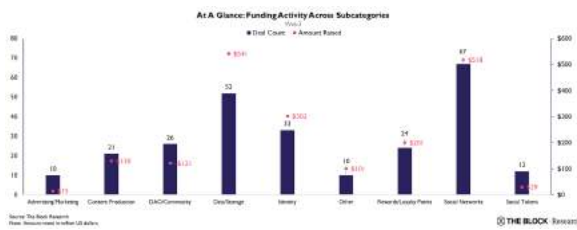


Figure 61: Web3 funding activity by subcategory in 2022

Source: The Block Research

In 2022, Web3 projects raised \$1.9 billion across 255 deals. Helium, a peer-to-peer wireless infrastructure that provides connectivity for the Internet of Things (IoT) devices powered by the Helium blockchain, raised \$200 million this year and \$326 million in total over the years from a16z, Tiger Global, Multicoin Capital, etc.

Data/Analytics/Information

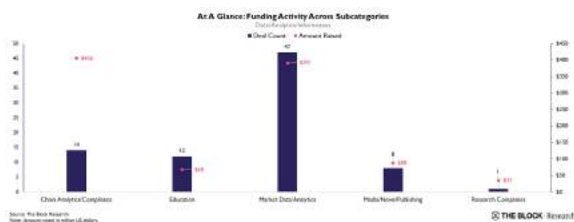


Figure 62: DAI funding activity by subcategory in 2022

Source: The Block Research

Companies that classify under the Chain Analytics and Market Data/Analytics subcategories raised \$406 million and \$391 million, respectively. 37% of the money raised by DAI projects is through Mid Stage deals. 8 Mid-stage deals correspond to \$370 million. Market Data/Analytics companies, Dune and Kaiko, each raised a Series B funding round in 2022.

Chainalysis, a blockchain analytics & surveillance company that helps government and private agencies

analyze cryptocurrencies for compliance, education, and investigation, dominates the funding landscape for the category. It raised \$170 million in 2022 in a Later Stage deal. Chainalysis raised \$535 million to date, corresponding to 27% of the total amount raised by this category.

Future is Multi-chain

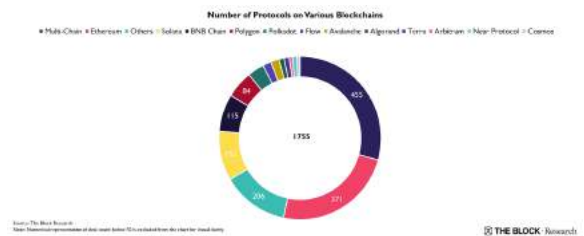


Figure 63: Number of deals by blockchain 2017 - 2022

Source: The Block Research

Since 2017, 1,755 projects have raised a total of \$18 billion in funding. Since the monumental DeFi summer in 2020, the decentralized financial applications gained some user confidence, further percolating into blockchain gaming and NFT projects. The rise in Ethereum gas fees caused more and more applications to consider other L1s as their base layer, such as Solana, BNB Chain, Polygon, etc.

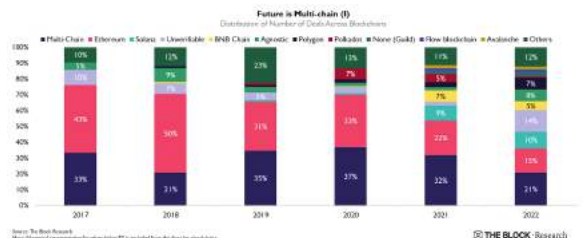


Figure 64: Share of deals by blockchain 2017 - 2022

Source: The Block Research

However, the future seems to be multi-chain with improving infrastructure for asset interoperability.

In the last two years, multi-chain projects raised the highest number of deals dethroning Ethereum.

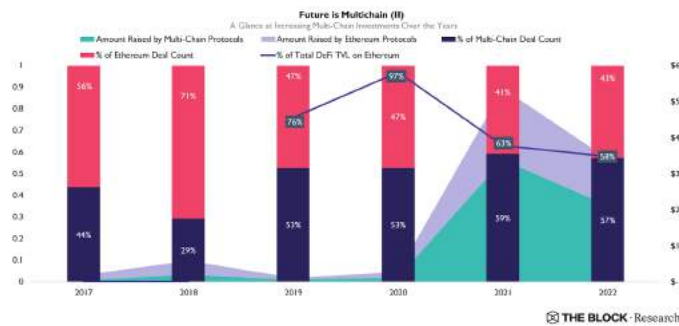


Figure 65: Amount raised by Ethereum- and multi-chain-based projects 2017 - 2022
Source: The Block Research

6 out of 23 largest deals in the digital asset sector occurred at the Mid-Stage level. 19 deals occurred in 2021 and 2022.

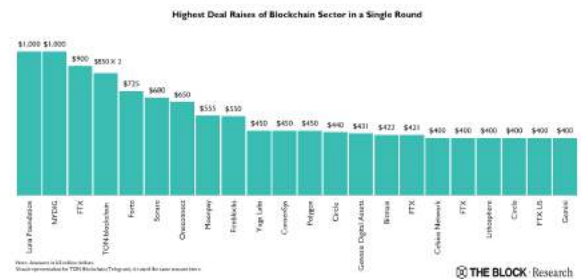


Figure 66: Largest crypto raises in a single round
Source: The Block Research

Since 2021, multi-chain projects also lead the way regarding the total amount raised. 92% of the total multi-chain investment occurred since 2021. In 2022, Polygon, Solana, Flow, and ImmutableX gained momentum since the 2020 bull run.

Overview of the Largest Raises

This section contains an analysis of the funding raises above \$400 million in the blockchain sector.

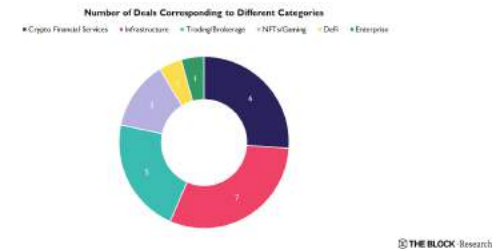


Figure 67: Largest crypto raises by category
Source: The Block Research

Notably, DAI and Web3 categories had no single deal worth above \$400 million.

Project/Company	HQ	Year Founded	Category	Sub-Category	Quarter	Amount (millions)	Valuation	Deal Type	Round
Luna Foundation Guard	Singapore	2022	DeFi	Decentralized Stablecoin/Indices	Q1 2022	\$1,000	n/a	Token Sale	Token Sale
NYDIG	United States	2017	Crypto Financial Services	Institutional/Asset Mgmt.	Q4 2021	\$1,000	n/a	Growth Equity	Growth Equity
FTX	United States	2018	Trading/Brokerage	Pure exchange	Q3 2021	\$900	n/a	Mid Stage	Series B
TON blockchain	BVI	2018	Infrastructure	Layer-1	Q1 2018	\$850	n/a	Token Sale	Token Sale
Forte	United States	2019	NFTs/Gaming	Gaming	Q4 2021	\$725	1000	Mid Stage	Series B
Sorare	France	2018	NFTs/Gaming	Sports/Betting	Q3 2021	\$680	4300	Mid Stage	Series B
Oneconnect	China	2015	Enterprise	DLT	Q1 2018	\$650	n/a	Early Stage	Series A
Moonpay	United States	2018	Crypto Financial Services	Payments/Payment services	Q4 2021	\$555	3400	Early Stage	Series A
Fireblocks	United States	2018	Crypto Financial Services	Institutional/Asset Mgmt.	Q1 2022	\$550	8000	Later Stage	Series E
Yuga Labs	United States	2021	NFTs/Gaming	Game Studio	Q1 2022	\$450	4000	Seed & Pre-Series A	Seed Round
ConsenSys	Switzerland	2014	Infrastructure	R&D	Q1 2022	\$450	7000	Later Stage	Series D
Polygon	India	2017	Infrastructure	Layer-1	Q1 2022	\$450	n/a	Token Sale	Token Sale
Circle	United States	2013	Crypto Financial Services	Payments/Payment services	Q2 2021	\$440	n/a	Growth Equity	Growth Equity
Genesis Digital Assets	United Kingdom	2021	Infrastructure	Mining/Staking Infra	Q3 2021	\$431	n/a	Growth Equity	Growth Equity
Bitmain	China	2013	Infrastructure	Mining/Staking Infra	Q3 2018	\$422	12000	Mid Stage	Series B Extension
FTX	United States	2018	Trading/Brokerage	Pure exchange	Q4 2021	\$421	25000	Mid Stage	Series B Extension
Celsius Network	United Kingdom	2017	Crypto Financial Services	Credit & Lending	Q4 2021	\$400	3000	Mid Stage	Series B
FTX	United States	2018	Trading/Brokerage	Pure exchange	Q1 2022	\$400	32000	Later Stage	Series C
Lithosphere	United States	2016	Infrastructure	Layer-1	Q2 2022	\$400	n/a	Commitment	Commitment
Circle	United States	2013	Crypto Financial Services	Payments/Payment services	Q2 2022	\$400	n/a	Growth Equity	Growth Equity
FTX US	United States	2020	Trading/Brokerage	Pure exchange	Q1 2022	\$400	8000	Early Stage	Series A
Gemini	United States	2014	Trading/Brokerage	Pure exchange	Q4 2021	\$400	7100	Unknown	Unknown

Note: BVI= British Virgin Islands

Source: The Block Research

Figure 68: Details of largest crypto raises
Source: The Block Research

Assessment of Crypto Unicorns

Since 2018, The Block Research observes and analyzes the digital assets sector. Although the industry is often referred to as nascent, the development and progression of later-stage companies over the past couple of years show signs of maturation.

To track this progression, The Block Research created “The Block Unicorn Index.” Qualification for the Index was determined through the public valuations of private rounds, estimated revenue based on comparable exchange volumes, and industry sources. Token-based projects were considered for unicorn status if they had conducted a private funding round that equated to a valuation of more than \$1 billion. It is crucial to note that the companies considered unicorns under the block index “were” unicorns at some point in time. Companies and projects included may or may not retain their unicorn status, due to reasons such as going public (e.g., Coinbase), completing a down round with a lower valuation, bankruptcy, repricing of private equity, etc. For this analysis, we consider a project to be a unicorn based on public valuations of a private round.

Of our list of 116 companies, at least 7 publically lost unicorn status, with the bulk of them being related to the FTX and Alameda Research fallout. This includes FTX, FTX US, and Liquid Global, the Japanese-based crypto exchange that was acquired by FTX in April 2022.

Other firms that lost unicorn status include crypto lenders BlockFi and Celsius Network, both of which filed for bankruptcy, and the crypto derivatives exchange Deribit, which raised a down round from existing investors at a \$400 million valuation. The one exception from the list includes the crypto exchange Coinbase, which only lost unicorn status due to the technicality that it is no longer privately owned.

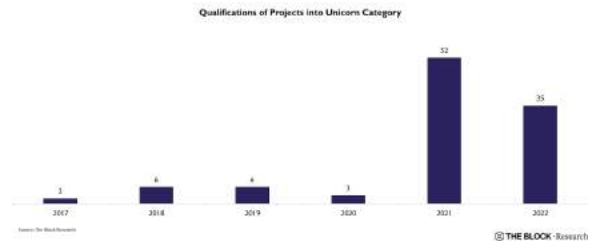


Figure 69: Number of crypto unicorns by qualification year
Source: The Block Research

Of the 116 crypto unicorns, 87 achieved the status in the last two years, suggesting maturation in the industry. The exact year of qualification of 12 companies, including Binance, Huobi, etc., is unavailable and is therefore assessed based on their revenues, exchange volumes, etc.



Figure 70: Number of crypto unicorns by continent
Source: The Block Research

North America is the frontrunner in the race to originate unicorns, and 59 of the tally is contributed by the United States.

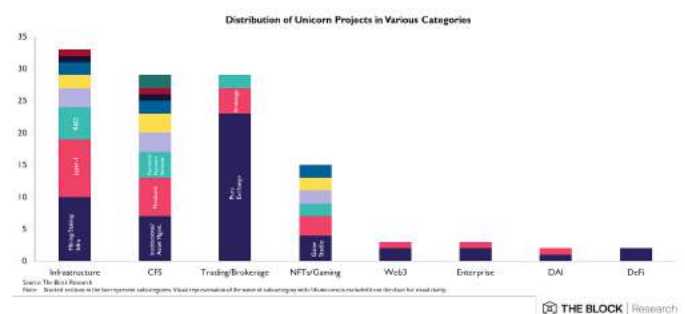


Figure 71: Number of crypto unicorns by category
Source: The Block Research

Infrastructure is the category with the highest number of projects with unicorn status. Mining/Staking

Infrastructure and L1 correspond to 19 of the 33 Infrastructure unicorns. The Trading/Brokerage category reflects 29 unicorns.

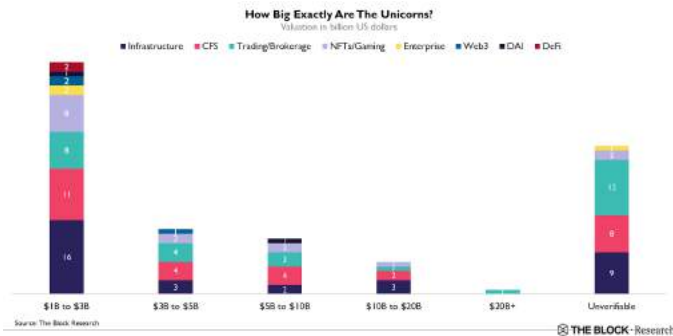


Figure 72: Number of crypto unicorns by valuation
Source: The Block Research

FTX's valuation of \$32 billion before it filed for bankruptcy was the highest valuation at which a crypto company raised a private investment round. It can be speculated that Binance, the largest crypto exchange, may also post a similar valuation.

32 companies raised money at a valuation upwards of \$1 billion but did not specify the exact number.

Aside from determining which companies in the crypto market reached unicorn status, The Block Research examined all of the funding rounds completed by these firms to track which investors had invested in the most unicorn teams at the seed to early-stage level.

Any investment by an investor that was made after a Series A deal or in a deal where the valuation was already at \$1 billion or more was not included in this analysis. By looking particularly at the seed to early-stage level, one can better decipher which investors could identify unicorns early as opposed to investors who had only participated in a funding round of a unicorn after it had already reached a degree of success.

Investors within the top ten of the most unicorn investments at the seed to early stage level include Coinbase Ventures, Digital Currency Group, a16z Crypto, Dragonfly Capital, Galaxy Digital, Polychain Capital, Pantera Capital, Paradigm, Blockchain Capital, CoinFund, Multicoon Capital, and Binance Labs. The tenth spot was tied three ways between CoinFund, Multicoon, and Binance Labs, with 7 investments each.

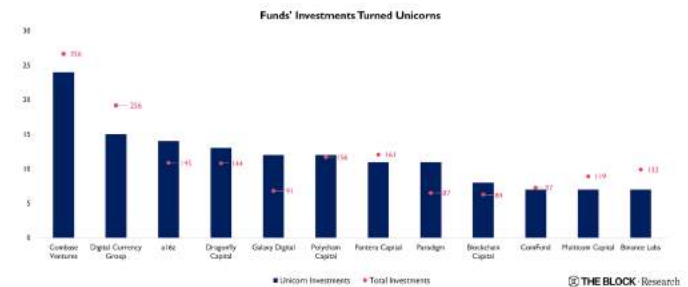


Figure 73: Number of investments turned Unicorns by investor
Source: The Block Research

Coinbase Ventures, the venture arm of the publicly traded cryptocurrency exchange Coinbase, historically made the most investments in the crypto sector (356) and also invested in the most unicorns (24) at the seed to early-stage level. Of its 356 investments, roughly 7% turned into a company valued at \$1 billion or more.

Digital Currency Group (DCG), founded by Barry Silbert in 2015, made at least 256 investments in numerous verticals that stretch the digital asset space and invested in at least 15 companies at the seed to early-stage level that turned into unicorns.

a16z, which launched its own crypto-specific fund with a16z Crypto, tops off the top three with the third most unicorn investments, where it made 14 investments at the seed to the early-stage level.

An intriguing observation amongst investors with unicorn investments was when these firms were

established. There was an even split between the two time periods. Half of the investors began investing in the crypto space between 2013-2016 (i.e., before the 2017 bull run), whereas another half were established in 2018, except for Multicoine Capital which was founded in May 2017.

Other Notable Unicorn Trends

Some firms that just missed the list of most unicorn investments at an early-stage level or lower included ConsenSys Ventures (6), Liberty City Ventures (5), Alameda Research (5), Lightspeed Venture Partners (5), SV Angel (5), Initialized Capital (5), CMT Digital (5), Libertus Capital (5), Fenbushi Capital (5), Electric Capital (5), and Hashed (5).

An interesting observation amongst Alameda Research and Animoca Brands is that they had a noticeably low percentage of investments that resulted in a unicorn startup. Animoca Brands completed the second most investments in the crypto sector since 2017, with 238; however, only four led to a unicorn company. Alameda Research, which eventually transitioned into FTX Ventures before eventually declaring bankruptcy, also turned 2% of its investment into a crypto-related unicorn.

On the contrary, Winklevoss Capital had a noticeably high percentage of its total investments turned into unicorns. Of the firm's 24 investments, 6 or 25% had made it to unicorn status.

For reference, among the investors within the top ten of the most unicorn investments at the seed to early stage, the average rate of their investment turning into a unicorn was ~8%.

Most Active Investors

Among the most active investors (MAIs) in 2022, ten of them stood out the most. Coinbase Ventures, Animoca Brands, Alameda Research & FTX Ventures (note: combined because they were closely related), Shima Capital, Jump Capital, Polygon Studios, Solana Ventures, GSR Capital, Spartan Group, Dragonfly Capital, collectively participated in 975 deals in 2022.

Investors' appetite lessened as the broader crypto market experienced a downturn, exacerbated by the bankruptcies that also sent shockwaves across the venture capital markets.

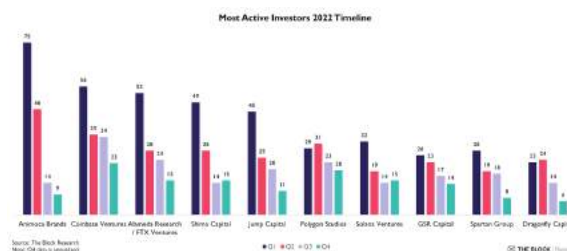


Figure 74: Number of deals made by MAIs in 2022 by quarter
Source: The Block Research

MAIs were more active in the first half of the year, while Q3 and Q4 saw funds tighten their belts across the board. Notable is the disparity between Coinbase Ventures and Animoca Brands decreases, because Coinbase Ventures is still steadily deploying capital albeit at a slower pace, whereas Animoca Brands slowed down significantly. Robby Yung, the CEO of Animoca Brands, commented that the quality of teams that approach them is still relatively high, but the slowdown reflects “what kind of teams have the ability to build and raise in a more challenging market.”

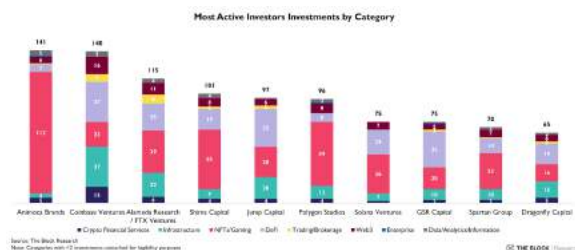


Figure 75: Number of deals made by MAIs in 2022 by category

Source: The Block Research

The NFTs/Gaming category was the leading theme in the 2022 venture capital market. Animoca Brands, Shima Capital, and Polygon Studios saw a big majority of their investments going to projects in the realm of crypto gaming and NFTs. On the other hand, Coinbase Ventures, Alameda Research & FTX Ventures, and Dragonfly Capital applied a more diversified approach to investing by allocating funds to more projects in Web3, Infrastructure, and CFS categories.

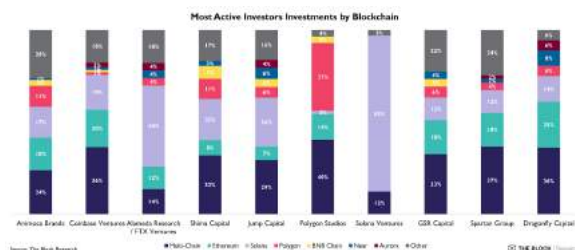


Figure 76: Share of deals made by MAIs in 2022 by blockchain

Source: The Block Research

Investments by blockchain depicted in Figure 76 only consider on-chain investments and exclude investments from unverifiable protocols. Multi-chain protocols seem to be a primary focus for MAIs, and projects hosted on Ethereum or Solana blockchains were the second and third most popular, respectively. It is important to note that a vast majority of multi-chain projects include Ethereum and a combination of other blockchains. Some of the outliers from this trend include native ecosystem funds such as Solana Ventures or Polygon Studios that organically try to foster growth within their ecosystem.

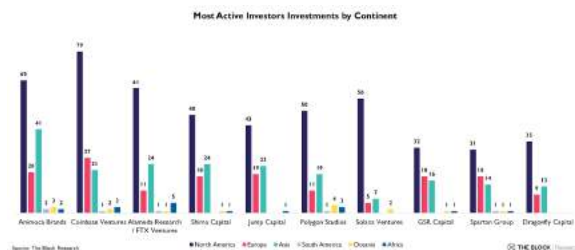


Figure 77: Number of deals made by MAIs in 2022 by headquarter continent

Source: The Block Research

Projects headquartered in North America and Asia are the most common locations that active crypto firms allocate their funds to, more specifically, the United States and Singapore being the major crypto hubs. It is natural to suspect that North American firms would allocate relatively more capital to projects headquartered in their local jurisdictions, and Asian funds such as Animoca Brands would do the same. The MAIs participated in very few deals for companies headquartered in Africa, South America, and Oceania. Deals with unverifiable headquarter location were omitted from this analysis.

Mergers & Acquisitions

Historical Overview

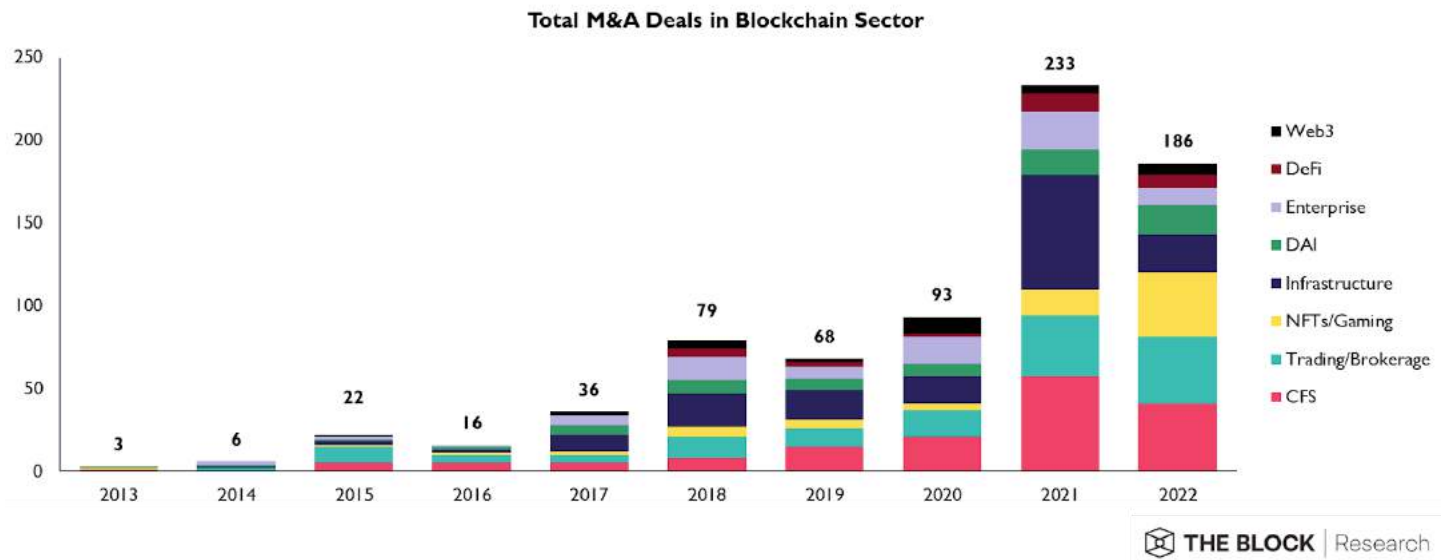


Figure 78: M&A deals in crypto 2013 - 2022
Source: The Block Research

Since 2013, the merger and acquisition (M&A) sector witnessed significant growth, with 88% of the deals occurring in the last five years. Meanwhile, 2021 saw the maximum consolidation across categories in the digital asset sector, showcasing a record 233 transactions. NFTs/Gaming witnessed record consolidation in 2022 with 39 deals, 23 more than in 2021.

More mature categories like CFS, Infrastructure, and Trading/Brokerage observed higher consolidation than the rest of the categories. These three categories accounted for 61% of the total M&A deals. In 2022, 86% of the documented amount transacted was attributed to the categories mentioned above. Infrastructure consolidations dropped from 69 to 23 YoY in 2022.

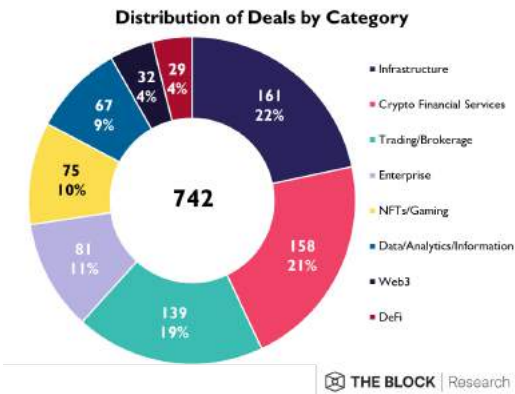


Figure 79: M&A deals by category
Source: The Block Research

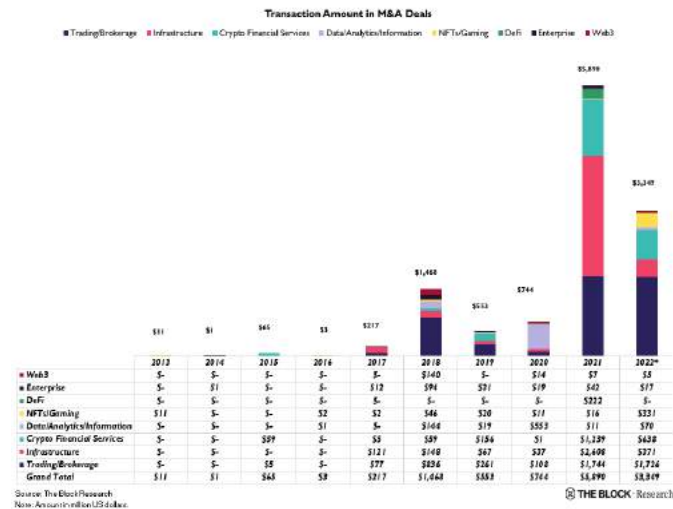


Figure 80: M&A transaction amount 2013 - 2022

Source: The Block Research

75% of the total amount transacted in M&A corresponds to the last two years, where most purchasing parties were pre-existing crypto native players, reflecting operational dynamics change for category-leading players as they changed strategies. More prominent organizations acquired the smaller players in the market to weed out the competition and diversify into an entity providing a full range of product/service suites. As markets cool off after bull runs, the correction tends to offer lucrative deals for acquirers.

A YoY increase of more than 100% happened only twice in the last 10 years, and both incidents occurred after bull runs in the sector.



Figure 81: M&A amount transacted by category (in billions)

Source: The Block Research

Trading/Brokerage accounted for 139 M&A transactions totaling \$4.94 billion. Pure Exchange and Brokerage subcategories contribute ~95% of the total amount transacted in Trading/Brokerage M&A.

\$3.5 billion of consolidation is attributed to projects under Infrastructure. R&D and Mining/Node Infrastructure are two dominating categories that contribute to 70% of the total deals under Infrastructure. It also makes up 93% of the total transaction amount recorded under Infrastructure deals.

The NFTs/Gaming category corresponds to 75 M&A deals. The deals are spread over various subcategories like Game Studio, Gaming, Infrastructure, Marketplace Platform, etc.

The Distributed Ledger Technology subcategory comprised the most consolidation under the Enterprise category, with 29 companies. Digital Asset Holdings, a company that offers developer tooling and infrastructure solutions to businesses, acquired three companies in 2015-2016. However, Huobi's acquisition of controlling interest in Patronics Holdings, a Hong Kong-based investment holding company, for \$77 million for 71.67% of the total shares is the most significant transaction to occur in the Enterprise M&A space.

The DeFi category saw only 29 deals totaling \$167 million. Its Asset Management subcategory attracted the most attention as it accounts for \$211 million out of the \$222 million transacted in DeFi M&A.

M&A Activity by Firm

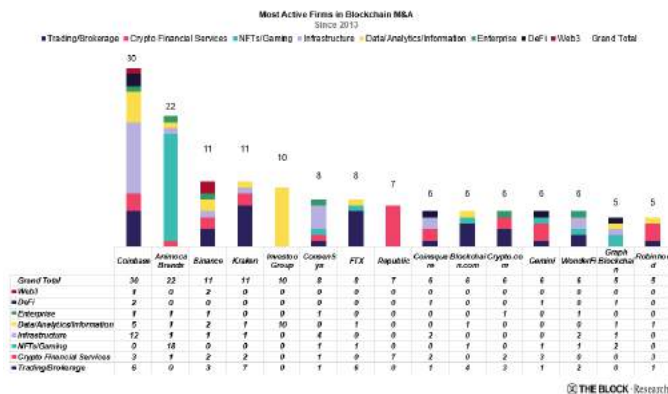


Figure 82: Most active firms in M&A 2013 - 2022

Source: The Block Research

Coinbase and Animoca Brands led the race with 30 and 22 acquisitions, respectively. Coinbase acquisitions are more diversified, with a soft focus on Infrastructure and Trading/Brokerage. On the contrary, Hong Kong-based blockchain gaming conglomerate Animoca Brands' acquisitions are highly concentrated in the NFTs/Gaming category. Notably, 18 out of 22 acquisitions for Animoca are from NFTs/Gaming. Animoca raised at least \$600 million YTD among its subsidiaries to fund strategic acquisitions, investments, and product development.

FTX, led by Sam Bankman-Fried, primarily played "clean up" for the crypto sector after the collapse of Terra and crypto lending providers. Although the firm itself did not have sufficient money to help itself, it extended lenders' support and concentrated on purchasing distressed assets. Such activities include its extended credit lines to BlockFi and Voyager Digital – the option to acquire BlockFi, and the purchase of Voyager's assets and intellectual property (IP).

10 of the 15 most active firms in blockchain-specific M&A provide digital asset trading services, which took over companies of various categories and are not

restricted to Trading/Brokerage. As user adoption increases in various stages of a market cycle, trading exchanges benefit immediately as their users access various services offered by exchanges like spot trading, margin trading, token listing, Initial Exchange Offering, over-the-counter (OTC) deals, etc. When user engagement is high, the exchanges experience a windfall, creating a sudden capital for investments and acquisitions. To stay relevant and stay ahead of the competition, these firms influx this capital into acquiring companies with strong potential or those that may fulfill voids that the current product/service suite may have.

However, cryptocurrency exchanges further up on the list, including Coinbase, Binance, and Kraken, have been noticeably inactive with their M&A pursuits in recent times. Of these three exchanges, Coinbase is the only one that made an acquisition this past year, purchasing the US-based derivatives platform FairX in January.

On the contrary, an intriguing observation among these companies is that the firms later down the list, including Gemini, WonderFi, Graph Blockchain, and Robinhood, made many of their acquisitions in 2021 and 2022. 20 of the 22 acquisitions by these four companies were over the past two years.

M&A Landscape in 2022

As a market cycle matures, category leaders use their windfall profits, along with money raised by outside investors at high valuations, to acquire smaller providers that are either emerging competitors or offer complementary product suites to expand in new geographies and/or improve their product/service offerings. They also tend to acqui-hire most of the firms

and acquire their talent to scale and diversify faster than the competitors.



Figure 83: M&A activity by category in 2022

Source: The Block Research

The acquisition of Gem by OpenSea in Q2 2022 for \$238 million is the largest M&A transaction in NFTs/Gaming category history. Although acquired, the NFT marketplace aggregator, Gem, still operates as a standalone entity.

Over 97% of the maturation phase funding rounds in NFTs/Gaming occurred in the last two years. Increased occurrence of Mid and Later Stage funding deals for NFTs/Gaming suggests maturation for the category. So naturally, as this subsector matures, the competition in the landscape will increase as more participants compete for the same piece of the pie, leading to consolidation.

Although the terms of the deals were not disclosed, one Q1 2022 M&A deal is worth mentioning. Yuga Labs, the spearhead studio of NFT PFPs and creators of the BAYC, acquired Larva Labs' IP rights of Cryptopunks and Meebits. After this acquisition, Yuga Labs introduced Otherside. Conceptualized as a metaverse that intertwines NFT-powered virtual worlds with elements of massively multiplayer online role-playing games (RPGs), Otherside is geared towards an interoperable virtual experience. Otherside is easily the most flamboyant attempt of a bootstrapped metaverse by a gaming studio whose promising value proposition

attracted an investment of \$450 million from ace investors like a16z, Animoca brands, etc.

Binance is the leading multinational crypto exchange growing its geographical operations and product offerings at a breakneck pace. In April 2020, Binance acquired CoinMarketCap for \$400 million. Since then, CoinMarketCap added various education and trading-related services to its service suite. Following up on this development from its competitor, in August 2020, FTX acquired Blockfolio, a live price tracking application, to expand its footprint in the retail market. FTX, too, projected a similar trajectory only to falter miserably in November 2022, but Binance's acquisitions are more distributed across various categories as compared to FTX. FTX's six out of eight acquisitions are within Trading/Brokerage, whereas Binance bought firms from every category except DeFi and NFTs/Gaming.

FTX's acquisition of the bankrupt lender Voyager's assets for \$1.4 billion at a bid auction in September 2022 is the largest M&A transaction ever recorded. The deal breakdown subjected FTX to paying at least \$111 million for Voyager's non-crypto assets, including its users and IP.

In 2022, DeFi exhibited 8 M&A transactions. The DeFi category generated the lowest M&A deal count in the history of the sector. This depicts that DeFi still exhibits nascency. None of the top 100 TVL DeFi protocols made an acquisition or was acquired by any company.

Similarly, Web3 development is in its initial phase. With only 32 deals in the last ten years, 8 in 2022, Web3 projects are set to evolve as we believe the necessary infrastructure for these projects is in better shape than before.

State of Employment in 2022

With a noticeable growth in user adoption, number of firms, and cash infusion in the industry, it becomes imperative that more employment opportunities will be generated to cater to the growing demands of the current operating market.

This subsection evaluates the hypothesis made above and offers commentary on the current state of employment in the digital asset sector.

Employment

The Block Research analyzed employment data of 424 firms. This dataset was sourced from The Block Research's funding database, which has aggregated funding data of over 4,200 companies that have raised over 6,500 funding rounds since 2017. Firms with a valuation above \$300 million and/or have raised a venture funding round of more than or equal to \$20 million were considered for this analysis.

The employment data has been sourced from firms' official documents and communication sources, press releases, LinkedIn, Pitchbook, etc. The official communication sources of firms, like their websites, press releases, and Twitter accounts, were prioritized over other sources when aggregating data.

Note that the data behind employee count can be misreported either by the data aggregators or by the companies themselves. Along with that, the actual employment count may have changed after the date of the last public disclosure. However, The Block Research's process of manual filtering and updating increases the accuracy of the data for this analysis.

For ease of assessment of various types of companies and macro-level estimations, the 424 firms were categorized into 11 different categories: (1) CFS, (2) Infrastructure, (3) L1, (4) Mining, (5) DeFi, (6) NFTs/Gaming, (7) Game Studio, (8) Trading/Brokerage, (9) Web3, (10) DAI, and (11) Enterprise. These categories are created based on the business model and value proposition of the firm.

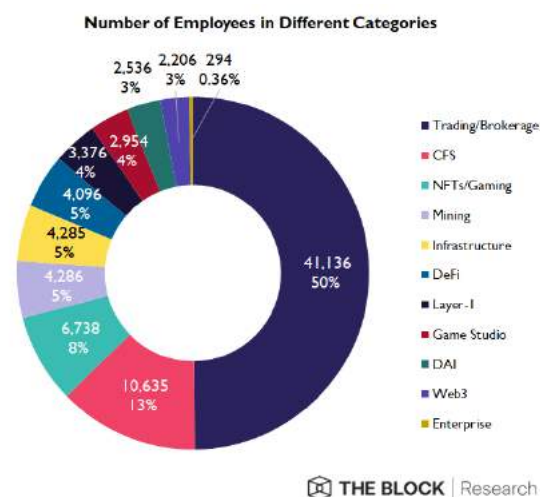
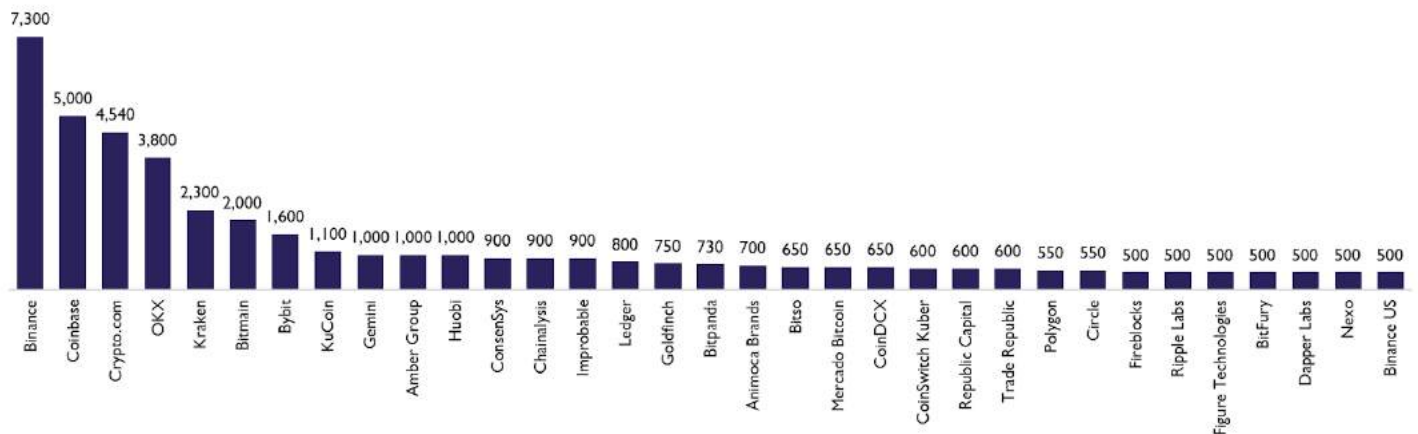


Figure 84: Number of employees by category in 2022
Source: The Block Research

In 2019, we [observed](#) 158 companies with a total employment count of 18,200. Based on our current study, 424 firms employ 82,542 people in the digital asset sector. 50% of the people are employed in the Trading/Brokerage category, whereas CFS employs 10,635 people.

State of employment for three companies in the Enterprise category was identified. Although there were other companies which fit our primary criteria of consideration for this study, they were excluded due to the difficulty in locating team members who work in blockchain-related departments.

Largest Companies in the Digital Asset Sector



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Figure 85: Largest companies in digital asset sector by employee count in 2022

Source: The Block Research

33 companies have an employee count of 500 or more. Binance has the largest team size of 7,300 people, followed by Coinbase's 5,000. Bitmain, the application-specific integrated circuit (ASIC) manufacturer, employs 2,000 people, the largest head count for a company that does not offer trading services.

According to our [2019 research](#), there were 50 companies with more than or equal to 100 employees. As of December 2022, 181 companies employ at least 100 people.

in size, with Binance exhibiting the highest growth at over 1,000%. The only aberration was Huobi, whose employment number dropped by 23%. This is because of the decline in Huobi's revenue caused by China's cryptocurrency ban in 2021.

Employment in Crypto Unicorns

As mentioned in the [Crypto Unicorns subsection](#), there are 116 unicorns in the industry, out of which 7 have lost their unicorn status following the FTX-Alameda Research disaster. For this analysis, we have excluded these companies from the list.



Figure 86: Changes in employee count over the years

Source: The Block Research



Figure 87: Number of employees in unicorn companies by category in 2022

Source: The Block Research

Comparing the largest companies in 2019 to their current status reveals that most companies increased

109 unicorns together employ 54,810 people in the industry. Although these 109 companies correspond to only 26% of the analyzed sample space of 424 companies, 66% of the employees belong to these companies. There are 33 Trading/Brokerage category unicorns employing over 35,000 people suggesting that this category may be relatively more mature than others.

Comparison with Non-crypto Technology Companies

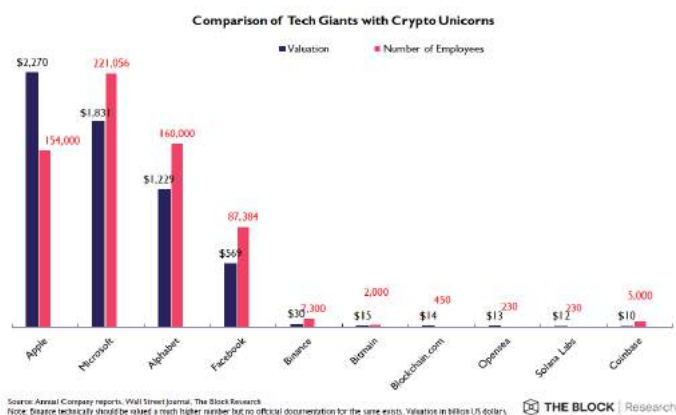


Figure 88: Comparison of tech giants with crypto unicorns in 2022
Source: Annual company reports, Wall Street Journal, The Block Research

It is interesting to note that although employment in the industry has increased at an unprecedented rate in the last two years, valuation and employee count in non-crypto tech giants are orders of magnitude higher than in crypto unicorns.

Sector-wide Estimation

The Block Research analyzed the state of employment for 424 companies, 10% of the total funding database, based on their valuation and venture funding history. We consider this dataset the top 10th percentile of the industry as it may employ a significantly higher number of employees than the rest. However, according to our venture funding database, there are more than 4,200

projects in the industry. In order to estimate the total employment in the digital asset sector, we estimated employment for the remaining 90% of the projects based on our current sample space via some conservative calculations.

As previously discussed, we categorized 424 companies into 11 categories. We calculated the average employee count per project for every category. While taking averages, we excluded 'outlier' firms that employ significantly higher people than the rest to eliminate bias. For example, the average number of employees excluding Binance in a Trading/Brokerage company is 269, but Binance employs 7,300 people. The Block Research identified 15 outlier firms that employ 32,300 people. Binance, Coinbase, Crypto.com, Chainalysis, and 12 others are considered outliers for the purpose of this analysis.

Average Number of Employees per Firm

Category	Top 10%ile
CFS	188
DAI	93
DeFi	50
Enterprise	100
Infrastructure	68
NFTs/Gaming	76
Trading/Brokerage	269
Web3	45
Mining	120
Game Studio	103
Layer-1	93

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Figure 89: Average number of employees in top 10th percentile by category in 2022

Source: The Block Research

These averages taken for every category represent the companies in the top 10th percentile of the industry. For the remaining 90% of the projects, we created five different models, which provide us with a range of

probabilistic numbers of employees. We assumed the average number of employees per category for the remaining 90% of the projects to be 10%, 20%, 30%, 40%, and 50% of the top 10% average.

Average employees in a top 10%ile mining firm (A) - 120

Estimation of average employees in a bottom 90%ile mining firm

Model	A	Employee Count
Model 1	10% of A	12
Model 2	20% of A	24
Model 3	30% of A	36
Model 4	40% of A	48
Model 5	50% of A	60

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Figure 90: Estimated average number of employees in bottom 90th percentile in 2022

Source: The Block Research

For example, a mining company in the top 10th percentile has 120 employees on average. If we apply Model 1 as shown in Figure 90, a firm in the bottom 90th percentile will have one-tenth of the employees of a firm in the top 10th percentile. Therefore, we consider a mining firm in the bottom 90th percentile to have 12 employees on average.

Sector Wide Employment Prediction

Categories	Model 1 10%	Model 2 20%	Model 3 30%	Model 4 40%	Model 5 50%
CFS	19,838	29,126	38,413	47,701	56,989
DAI	3,190	4,618	6,045	7,473	8,901
DeFi	5,322	8,558	11,795	15,031	18,268
Enterprise	5,230	10,260	15,290	20,320	25,350
Infrastructure	5,180	7,858	10,537	13,215	15,893
NFTs/Gaming	12,639	19,364	26,089	32,814	39,539
Trading/Brokerage	22,916	30,500	38,085	45,670	53,254
Web3	4,230	6,255	8,280	10,305	12,330
Mining	3,549	4,692	5,835	6,978	8,121
Game Studio	2,755	3,549	4,344	5,138	5,933
Layer-1	3,215	3,821	4,426	5,032	5,638
Outliers	32,300	32,300	32,300	32,300	32,300
Grand Total	120,363	160,901	201,439	241,978	282,516

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Figure 91: Estimated number of employees by category in 2022

Source: The Block Research

Based on our estimation, the digital asset industry employs between 120,363 and 282,516 people. 22,940 out of 32,300 in the outliers category are from Trading/Brokerage. When combined with the rest of the Trading/Brokerage firms' employment, the category may have an employee count in the range of 45,856 to 76,194, the highest number of employees in any category.

In light of the current state of the market, courtesy of events around Terra, 3AC, various lending providers, and FTX, there exists a bearish sentiment across the crypto community. The Trading/Brokerage category has achieved maturity regarding available resources for users for the scale at which markets are currently operating. Given the bearish market structure and maturation of the Trading/Brokerage category, which is responsible for half of the employment in the industry, we expect a pullback on employment generation in the sector for the following quarters.

Layoffs

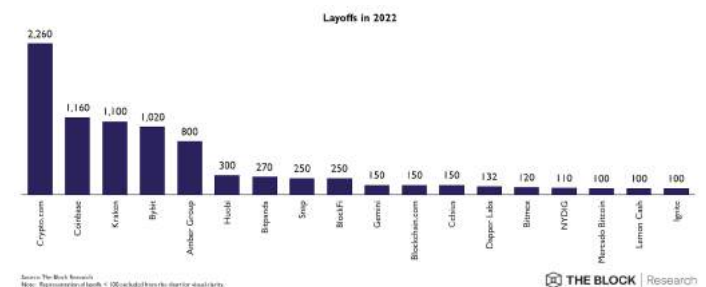


Figure 92: The largest layoffs in 2022

Source: The Block Research

As evidenced throughout the report, the digital asset industry experienced unprecedented collapses in the span of a few months in 2022, the irrational exuberance of 2021 turned into despondency. The ominous state of the market caused a drop in the revenue for companies

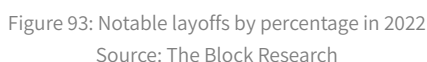
and Celsius, albeit insolvent, reduced their size by 20% and 23%, respectively, before filing for bankruptcy.

Crypto.com reduced its team size by 2,260 across two separate layoffs of 260 in June and 2,000 in October. This is the biggest layoff of the year in the digital asset sector. Although its spokesperson denied the news of laying off 2,000 people, no additional information was provided to turn down the legitimacy of the reports. Hence, for the purpose of this study, we do consider that layoffs occurred.

Reduction in team sizes from companies like Crypto.com, Coinbase, Kraken, Bybit, and other exchanges contributed 7,037 or 74% of the total layoffs in 2022. Based on The Block Research's recent analysis, over 41,000 people work under the Trading/Brokerage category out of estimated 82,248 employees in the digital asset sector. Given that almost half of employment in the digital asset sector corresponds to the Trading/Brokerage category, it is fair to observe significant layoffs in that category.

On the other hand, social media giant Snap disbanded its Web3 team in the face of sharply reduced growth this year, laying off 250 employees.

Companies like Stripe and Robinhood, which offer crypto-related products and traditional fintech services, have laid off 1,000 and 1,090 people, respectively. Since it remains unclear whether the staff reduction has occurred on the crypto side of the team



As mentioned, trading exchanges have laid off the highest percentage of people from their teams. BlockFi

or the rest, these companies were not considered for the layoff count mentioned above.

Although the total layoffs are about 9,500, the industry has also witnessed demises of some major companies this year. The industry observed the Terra crash, 3AC's downfall, and bankruptcy filings of behemoths like FTX, Celsius, BlockFi, and Voyager. Based on head counts of all the bankrupt companies, their affiliated firms, and the Terra ecosystem, these events have affected 1,600 more employees in some capacity, as per our estimation.

An unprecedented series of unpropitious events have occurred this year and will have a negative impact on the industry in the longer run. As over 9,500 employees were let go in 2022, we already notice changing employment structures and hiring patterns across companies. As hypothesized by industry veterans, crypto winter might be here, and companies will err on the cautionary side and keep their teams lean to extend their runway.

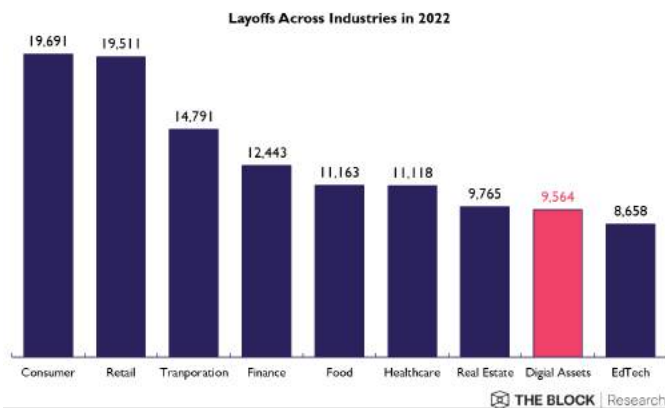


Figure 95: Layoffs across industries in 2022

Source: The Block Research

Based on the data from layoffs.fyi, over 151,600 job cuts occurred across tech industries. As previously mentioned, the digital asset sector currently employs at least 82,248 employees, which would put the attrition rate of the industry at ~10%.

Despite the grim state of the industry, some companies continued to hire. Binance doubled its size to 7,300 employees from a year ago, the largest company in the space considering headcount. Polygon hired over 50 people for its senior positions. Fireblocks raised \$550 million at an \$8 billion valuation at the start of the year, allowing it to increase its company size from 300 to 500.

4

Layer-1 Networks: 2022 Overview

Kevin Peng

Layer-1 Networks: 2022 Overview

Kevin Peng

A look at the competitive landscape of Layer-1 networks and their ecosystems, the growing challenges of an increasingly multi-chain world, and the renewed focus on execution environments for their impact on scalability and user experience.

Quick Take

- L1 ecosystems broadly endured the negative effects of several major collapses in the crypto industry in 2022.
- Cross-chain protocols enabled more liquidity to flow between previously siloed ecosystems than ever before, but they also magnified the impact of unexpected events in some cases.
- The EVM continued to dominate among smart contract platforms, but a growing number of alternative execution environments and a trend toward app-chains reaffirmed the need to abstract away the complexities of blockchain interactions for the benefit of both users and developers.

State of Layer-1s in 2022

The L1 blockchain landscape underwent frequent evolution in 2022, reflecting the constantly shifting demands of the crypto market in a period of extreme economic volatility. Whereas 2021 was marked by relentless consumer optimism and rapid growth of the crypto industry, 2022 will likely be remembered for the sudden and unexpected breakdown in numerous key

components of the crypto ecosystem. The implosion of major centralized entities, including FTX & Alameda Research, Celsius, BlockFi, 3AC, and many more, exposed the web of risks that underlies many of the companies providing financial services in crypto today. DeFi protocols also suffered a host of failures arising from critical design or implementation flaws, with the collapse of Terra and UST, as well as numerous large exploits of cross-chain bridges, lending protocols, yield aggregators, and others highlighting the growing economic interactions between L1 ecosystems.

The shocking string of calamities that plagued crypto in 2022 forced the industry to confront the existing limitations of L1 networks that underpin the wide range of on-chain financial activities today. These limitations are best understood within the context of the various functions that L1s serve, which grew increasingly complex with the adoption of smart contracts and DeFi applications in recent years. At a basic level, blockchains allow digital money to be securely transferred and stored in an immutable and permissionless manner.

Achieving these capabilities in a production environment is far from trivial; functional blockchains require careful coordination of various tasks that can essentially be broken down into the following: execution, settlement, consensus, and data availability. These four “layers” can be thought of as the key modules within a smart contract-capable blockchain architecture. As such, they also represent the primary variables that influence a particular blockchain’s overall scalability. Blockchains today are limited by what is known as the “[scalability trilemma](#),” wherein optimizing for scalability, decentralization, or security in conjunction often necessitates sacrificing proficiency in at least one of the three.

It is useful to think about L1 development through the lens of the scalability trilemma, which can help put many of the key decisions and events in 2022 into context. In spite of the abnormally chaotic market environment that persisted for much of the year, many L1 ecosystems nonetheless saw some of their most consequential changes to date. While bull markets tend to obscure major flaws in poorly developed ideas through speculative growth, prolonged bear markets like the one in 2022 can mask some of the tangible innovations occurring at the interface of the modular blockchain layers. In this section, we will review some of the biggest developments in the L1 landscape from the past year, beginning with a general focus on blockchain security, followed by decentralization and scalability.

Dynamics of Layer-1 Consensus

One of the most important things to realize about modern blockchains is that they are highly dynamic by nature. This might seem counterintuitive, especially given the automated feel of making on-chain transactions, but consistently and reliably achieving consensus among miners or validators is a task that entails significant technical, social, and economic coordination. By definition, consensus is a critical part of normal blockchain function. Failure to reach consensus will typically result in forks, and even a single occurrence can pose an existential threat to a network. Often, consensus failures require intensive coordination between developers, validators, and stakeholders to resolve, ending with the selection of a

canonical fork that ideally represents the combined interests of the community. Hard forks can be executed deliberately as well, typically during major network upgrades that lead validators to break consensus if they are not on the same client software versions.

Proof-of-stake Consensus Dominance

The most significant upgrade of 2022 by far was the Ethereum Merge, which, on September 15, successfully transitioned the Ethereum network from a PoW to a PoS consensus mechanism. The Merge was, in part, notable for the process through which it “merged” the original Ethereum chain and the PoS Beacon chain, designating the two chains as the execution and consensus layers, respectively. Although the upgrade did not provide any noticeable performance enhancements for Ethereum, it nonetheless reiterated the fact that the world’s largest smart contract platform is committed to a [rollup-centric](#) roadmap that required it to gradually abandon its previous monolithic architecture in favor of a modular one.

The most important aspect of the Merge was its transition to PoS, which made former Ethereum miners irrelevant and eliminated miner ETH subsidies in one swoop. The end of ETH emissions to miners represented a major revamp of the Ethereum monetary policy, drastically reducing daily ETH issuance – now consisting only of validator staking rewards – while retaining the ETH burn feature implemented in EIP-1559. The daily net issuance of ETH hit its first negative day since the Merge on October 8, and as of this writing, the supply of ETH dropped slightly below its value at the time of the Merge.

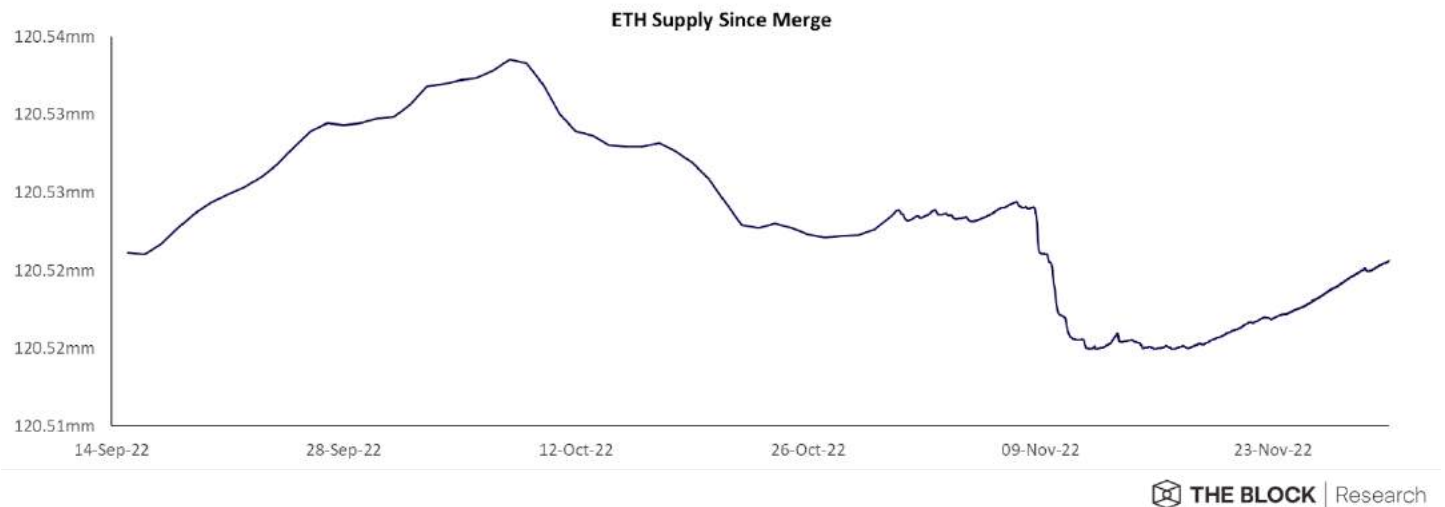


Figure 96: ETH supply since Merge
Source: Ultra Sound Money

Beyond the quantifiable changes to ETH supply dynamics, the Merge was especially significant because of its shift in Ethereum security policy. With the transition to PoS, the security of the Ethereum network, as with other PoS networks, became dependent on the price of ETH and its ability to continuously accrue value into the future. In theory, a collapse in the price of ETH would significantly increase the probability of a single or group of entities gaining enough stake to control the entire network. With a current market cap of ~\$154 billion, it remains highly unlikely that Ethereum could become compromised through the direct accumulation of ETH alone. Still, Ethereum's adoption of PoS consensus brought renewed focus to the economics underlying PoS networks, most of which, by design, rely on value accrual to the native L1 token being staked for security.

Layer-1 Valuations & Ecosystem Health

Establishing a valuation model for L1 networks is a difficult task in itself. L1s are comprised not only of the validators who provide consensus and security, but also the core developers who work to improve the

network, the application developers building atop the L1, the investors who support these efforts, and the users who actively use the network. Maintaining this system requires a delicate balance of economic incentives through the L1 token, which is typically used for gas payments that go to reward validators and stakers. These tokens are also used by L1 teams to raise money and fund the growth of their respective ecosystems.

In 2021, L1 teams [raised](#) billions of dollars in funding through the sale of their tokens while also running large incentive programs to reward activity from users, developers, and liquidity providers (LPs). These strategies underscore the growing interdependence between L1 networks and DeFi protocols that emerged in recent years. In addition to funding from treasuries, L1s provide the execution environment in which developers can build applications, while the applications themselves are a major driving force for network activity. While this relationship contributed to the rapid growth of L1 ecosystems in 2021, it also served to accelerate the impacts of negative externalities in 2022.

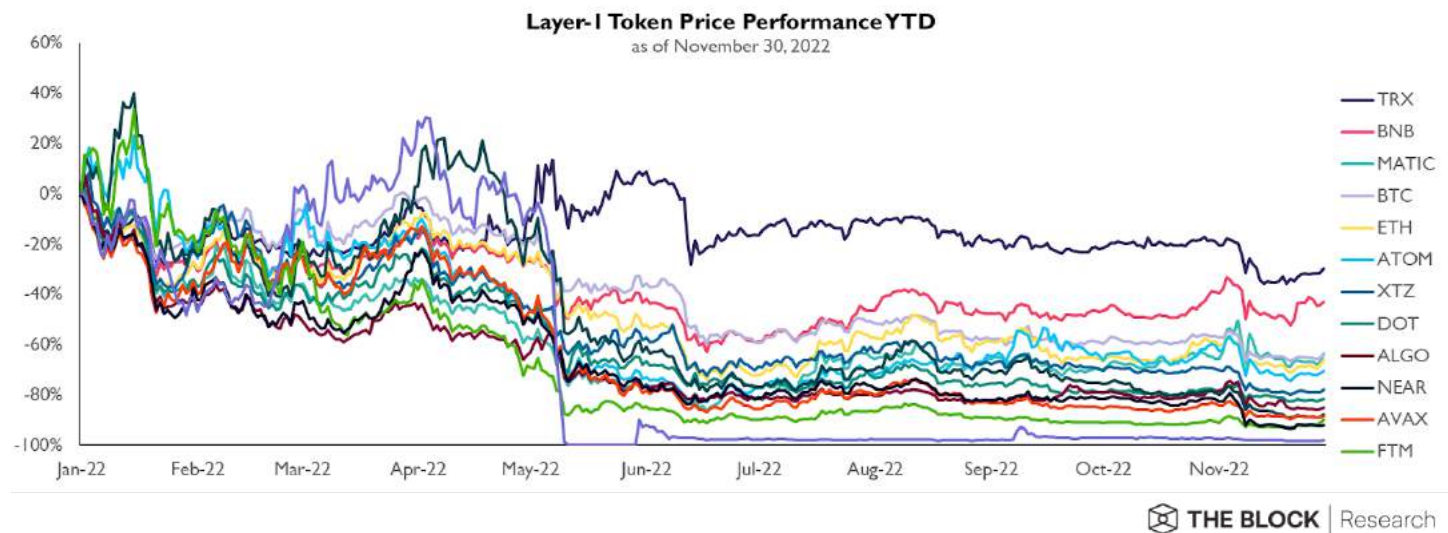


Figure 97: Layer-1 token price performance in 2022
Source: TradingView

L1 token valuations fell sharply in 2022 alongside the broader drawdown in crypto and traditional equities markets, leading to further additional strain on the many participants in L1 ecosystems. Plummeting valuations for native L1 tokens had a direct impact on the TVL in DeFi protocols across L1 ecosystems, contributing to diminished growth and yield opportunities, as well as an overall reduction in on-chain user activity. L1 DeFi TVL peaked at ~\$228 billion in December 2021 and has since declined to around \$58 billion as of the end of November, representing a 72% loss YTD.

Ethereum and BNB Chain maintained their dominance as the top two L1 ecosystems by TVL, while Solana fell to the tenth spot amidst the fallout of the FTX collapse. Terra also played a major role in shaking up the distribution of DeFi liquidity, with the complete unraveling of its algorithmic stablecoin protocol leading to one of the largest wealth destruction events in crypto history, as discussed in the [Algorithmic Stablecoins subsection](#). L1 ecosystems that managed to avoid the contagion from the Terra event were able to better retain TVL in relation to their more exposed competitors. For instance, the Tron ecosystem gained significant ground during the second half of 2022 due to the relative outperformance of its native TRX token and its large supply of stablecoins as a percentage of TVL.

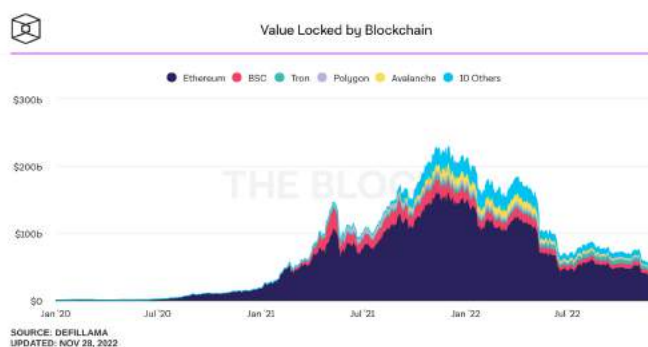


Figure 98: Value locked by blockchain since 2020
Source: The Block Data Dashboard

User growth slowed considerably across L1s in 2022 following a pivotal year in 2021 that saw many L1 networks achieve record-high activity and user counts. Among the top four L1s by active users, assuming 1 address equals 1 user, BNB Chain, and Polygon saw their monthly active users increase between January

and November 2022 by ~35% and 25%, respectively. Meanwhile, Solana and Ethereum saw a decrease of 28% and 48%, respectively, by the same metric during this period, reflecting some of the major shifts in L1 market share that occurred in an especially tumultuous year.

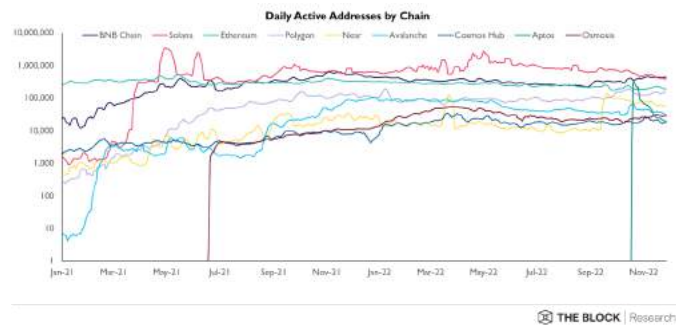


Figure 99: Daily active addresses across various Layer-1 networks since 2021
Source: BSCScan, ChainCrunch, Etherscan, Near, Ava Labs, Artemis, The Block Research

Declines in an L1's token price directly impact network security by reducing the theoretical cost of attack. Although such scenarios are rare for larger networks, several L1s faced moments of high vulnerability in 2022 due to their tokens falling in value. The biggest example of this came immediately following the collapse of Terra, which saw LUNA's market capitalization plummet from ~\$30 billion to ~\$500 million over the course of just one week. This would have made it possible for attackers to coordinate with malicious validators to take control of the network with a few hundred million dollars. By May 12, Terra developers had deemed the risk of attack to be high enough to [halt block production](#) entirely in an attempt to protect what remained of the largely defunct chain. A detailed timeline of events can be found in the [Macro section](#).

The failure of the Terra network was extreme, but it serves as an insightful demonstration of the risks that come with tying DeFi mechanisms to the supply dynamics of an L1 token used for PoS security. This sort

of relationship exists to varying degrees in many L1 ecosystems because of the inherently greater liquidity for native L1 tokens that can be used in DeFi protocols, but Terra's design was particularly vulnerable because LUNA supply was directly affected by the demand for UST. In the aftermath of the collapse of both LUNA and UST, one chain that inadvertently became at risk of attack was Osmosis, which had grown to become the deepest source of stablecoin liquidity in the Cosmos ecosystem through UST over the past year.

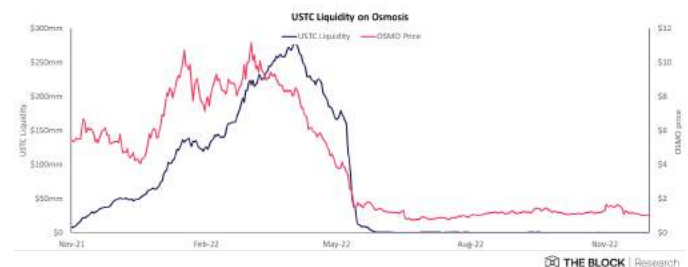


Figure 100: USTC liquidity on Osmosis since November 2021
Source: Osmosis

UST, now known as USTC, liquidity grew to over \$250 million on Osmosis at its peak, where it was primarily paired with Osmosis's native OSMO token. As both the price of LUNA and UST began to capitulate in early May, the price of OSMO began to fall rapidly as well, losing ~60% of its value within the first two weeks of May. Similar to the case with LUNA, this situation created the potential for malicious actors to quickly gain a significant stake in the Osmosis network. Interestingly, the Osmosis team [credited](#) the network's ability to resist a theoretical $\frac{1}{3}$ stake [liveness attack](#) to its implementation of "superfluid" staking, which essentially allows LPs to stake the OSMO portion of their liquidity positions for additional staking rewards while contributing to network security. While superfluid staking is not exactly the same as liquid staking, which refers to the creation of liquid derivatives for staked assets, the end effect is similar in that it reduces the

circulating supply of OSMO and increases the cost of acquiring large sums on the open market. Liquid staking adoption expanded significantly throughout 2022, largely due to the growth of Lido's stETH, most of which came in the earlier half of the year prior to the Merge. As of this writing, the market capitalization of stETH has grown to ~\$6 billion, demonstrating the strong demand for unlocking liquidity in otherwise illiquid staked assets.



Figure 101: stETH market cap and ETH price in 2022

Source: CoinGecko

Liquid-staked derivatives (LSDs) for other L1 tokens garnered increasing usage in 2022 as well, including stSOL, mSOL, sAVAX, stMATIC, stNEAR, lcDOT, stATOM, and many others. For PoS chains, LSDs became a key part of the strategy to ensure a high staking ratio relative to the total token supply. By incentivizing support for LSDs in various DeFi protocols, L1 teams can allow users to capitalize on yield opportunities in the DeFi market without sacrificing network security. While liquid staking presents an opportunity for PoS networks to improve their marginal security, it can also grow to become a centralizing force over time.

Security Through Social Consensus

Over the past few years, the Cosmos vision of an interconnected network of app-centric blockchains has emerged as a compelling alternative to the DeFi

ecosystem that is currently dominated by Ethereum. The Cosmos approach of improving cross-chain communication through the Inter-Blockchain Communication (IBC) protocol became especially relevant in 2022 as a growing number of cross-chain bridges continued to add new connections between L1 networks. TVL in bridges reached a new ATH in April 2022, with ~\$54 billion bridged from Ethereum alone.

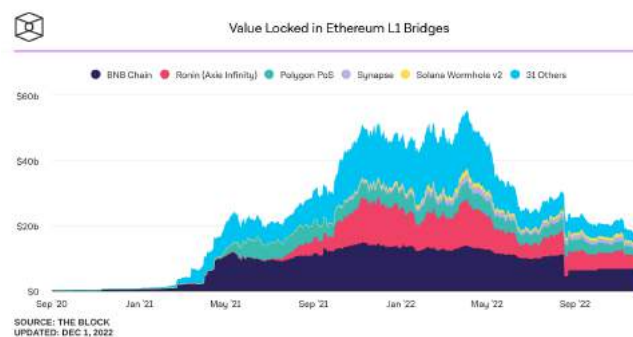


Figure 102: Value locked in Ethereum layer-1 bridges since 2020

Source: The Block Data Dashboard

There currently remains ~\$19 billion in Ethereum-native assets that exist as so-called wrapped assets on other chains. With only ~\$21 billion in DeFi TVL, excluding the Ethereum ecosystem, the extent of Ethereum as the originating source of liquidity in L1 ecosystems is clear. In other words, a significant majority of TVL in L1 ecosystems is backed by the Ethereum network; if Ethereum were to fail or become compromised, all of the wrapped assets backed by collateral on Ethereum would become compromised as well.

Of course, the Ethereum network as a whole does not need to fail for bridged assets to become unbacked. As we discussed in our [DeFi Exploits subsection](#), many of the largest hacks in 2022 involved the compromise of cross-chain bridges, with the Ronin, Wormhole, Nomad, BSC Token Hub, and Horizon bridge exploits combining for a total loss of over \$1.3 billion. These

exploits were carried out by targeting a variety of vectors that included Ethereum and destination chain smart contracts, as well as the off-chain components that typically enable bridges to execute the proper burn and mint commands on each chain.

One takeaway from the bridge exploits of 2022 and their current state is that the crypto market is essentially expressing a view of Ethereum as the main settlement layer for smart contract platforms. With potentially hundreds of millions of dollars on the line, protocol exploiters nearly always choose to store the majority of their stolen assets on Ethereum or as native BTC. There could be several reasons for this, such as the availability of liquidity with which assets can be laundered through protocols like Tornado Cash on Ethereum and CoinJoin on Bitcoin, or simply the possibility that the stolen assets are backed by BTC, ETH, or ERC20 assets. This trend also suggests that, aside from Bitcoin, the exploiters generally believe Ethereum to be the network that poses the lowest risk of consensus failure or censorship, both of which could render stolen assets worthless.

Ethereum's de facto role as a settlement layer is derived partly from the high economic cost of attacking the network relative to other L1s. Another factor is the network's ability to reach social consensus, which is difficult to quantify but critical for being able to guide developments that improve the network over the long term. A clear example of this dynamic arose in the leadup to the Merge, when a subset of former Ethereum miners – set to lose the entirety of their revenue source – mounted a challenge to the transition to PoS by pledging not to upgrade to the new client version. In doing so, they created an Ethereum fork remaining on PoW, dubbed Ethereum PoW (token ETHW), that effectively went live at the time of the Merge.

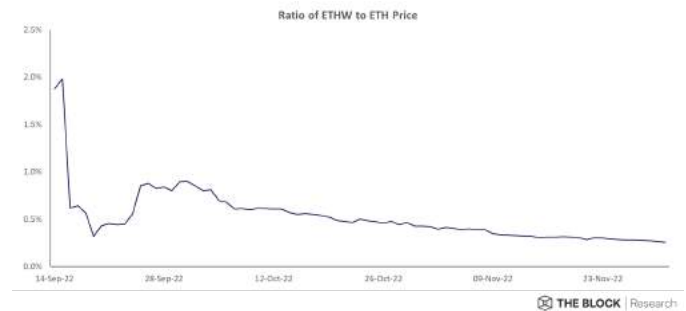


Figure 103: Ratio of ETHW to ETH price since inception

Source: CoinGecko, The Block Research

Despite capturing the attention of the market in the weeks surrounding the Merge, contributing to fears of potential DeFi protocol disruptions, adoption of the Ethereum PoW fork largely failed to materialize as major Ethereum protocols and stakeholders overwhelmingly supported the canonical PoS chain. Ethereum PoW's TVL currently sits at just \$1.6 million, and its market capitalization of \$418 million represents only 0.27% of Ethereum's \$154 billion.

Security & Decentralization

Along the spectrum of scalability, Ethereum's strengths lie primarily in its security and decentralization at the expense of throughput. Over the past two years, the Cosmos ecosystem has emerged as a major alternative to this system, making notable security trade-offs in favor of decentralization and scalability. Security and governance were a major part of the Cosmos story in 2022, exemplified by a pivotal vote on the ATOM 2.0 proposal in November that ultimately resulted in rejection through on-chain governance.

The on-chain governance system used throughout Cosmos/IBC chains is a notable departure from the off-chain system used by Ethereum. Major protocol

changes are typically preempted by an on-chain proposal and vote, the latter of which is weighted linearly by staked token amount. The result of this arrangement is that native tokens for Cosmos chains are used for both securing the network and directing governance decisions.

The ATOM 2.0 vote keyed into the ATOM token's role in network and social consensus, with liquid staking and token issuance at the center of discussion in the proposal. Voters generally expressed little opposition to the plan to expand liquid staking offerings to bolster network security. As in the example with Osmosis above, ensuring a high percentage of staked native token supply is an important defense against network attacks, and is especially true for relatively smaller market capitalization Cosmos chains.



Figure 104: Percentage of ATOM bonded since July 2021

Source: Cosmoscan

The percentage of bonded (staked) ATOM increased steadily throughout 2022 after reaching a six-month low of 58% in January. The current 62% bonded ratio equates to a theoretical cost of ~\$2 billion to acquire more than two-thirds of the staked supply. For comparison, the same task would cost ~\$12.9 billion on Ethereum at current market valuations. In some ways, the lower cost to attack IBC chains versus Ethereum is

balanced by the relatively greater ability of stakeholders to affect governance, which can ultimately supersede even state consensus in extraordinary circumstances.

This decentralization of governance exists on a spectrum among sovereign chains in the Cosmos ecosystem, with newer chains generally more centralized as a necessity for producing updates quickly enough to attain user adoption and relevance. Because IBC chains are primarily intended to exist as application chains (app-chains) within the broader ecosystem, the entities that make up the set of validators, stakers, and developers often overlap, which effectively gives more stake and governing power to developers compared to L1s that do not intertwine governance and security to the same extent. On the extreme end, some IBC chains can have a highly centralized form of governance. For instance, the DeFi-centric [Canto](#) network passed 27 governance proposals with over 99% vote in favor in 2022.

One of the more contentious governance debates within the Cosmos ecosystem occurred in March when the Juno community elected to take the unprecedented step of forking the chain in order to confiscate the JUNO holdings of a large stakeholder who voters believed to be a potentially malicious actor. While the outcome remains fairly controversial, the incident nonetheless demonstrates the power of governance and social consensus in Cosmos chains.

In the ATOM 2.0 vote, one of the primary disagreements was over the proposed changes to ATOM issuance,

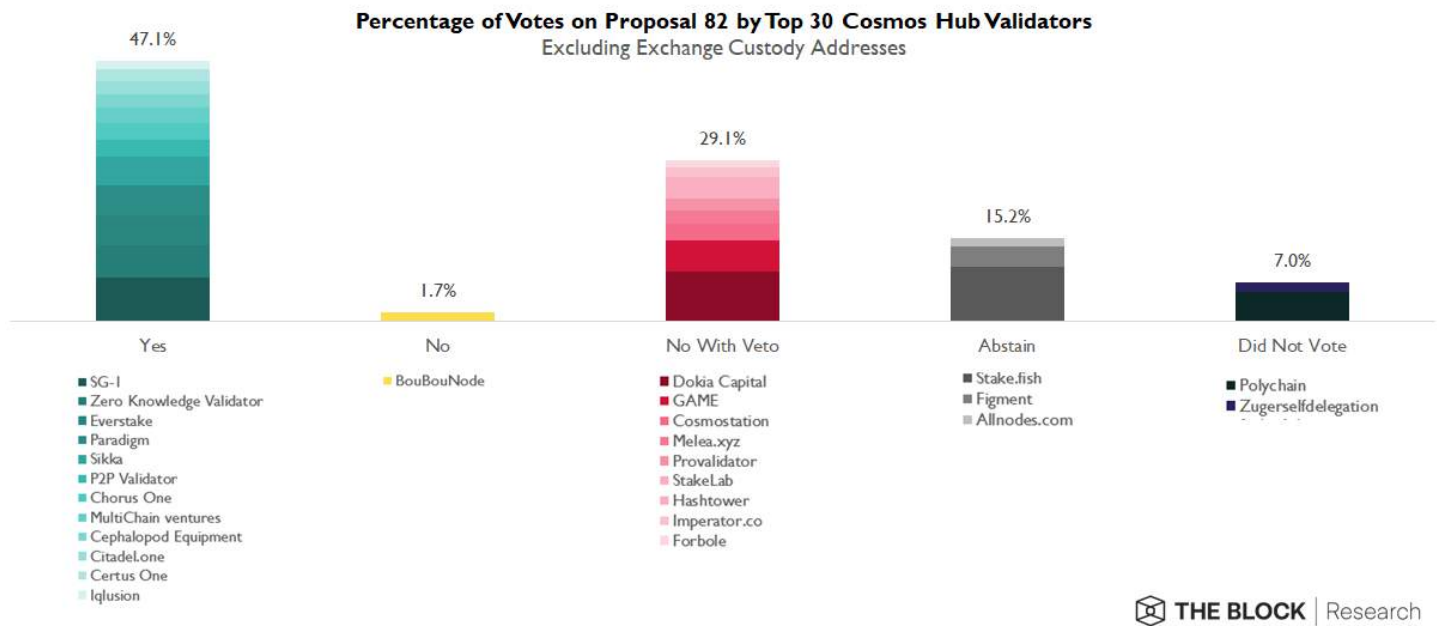


Figure 105: Percentage of votes on proposal 82 by top 30 Cosmos hub validators
Source: Mintscan, The Block Research

which would reduce the amount of ATOM paid to validators as a security subsidy over time while inflating ATOM supply in the short-term to allocate to a new Cosmos Hub treasury that would have an increasingly greater ability to dictate the future of the chain.

In the end, the 29.1% NoWithVeto votes from validators that contributed to the rejection of the proposal are a clear demonstration of how on-chain governance can be an effective decentralizing force for a network, particularly when it has grown in size and reach of the Cosmos Hub. While ~70% of the vote was controlled by the top 30 Cosmos Hub validators, the wide range of stances, even among the top validators, speaks to the diversity of opinion that exists among the Cosmos Hub governing body.

In a sense, the Cosmos Hub community's dismissal of the proposed issuance schedule can be interpreted as a rejection of policies that would decrease the marginal

security of the network (i.e., by removing subsidies) while increasing the centralization of governing entities. This is a subtle point, as the community's broad acceptance of ATOM liquid staking growth also represents a contrast to the situation on Ethereum, where one liquid staking provider, Lido, has grown to the extent of becoming a potential central point of failure for the network.

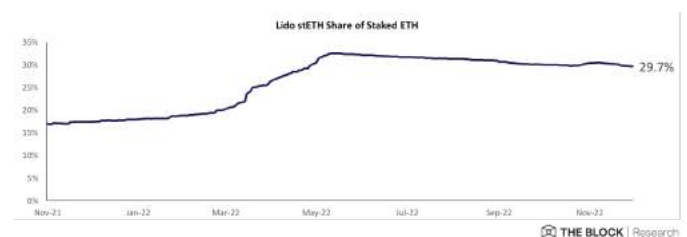


Figure 106: Lido stETH share of staked ETH
Source: Dune Analytics, Lido

The share of staked ETH deposited in Lido has grown to 29.7%, representing a ~70% increase YoY. Whereas Ethereum proponents grew increasingly concerned about a centralized attack vector through stETH in 2022, the Cosmos Hub community appeared to be

primarily focused on increasing the marginal security of the network through liquid staked ATOM while rejecting the idea of potentially centralized entities (i.e., the Hub Treasury) capturing additional governing influence through increased value accrual to ATOM.

On a similar note, the centralizing impacts of optimized MEV capture came into greater focus in 2022 with the continued success of Flashbots products, which primarily serve to democratize consumer access to MEV captured from on-chain activity. With the transition to the PoS consensus, the Flashbots team demonstrated the economic implications of lopsided competition in the MEV market by releasing its MEV-Boost relay software, which gives a major financial advantage to validators who use the software to sell blockspace to block builders.

As mentioned in the [Mining section](#), the growing dominance of entities like Flashbots can also pose a threat to network censorship resistance, especially when Flashbots is now censoring transactions originating from Tornado Cash to comply with OFAC sanctions. Questions about Ethereum's long-term future are starting to rise less than three months after the Merge.

MEV opportunities arise wherever on-chain value and activity exist, most commonly as arbitrage and liquidation opportunities presented in DeFi markets. In monolithic blockchain ecosystems, these MEV opportunities typically revolve around activity originating from decentralized exchanges (DEXs) and lending protocols, and they become magnified during periods of heightened volatility.

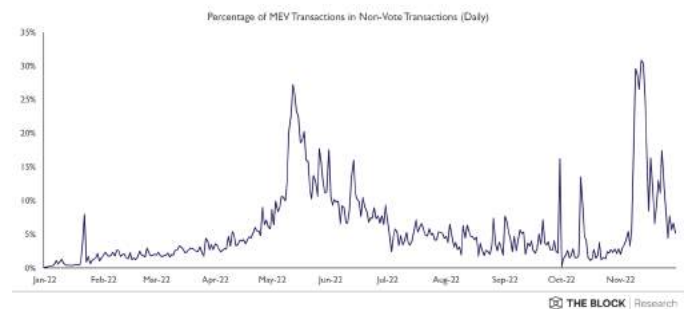


Figure 107: MEV transaction share in Solana non-vote transactions in 2022
Source: Jito labs

For example, MEV activity became a constant presence on Solana in 2022, ramping up during extreme market events like the Terra and FTX collapses in May and November, respectively. Cross-chain MEV capture in the Cosmos ecosystem and beyond also became a key topic of discussion in 2022 when the authors of the Cosmos 2.0 whitepaper proposed the concept of the “Interchain Scheduler” as a primary way of bringing revenue to the Cosmos Hub in the future. The Interchain Scheduler is essentially a cross-chain blockspace marketplace of which the Cosmos Hub would theoretically be the main beneficiary, provided it can first accrue value through an upcoming IBC upgrade dubbed Interchain Security. It remains unclear whether the planned Interchain Security feature, which aims to lease the security of the Cosmos Hub to newer and/or smaller IBC chains, will result in tangible growth of cross-chain activity dependent on the Hub, especially in light of the strong presence of Osmosis and its native DEX in the Cosmos ecosystem.

Economics of Cross-chain Value Capture

Ultimately, the challenges being tackled in MEV research today are an extension of more fundamental questions on the economics of value distribution across chains. Namely, who captures the value generated by cross-chain activity, and what attracts this activity to specific protocols over others? For

monolithic blockchains, the answer to the first question consists partly of LPs and security providers, who are relevant both on an application and blockchain level. LPs generally take the risk of price exposure and smart contract failure in exchange for trading fees or lending fees, while network validators take on the cost of computational resources and the risk of price exposure in exchange for validator fees, either directly from transaction fees or from token subsidies.

Similar to its use of on-chain governance, the Cosmos Hub attempted to codify this security-based system of value accrual by tying the security of so-called “subscriber” chains to its own as a “provider” chain in the Interchain Security design. However, security provision alone is typically insufficient to drive activity to specific protocols or chains. In the IBC ecosystem, the Cosmos Hub’s idea of a group of chains secured by a single validator set is largely untested, but it also resembles the concept of shared security that underpins the Polkadot ecosystem.

In 2022, development in the Polkadot ecosystem was punctuated by a notably subdued pace of critical feature releases from the core Polkadot team, particularly with regard to its flagship cross-chain message passing (XCMP) protocol, which is intended to enable seamless communication secured by the Polkadot relay chain, including asset transfers, between Polkadot parachains. Persistent delays to the release of XCMP forced many parachain teams to use workarounds such as horizontal relay-routed message passing (HRMP), which allows parachains to transfer assets between one another but also requires individual one-way channels to be opened between parachains in order to function. Furthermore, the opening of HRMP channels is subject to the governance

process of the Polkadot relay chain, which serves as yet another bottleneck for parachain developers looking to expand their connectivity with other Polkadot parachains and L1 chains outside the ecosystem. Clearly, one of the major flaws of the shared security model is the strong dependence of consumer chains (i.e., parachains) on the provider chain (i.e., relay chain), which can become progressively limiting over time if application development begins to outpace core protocol development.

One way to roughly gauge the market value of the security provided by the Polkadot relay chain is through the parachain auctions, which are essentially a bidding process for blockspace secured by the relay chain. Over time, the average amount of funds raised to secure a parachain slot has decreased significantly.

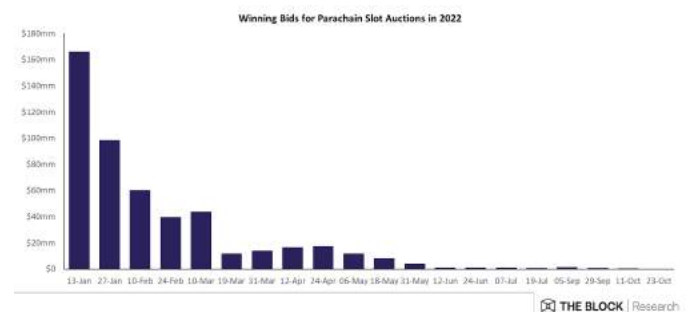


Figure 108: Winning bids for parachain slot auctions in 2022

Source: Parachains.info

The steep dropoff in average crowdloan sizes throughout 2022 reflects a palpable decrease in interest for blockspace in the Polkadot ecosystem. When the first five Polkadot parachain slot auctions began in mid-November 2021, the average size of a winning parachain slot auction bid was ~\$109 million based on the price of DOT at the time of this writing. By the 12th to 18th parachain auctions that spanned from March through May, the average winning bid had dropped to \$4 million. For the latest round of completed auctions

spanning from late August to mid-November, the average winning bid was just \$690,000.

At this point, it is worth revisiting our original question of how value is captured by cross-chain activity, and by whom. Within individual L1 ecosystems, LPs and validators collect a significant portion of the value from various possible DeFi activities. MEV extractors also capture a chunk of this value by taking advantage of market inefficiencies. For now, the competitive landscape for cross-chain value capture remains in its infancy, but the surge of inter-chain connections enabled by bridges and cross-chain messaging protocols in 2022 indicates a significant value in reducing inefficiencies in cross-chain capital flow.

Arguably, MEV extraction is one of the main ways to resolve cross-chain capital inefficiencies, wherein arbitrage and liquidation activities reduce discrepancies between prices and interest rates between chains. The proposed Interchain Scheduler introduced in the Cosmos 2.0 whitepaper reflects this desire on the part of the Cosmos Hub team to capture some of this value that is essentially open for claim by the most competitive MEV searchers. In a sense, the parachain slot auctions for Polkadot blockspace also resembles the blockspace marketplace described in the Interchain Scheduling thesis. Yet aside from the strategies currently being explored by MEV research teams such as Skip and Mekatek in the IBC ecosystem, the state-of-the-art for MEV value capture cross-chain remains largely undefined.

Another approach to improve cross-chain capital efficiency is to increase the amount of accessible liquidity across chains, which also involves reducing the latency of cross-chain capital movement. On this front, cross-chain bridges played an increasingly

important role in 2022, though, as we've seen throughout the numerous bridge exploits of the past year, they grew to become high-value targets through which malicious actors seek to extract value from honest participants. As such, cross-chain messaging protocols originally designed with blockchain scalability in mind are gaining increased relevance as well. From a broader perspective, the questions of how value is captured from cross-chain activity and what drives capital accumulation can essentially be boiled down to differences in execution and user and developer experience. We explore some of these key differences between L1 networks in the following section.

Scalability & Execution Environments

Thus far, our discussion on the state of L1 ecosystems in 2022 has primarily focused on differentiating factors with respect to blockchain security and decentralization that have become clear among the largest networks in recent years. However, improving blockchain scalability remains one of the paramount challenges for the blockchain industry today, particularly due to the severe negative consequences of sacrificing either security or decentralization. Let's take a look again at the Cosmos ecosystem, whose primary method of scaling optimization echoes throughout the L1 landscape in varying forms.

One of the biggest step changes in functionality for chains in the Cosmos ecosystem came in Q1 2021 with the activation of IBC transfer functionality, which effectively opened the floodgates for liquidity to flow freely between IBC-enabled chains. With the introduction of this feature following the passage of Cosmos Hub proposal 41, the path was paved for the Cosmos ecosystem to move closer than ever before to

the vision of interconnected app-chains first laid out in the original Cosmos whitepaper. Within this vision, the Cosmos approach to blockchain scalability can essentially be thought of as a distribution of key blockchain responsibilities, more specifically execution and consensus, to sovereign blockchains connected by a standard cross-chain messaging protocol (i.e., IBC).

Cross-chain Communication in Scaling Solutions

A similar version of this approach to scalability has emerged independently outside of the Cosmos ecosystem over the course of 2021-2022, with a host of Ethereum-alternative L1 networks now connected by a variety of cross-chain bridges. Compared to the collection of bridges that currently provide channels for asset transfers between otherwise siloed L1 chains, the Cosmos IBC protocol's key differentiator is its standardization of cross-chain communication between all IBC-enabled chains. This seemingly minor improvement bears significant practical consequences in terms of security, implementation, and user experience.

Cross-chain bridges generally exist on a spectrum of decentralization, ranging from single custodial entities controlled by a multi-sig to decentralized sets of validators responsible for verifying transactions. Most bridge processes, including IBC transfers, use a lock-and-mint model to transfer assets cross-chain, whereby native assets are locked on their origin chain, and an equivalent amount is minted on a destination chain. Users are typically required to place their trust in several components of standard bridges, including the validators (if any) and the off-chain relayers. In February, the Wormhole bridge was exploited for ~\$323 million through a simple implementation error,

demonstrating the fragility of even robust security practices relative to the tremendous stakes that are often at play. More information on various bridges can be found under the [Blockchain Interoperability Solutions subsection](#).

IBC transfers look similar to common third-party bridges at a high level, relying on relayers to transmit messages between chains. However, the main difference with IBC transfer security is that users and developers only need to trust in the security of the chains with which they are interacting, as light clients always verify state proofs from the interacting chain before assets are transferred. Therefore, even a fully compromised set of relayers could only do damage to the extent of pausing IBC transfers between two chains. For developers in the Cosmos ecosystem, an additional benefit of the IBC protocol is its standardization across chains, which dramatically reduces the risk of fatal implementation errors.

The IBC protocol is a fundamental part of the Cosmos ecosystem value proposition, which otherwise improves blockchain scalability only by splitting up transaction execution across multiple app-chains. Faced with sudden spikes in blockspace demand, individual Cosmos chains would unlikely be able to produce measurable improvements over other monolithic chains in terms of throughput or cost. Without the existence of cross-chain transfer functionality enabled by IBC, liquidity and user activity on Cosmos chains would also be prohibitively isolated.

This hypothetical situation is largely representative of the state of scaling in the Avalanche ecosystem, which leaned heavily into the concept of subnets as a scaling solution in early 2022. In theory, subnets are designed to be similar to app-chains in the Cosmos ecosystem,

with independent validator sets to secure the network and customized fee structures to suit specific applications. One subtle difference is that subnet validators must also be validators for the Avalanche C-Chain, which is intended to drive additional demand for Avalanche's native AVAX token but is highly dependent on the market demand for becoming new subnet validators. Despite this requirement, subnets do not inherit the security of the C-Chain, nor do they have the ability to directly transfer assets between one another via a standard messaging protocol.

As a result, Avalanche subnets in their current state mostly function as sidechains, alleviating congestion on the primary C-Chain by executing transactions and performing validation on a separate chain entirely. For the most part, existing subnets served this purpose well, hosting the high-volume, low-value transactions from on-chain gaming protocols that would otherwise drive up gas costs on the C-Chain.

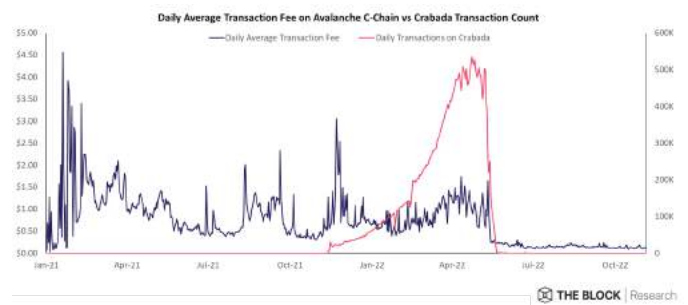


Figure 109: Daily average transaction fee on Avalanche C-chain vs. Crabada transaction count 2021 - 2022

Source: Snowtrace, DappRadar, The Block Research

In May, the launch of the Swimmer Network subnet and subsequent migration of the Crabada gaming protocol led to a substantial decrease in average transaction fees on the C-Chain. Alongside the launch of another gaming subnet, the DeFi Kingdoms' DFK Chain, the Swimmer Network launch led to a significant reduction in Avalanche C-Chain network activity, which became relatively stagnant for the remainder of 2022. As a result, subnets effectively contributed to a reduction in demand for AVAX. Meanwhile, the limits to the scalability of single subnets became readily apparent in the latter half of the year.

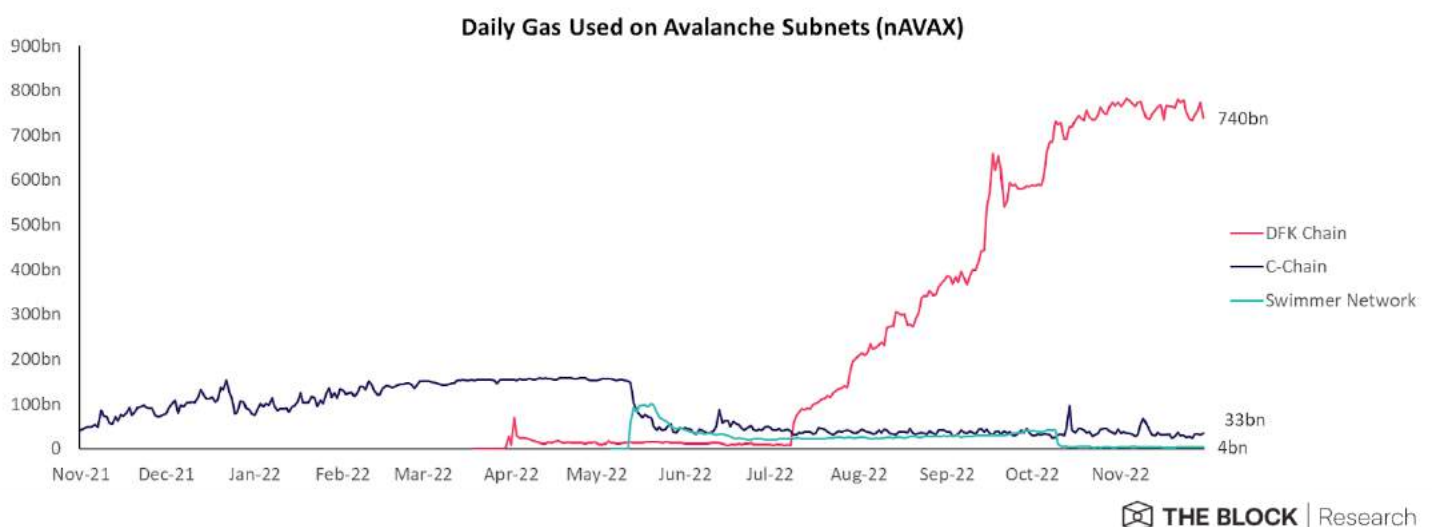


Figure 110: Daily gas used on Avalanche Subnets (nAVAX) since November 2021

Source: Avalabs

Beginning in July, daily transactions on DFK Chain rose at a rapid pace, leading to a commensurate increase in the amount of gas used per day. In November, the average daily gas used by DFK Chain reached a new monthly high of ~760 billion gwei, more than 3.5x higher than any single day of gas usage on the C-Chain over the past year. This trend highlights one of the key issues with adopting a multi-chain model as a primary means of addressing blockchain scalability. In the absence of any modifications to directly increase transaction throughput, monolithic blockchains – even those that comprise a larger multi-chain scaling approach – can generally be expected to perform comparably to those that utilize the same execution environment. For reference, both DFK Chain and Swimmer Network use an implementation of the Ethereum virtual machine (EVM), which continues to be the most popular execution environment among smart contract platforms today.

The EVM Dominance

Execution environments are critical components of any blockchain architecture and are largely responsible for dictating the behavior of assets, transactions, smart contracts, and more. Among those being actively used in blockchains today, the EVM is by far the most dominant, setting the standard for transaction execution and user interactions across a range of L1 chains. In fact, as of this writing, 9 of the 10 largest smart contract platforms by TVL feature the EVM or an EVM-compatible VM as their execution layer.

In 2021, EVM compatibility played a significant role in the meteoric rise of major Ethereum-alternative L1 ecosystems such as BNB Chain, Avalanche, and Polygon, among others. By co-opting the execution environment familiar to both DeFi users and

developers in their own blockchain designs, EVM-compatible L1s were able to onboard communities and attract activity originating from Ethereum with relative ease. These ecosystems largely maintained their positions among the top in TVL throughout 2022 despite enduring significant drawdowns in line with the broader crypto market. The BNB Chain ecosystem has been a particularly substantial beneficiary of the spread of DeFi from Ethereum to other L1s. BNB Chain is now the second-largest L1 ecosystem behind only Ethereum, with a TVL of ~\$5.4 billion. Its share of overall DeFi TVL remained relatively steady throughout the turmoil of 2022 and increased steadily from May onwards.

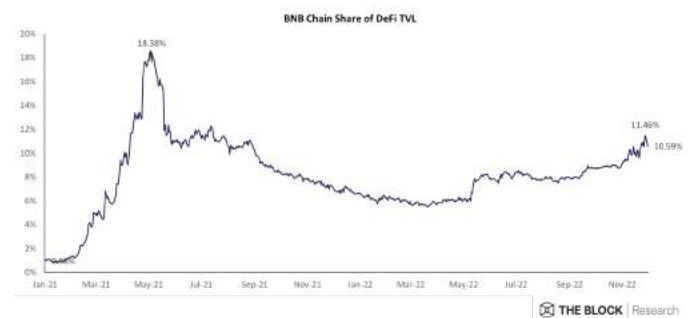


Figure 111: BNB Chain share of DeFi TVL

Source: DeFiLlama

With its large on-chain supply of ~\$10.5 billion in stablecoins, the BNB Chain ecosystem was well-positioned in November to capture significant DeFi market share in the fallout of the FTX collapse. On November 27, the ecosystem reached a YTD-high of 11.5% of overall DeFi TVL. The key trade-off made by the BNB Chain network with respect to scalability is its decentralization. As of this writing, the BNB Chain features an active [validator set](#) of just 26, with many of them speculated to be affiliated with or funded by Binance. By comparison, Ethereum currently has an active validator set of ~484,000.

BNB Chain's disregard for decentralization within its validator set poses significant risks with respect to security and censorship resistance, but this tradeoff has yielded major advantages in terms of throughput as well. In 2022, BNB Chain processed an average of 4.37 million transactions per day, which equates to a throughput of roughly 50 TPS. Meanwhile, Ethereum's throughput typically averages ~13 TPS.



Figure 112: Daily transaction count by blockchain
Source: Artemis

The advantages of BNB Chain's high transaction throughput relative to Ethereum are clearest when viewed through the lens of user experience. With the ability to process transactions on BNB Chain at nearly 4 times the speed of Ethereum on average, there is little doubt that users who are unconcerned with the risks of validator centralization would be drawn to the former's high-speed, low-cost environment for making DeFi transactions. In some senses, the design of BNB Chain can be viewed as a maximization of the transaction execution capabilities of the EVM, wherein the latency bottleneck imposed by the need for validators to reach consensus is reduced to the bare minimum at the cost of decentralization. When pushed to its maximum capacity, the [latest estimates](#) for BNB Chain's throughput in the context of DEX trades (considered common user behavior) indicate that the network would be able to process ~195 DEX trades per second.

Optimizations Beyond the EVM

Excluding the use of L2 rollups, attempts to scale L1 blockchains beyond the limitations of the EVM require customization of the execution environment by necessity. Alternative environments such as WebAssembly (WASM) became popular in recent years through multi-chain ecosystems, including Cosmos and Polkadot, due to their support for a wide range of programming languages. However, the act of changing execution environments alone is not sufficient for substantially increasing execution capabilities.

In 2022, the Solana network and its Sealevel runtime remained at the forefront of development in terms of maximizing transaction throughput on a monolithic blockchain. The main trade-off made in Solana's blockchain architecture for the sake of increasing execution speed is decentralization. Unlike the case with BNB Chain, Solana has an active [validator set](#) that totals more than 1,800. The fact that the top 29 validators currently control over 33% of the total stake is also not ideal from a decentralization perspective, but the main centralizing force in Solana is a result of the network's design itself.

Transaction execution on Solana involves a complex interplay between client software and the underlying hardware used by validators. The reference to its execution environment as a "runtime," as opposed to a VM, specifically alludes to the fact that Solana's transaction execution leverages the processing power of validator hardware in order to maximize throughput. As a result, Solana validators have significantly higher hardware and network requirements than validators for any other major L1s. This maximization of hardware capabilities enables unique features like parallel

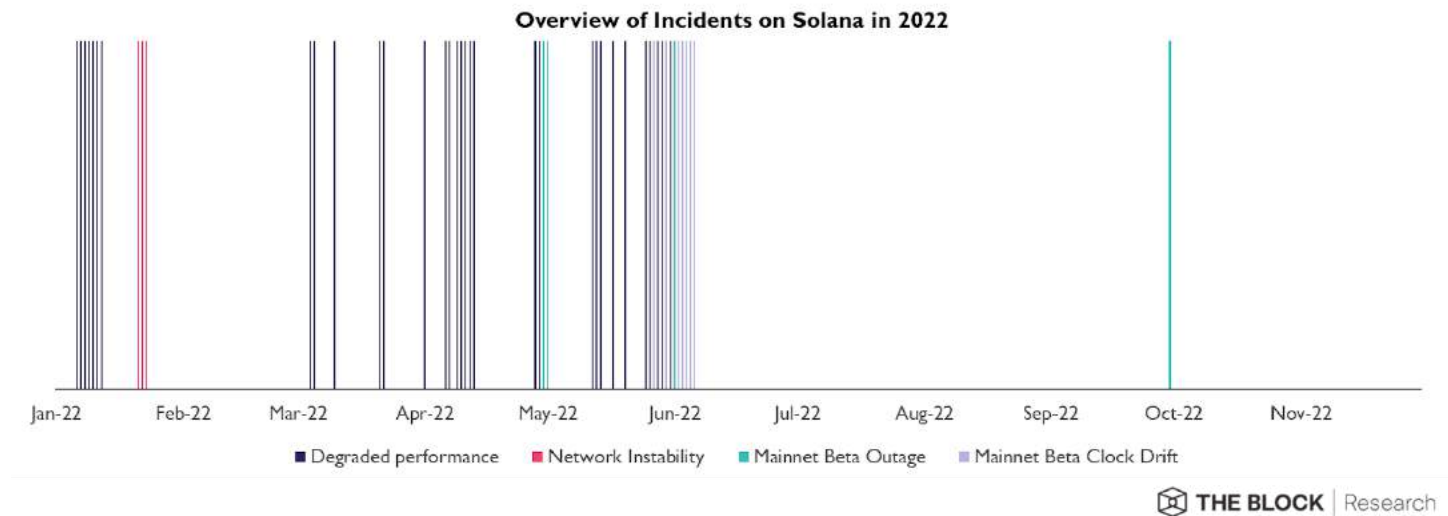


Figure 113: Overview of incidents on Solana in 2022
Source: Artemis, Solana Foundation

processing of transactions, but it has also led to situations where validators became overwhelmed by sudden surges in network demand.

Network performance issues plagued the Solana ecosystem throughout 2022, with several incidents severe enough to halt the network entirely. The common denominator with most of these incidents was an overabundance of spam transactions submitted by bots in an attempt to capitalize on MEV opportunities. Due to the negligibly low cost of sending transactions on the network, malicious actors were insufficiently penalized for spamming requests, and validators often became unable to separate them from legitimate user requests.

To make matters worse, the Solana ecosystem became one of the largest victims of the FTX and Alameda collapse in November and was forced to cope with the loss of one of the biggest market makers in its ecosystem. Major stakeholders and investors in the Solana ecosystem also suffered direct losses from the FTX/Alameda debacle, in addition to the laundry list of

destructive events from the fallout that included the potential loss of underlying collateral in the Sollet bridge, direct losses borne by the Solana Foundation, and the general exodus of liquidity from the ecosystem. Between the start of the year and November 30th, the Solana ecosystem's TVL fell by over \$7.9 billion for a shocking loss of 95% YTD.

The spate of troubles for the Solana ecosystem throughout 2022 ultimately proved to be an exceedingly frustrating experience for users, developers, validators, and investors. As a result, the Solana team's eventual rollout of critical features for combatting its prior network issues, including QUIC packet filtering and the activation of fee markets, went largely unnoticed by most market participants.



Figure 114: Solana additional revenue from fee market (SOL)
Source: Dune (@rawrmaan)

Use of the preliminary release of the fee market spiked in mid-November during the FTX debacle, coinciding with a rare streak of network stability during one of the most volatile periods in crypto history, which offers hope that the ecosystem will be prepared for a rebound in user activity if and when the time comes. One of the newest L1 chains of 2022 that has drawn comparisons to Solana is Aptos, which officially deployed its mainnet on October 12 and went live for public use on October 17. The relationship between Aptos and Solana mostly exists in the form of investor and developer overlap between the two ecosystems, as well as a parallel transaction processing mechanism that has yet to be fully battle-tested.

Aptos, along with another protocol that emerged from the formerly Meta-backed Diem project, Sui, primarily drew attention in 2022 for its use of the Move VM. Originally conceived at Meta during Diem development, the Move language and VM are the latest entrants to the blockchain development landscape still largely dominated by Solidity and the EVM. One of the most notable aspects of Move is that it has been designed with the intent of enabling a more streamlined experience for developers and a safer on-chain environment for users through the implementation of common-sense linear logic rules. As alluded to

throughout this report, thoughtfully designed user experiences in blockchain development are paramount to attracting user activity and enabling further growth in the space. For now, efforts are underway to create tools that make it easier for developers to translate their efforts in the EVM to the Move VM.

Looking ahead, bridging the technical gap between networks, including the EVM and other emerging execution environments, is one of the major challenges that remain in blockchain development. A near-endless list of existential wealth destruction events throughout 2022 has served as a wake-up call for the broader crypto industry to critically consider its security and trust assumptions at every location where capital resides, whether on-chain or off-chain. Meanwhile, connections between blockchains continue to be built at a rapid clip, which now makes it easier than ever to transfer capital between chains. Developments in cross-chain tooling also continue to bring the EVM to a growing number of networks through cross-compatible chains like Canto and Evmos in the Cosmos IBC ecosystem, at once deepening the influence of Ethereum as a social consensus layer and increasing the range of possible DeFi interactions between chains.

However, L1 teams will also need to consider the additional risks that come with increased asset composability and access to DeFi. In 2022, we saw how L1 adoption of faulty DeFi mechanisms could damage the health of an ecosystem if exploited, exemplified by the collapse of Terra's UST and later replicated on a smaller scale with decentralized stablecoins like aUSD on Acala and USN on Near. We also saw how deep L1 integrations with liquidity originating from exploited cross-chain bridges, like Moonbeam and Evmos with the Nomad bridge, can wreak havoc on the health of an ecosystem. Clearly, breaking consensus is not the only

way to damage an L1 network; commingling large amounts of liquidity with corrupted protocols can be damaging as well.

Cross-chain messaging protocols are likely to continue growing in importance. How exactly the value of facilitating cross-chain communication is ultimately distributed remains an open question, whether it be to MEV extractors, bridges, cross-chain messaging protocols like IBC, LPs, or others. The abundance of available blockchain dev tools has simplified the process of launching app-chains even outside the Cosmos and Polkadot ecosystems, with L1s like Avalanche and Polygon now embracing the concept of application-focused blockchain development as well. Execution environments will ultimately play a significant role in defining the typical end-user experience, as well as quality-of-life improvements to cross-chain UI enabled by increasingly feature-rich cross-chain messaging protocol. L1 ecosystems became increasingly connected and interoperable throughout 2022, and the continuation of this trend in the coming years provides more reason than ever to ensure robust security and decentralization in crypto's most popular protocols.

5

Blockchain Scaling Solutions & Bridges: 2022 Overview

Arnold Toh, Brandon Kae



Blockchain Scaling Solutions & Bridges: 2022 Overview

Arnold Toh, Brandon Kae

An overview of blockchain scaling and interoperability solutions, including: rollups, data availability, arbitrary messaging bridges, and more.

Quick Take

- Rollups saw their TVLs decline throughout 2022, a likely impact of the bearish market outlook, with a handful retaining users as a result of their airdrop or potential airdrop.
- Other scaling solutions made significant development, from data availability solutions like Celestia to zkEVM efforts like Polygon Hermez.
- Liquidity bridges have also lost significant TVL, a result of declining asset prices as well as multiple bridge hacks in 2022.

State of Blockchain Scaling Solutions in 2022

As blockchain adoption grows, we begin to see accelerated developments in scaling technology. There are multiple approaches to improving blockchains' throughput, from rollups to data availability optimization to modularization. The current scaling efforts are predominantly Ethereum-based or data availability-based. While there are scaling efforts on other blockchains such as Cosmos, the implementations are typically marginally different.

Overall, scaling solutions attracted significant attention with the launch of Optimism's governance token, OP. This resulted in speculation on the airdrop criteria for existing rollups that are yet to launch a token, such as Arbitrum and StarkNet. While the crypto market has generally slumped, a token airdrop usually stimulates short-term hype and activity that can bootstrap significant adoption. With zkSync 2.0's and Polygon's zkEVM launch, along with Arbitrum's and StarkNet's highly anticipated token drop, it is likely that we see significant growth in on-chain activity for the L2 ecosystem in 2023.

Ethereum-based Scaling Solutions

The overall landscape for Ethereum-based scaling solutions has largely been dominated by Arbitrum, Optimism, and dYdX, currently accounting for close to 90% of the TVL across all Ethereum-based rollups.

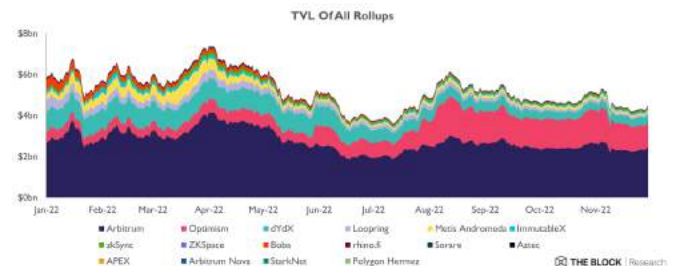


Figure 115: TVL of all rollups in 2022

Source: L2Beat

The reason for their dominance would be a mix of first-mover advantage, strong utility and deep liquidity. We will look at some of the existing rollups in-depth in the next section.

Optimistic Rollups

Optimistic rollups (ORs) rely on fraud proofs to ensure the validity of their states on Ethereum. This requires vigil watchers to call out any invalid states proposed,

which can take some amount of time. As a result, all ORs necessitate some arbitrary period of time (i.e., a challenge period) when facilitating withdrawals from the OR back to Ethereum. This time period is typically 7 days (i.e., Arbitrum and Optimism) but can be arbitrarily shortened to 7 minutes (i.e., Metis). Generally, the shorter the challenge period, the lower the level of security.

While a robust watcher network could improve security to some degree, by having watchers on alert for all new states proposed, it involves some trade-off between centralization and performance. For instance, a series of newly proposed state roots would need to be checked by a handful of watchers (centralized) or apportioned to be checked by multiple watchers (trust every watcher) or all checked by multiple watchers (slow). With the right incentive design, the ideal approach would be trusting every watcher. However, most ORs today rely on centralized watchers to submit fraud proofs.

Arbitrum

Arbitrum currently has a permissioned fraud-proof system where only whitelisted validators are allowed to submit fraud proofs.

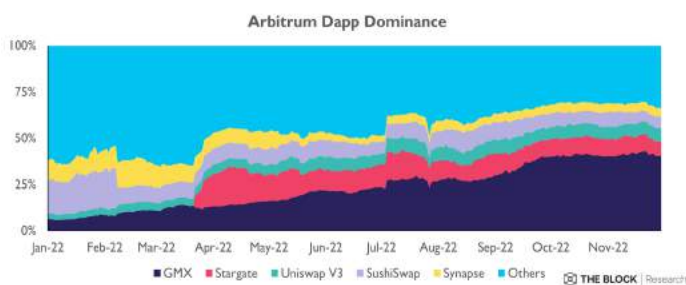


Figure 116: Dapp dominance on Arbitrum in 2022

Source: DeFiLlama

In terms of Arbitrum dapps growth, GMX would be the most significant one for 2022, sitting at ~43% of

Arbitrum's TVL. GMX is a decentralized perpetuals exchange, where users can trade perpetuals contracts or provide liquidity for traders.



Figure 117: GMX usage metrics in 2022

Source: GMX

GMX attracted over 57,000 users and accrued \$21 million in fees over the past 2 months and is still steadily growing throughout the bearish climate of the past year. GMX also expanded to Avalanche, though adoption is relatively modest there for now. There is [contention](#) on the viability of GMX's model now, after LPs were economically [exploited](#) on Avalanche in September 2022 as a [result](#) of GMX facilitating zero-slippage trades. Essentially, GMX serves as a platform where active traders are effectively trading against passive LPs. Only time can tell if such a dynamic is sustainable for all stakeholders.

Arbitrum Nova

Arbitrum Nova is an AnyTrust variant that lowers costs by posting transaction data to a Data Availability Committee (DAC) instead of on-chain. A DAC has N members, of which AnyTrust assumes at least two are honest, which is attested with a Data Availability Certificate that ensures the data will be made available if required.

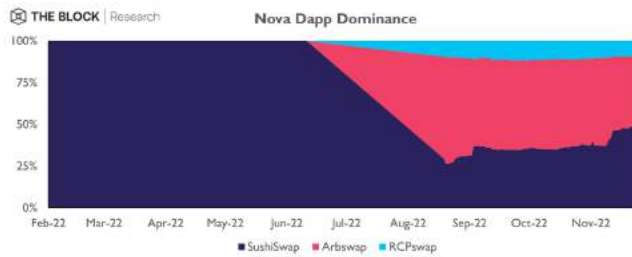


Figure 118: Dapp dominance on Arbitrum Nova in 2022

Source: DeFiLlama

While Arbitrum Nova's adoption is relatively modest, at around \$4.8 million TVL, it primarily serves as a cheap blockchain with sub-cents fees instead of a platform for meaningful financial activity as of its current implementation. This is because relying on an off-chain DAC is still less secure than on-chain data availability, which is an important criterion for a rollup to inherit Ethereum's security. The concept of data availability and its implications will be discussed in a later section.

Optimism

Optimism's fraud-proof system is still under development, as such, users are currently trusting one block proposer, OP Labs PBC, to submit valid L1 state roots.

The most notable event for Optimism in 2022 would be the launch of its governance token, OP, in June 2022.

This brought significant attention and hype for Optimism and also boosted Optimism's on-chain activity. In fact, the OP airdrop garnered so many users that it caused a [noticeable slowdown for Optimism's RPC](#). Additionally, it was announced that 5.4% of OP's supply would be distributed to projects on Optimism over the next six months via governance, which helped bootstrap significant liquidity on Optimism.

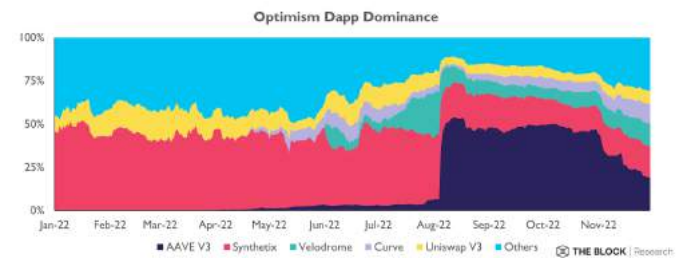


Figure 119: Dapp dominance on Optimism in 2022

Source: DeFiLlama

Optimism was largely dominated by Synthetix in 2021 but had seen the proliferation of other dapps in 2022, such as Aave and Velodrome, both of which were recipients of OP token grants. Most of Synthetix's TVL on Optimism came from the staking of SNX tokens, which does not stimulate much on-chain activity. Velodrome, an Optimism-based DEX, saw decent growth in TVL, bootstrapping significant liquidity for major altcoins on Optimism, such as ETH and OP, as well as stablecoins, such as USDC and sUSD.

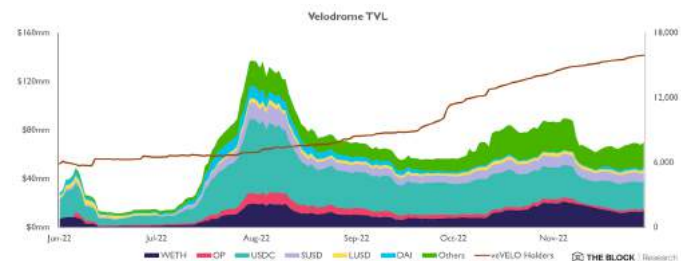


Figure 120: Value locked in Velodrome in 2022

Source: DeFiLlama

The spike in TVL in July was the result of a 3 million OP token grant that was awarded to Velodrome by OP Labs PBC to deepen the liquidity on Velodrome. This had a great impact on Velodrome's ability to attract liquidity, especially for stablecoins, overtaking Curve in terms of TVL on Optimism. Another notable design of Velodrome would be their vote-escrowed (ve) token model, where veVELO holders are incentivized to vote on the distribution of rewards to different liquidity pools. This resulted in a generally increasing trend for the number

of veVELO holders as there are sustainable incentives for LPs to hold veVELO. However, this trend could change quickly should liquidity on Velodrome start leaving.

Metis

Metis' fraud-proof system is a fork of Optimism. Like Optimism, Metis' fraud-proof system is under development, so users are expected to trust Metis' block proposer to submit valid L1 state roots. In April 2022, Metis' transaction data started being posted to MEMO-distributed data storage instead of on-chain, meaning that Metis no longer relies on Ethereum for data availability. MetisDAO had announced that there would be an additional challenge process to force Metis' sequencers to post missing data to Ethereum, but it has yet to be implemented.

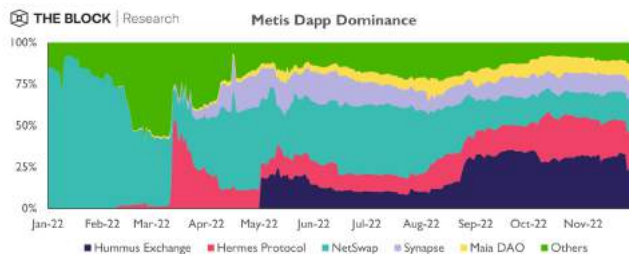


Figure 121: Dapp dominance on Metis in 2022
Source: DeFiLlama

While NetSwap dominated Metis' TVL for most of 2021, it saw various competitors in 2022, such as Hummus and Hermes, which had their own liquidity mining incentives that caused mercenary capital to flow from NetSwap to these other DEXs. Aside from DEXs, the only dapp on Metis with notable liquidity would be Synapse bridge.

Boba

Boba is another fork of Optimism whose fraud-proof system is also currently under development. Similar to Optimism and Metis, Boba users are required to trust a

single block proposer to submit valid L1 state roots. In Boba's case, enya.ai, the core developer of Boba, is responsible for this role.

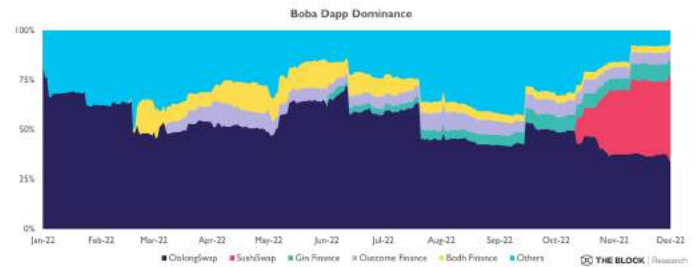


Figure 122: Dapp dominance on Boba in 2022
Source: DeFiLlama

OolongSwap, the first DEX on Boba, dominated the TVL for most of 2021, but SushiSwap quickly ate into OolongSwap's market share when it was brought onto Boba's ecosystem in October 2022. Similar to Metis, Boba's TVL is mainly concentrated in DEXs, in particular, OolongSwap, SushiSwap, and Gin Finance. In comparison, there is lackluster adoption for other dapps on Boba, such as Outcome Finance, a liquidity bootstrapping service, as well as Bodh Finance, a decentralized lending platform.

Zero-knowledge Rollups & Validiums

Zero-knowledge rollups (ZKRs) differ from ORs in that they utilize advanced cryptographic techniques to generate a validity proof that ascertains the validity of a particular state. There are two general types of validity proofs, Succinct Non-Interactive Arguments of Knowledge (SNARK) and Scalable Transparent Arguments of Knowledge (STARK). The former is generally more widely adopted though the latter is arguably more optimized for proving more information.

Another unique feature of scaling solutions utilizing validity proofs is that they can leverage off-chain data availability, though there is a different classification for

such solutions: Validiums, a term coined by StarkWare. This is because submitting a valid validity proof on-chain is considered highly improbable without a valid execution trace, meaning that a malicious attacker would find it nearly impossible to submit a valid proof for fraudulent states. As such, the data used in the generation of the validity proof can be hosted off-chain with a marginal trade-off in security.

Various Validiums were launched with the help of StarkWare, each with its own unique DAC, a handful of entities that guarantees all transaction data will be posted on-chain. In the event that the Validium operator refuses to service withdrawal requests, the transaction data posted on-chain will allow individual users to submit withdrawal requests on their own by submitting a Merkle proof for the latest state. That said, the trade-offs for data availability modes are nuanced and will be further discussed in a later section.

dYdX

The leading ZKR by TVL is dYdX and it leads the other ZKRs by a significant amount. As of this writing, dYdX holds \$385 million in TVL, which is more than 3 times larger than Loopring's TVL of \$114 million, the second largest ZKR. The reason for dYdX attracting so much liquidity is that it offers a perpetuals trading experience much better than its competitors for now. This is apparent from the high trading volumes on dYdX, and although volumes fell significantly in 2022, dYdX still managed to retain a significant amount of trading activity, averaging \$1 billion in daily trading volume in the month of November.



Figure 123: dYdX trading volume in 2022

Source: dYdX Metabase

Another indicator that stands out for dYdX would be the number of unique depositors, which has been climbing steadily since its inception. While the growth in unique depositors tapered off in 2022, the fact remains that dYdX is gaining traction in adoption even in a bear market. The collapse of FTX may well have been the catalyst to push the crypto community to start adopting DEXs with full transparency instead of relying on CEXs.

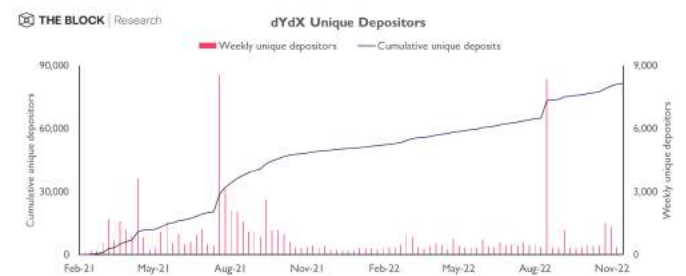


Figure 124: dYdX unique depositors since 2021

Source: dYdX Metabase

While dYdX has been steadily onboarding new users, it is not unaffected by the ongoing bear market. Daily open interest fell significantly from the highs of \$1 trillion in early 2022 to an average of \$225 billion for the month of November.

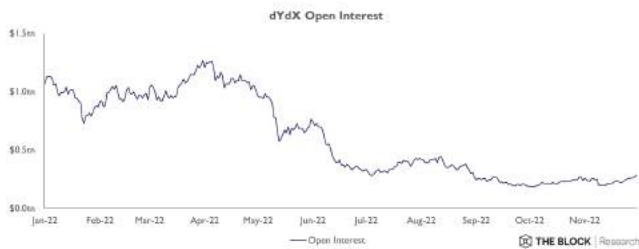


Figure 125: dYdX open interest in 2022

Source: dYdX Metabase

It is worth pointing out that dYdX is a self-custodial solution, which means that traders remain full control of their funds. Even when funds are bridged to the ZKR, users are able to withdraw their full account balance at any time without relying on any centralized entity. This is because dYdX posts all data, including its state root, on-chain, so users are able to submit a withdrawal request on Ethereum itself, to pull their own funds out from dYdX.

That said, dYdX announced that they will soon be [migrating](#) to the Cosmos ecosystem. The migration comes with the launch of dYdX v4, which is supposed to bring improvements in terms of throughput and decentralization. dYdX also indicated that the existing perpetuals exchange will be deprecated once the migration to a standalone Cosmos chain is complete, which raises the question of whether all of dYdX's users will migrate to the Cosmos ecosystem, given that there is likely a significant number of users who chose dYdX because it was built on top of Ethereum. The migration is estimated to start at the end of 2022.

Loopring

Loopring was launched in March 2020, making it the oldest ZKR in the space. It attracted a considerable TVL since and remained one of the top few ZKRs by TVL. That said, Loopring's TVL is largely comprised of the LRC token, their native governance token.

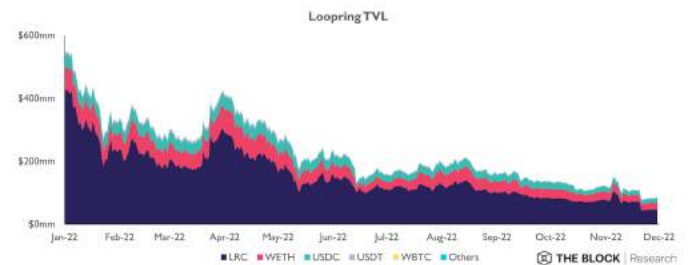


Figure 136: Value locked in Loopring in 2022

Source: DefiLlama

The other metric that provides some insight into Loopring's usage would be the daily trading volume. The trading volume on Loopring's automated market maker (AMM) has been relatively modest, averaging \$1.6 million in daily volume, with large spikes on November 4 and 10, 2022. The reason for the spike in volumes might be due to the collapse of FTX, which saw high trading volumes throughout that period in general and also pushed traders to find alternative trading avenues instead.

Additionally, Loopring has an order book exchange built on L2, though its trading volume is far lower than that of the AMM. This trend indicates that most of Loopring's users prefer using the AMM interface instead of the order book. There could be various reasons for this, though the most likely one is that the AMM interface is simply easier to use.

Aside from the AMM and order book, Loopring also supports the minting of NFTs and has an NFT marketplace. The traction for NFTs on Loopring is relatively slow, averaging \$145,000 in daily volume over the past three months.



Figure 127: Loopring trading volume in 2022

Source: Dune Analytics (@Brecht)

ImmutableX

ImmutableX is an NFT-specific Validium developed by StarkWare. Such solutions are cheaper than their on-chain data availability counterparts, such as dYdX, but there are additional trust assumptions made for Validiums. The trade-offs between on-chain and off-chain data availability will be addressed in a later section.

In terms of trading volume, ImmutableX facilitates an average daily trading volume of \$850,000 over the past three months. Additionally, in recent months, Gods Unchained began dominating the trading volume on ImmutableX, accounting for 90% of ImmutableX's trading volume since September 2022. While Gods Unchained has grown significantly in terms of trading activity, the same cannot be said for the other collections. Given that ImmutableX's revenue is dependent on the trading volume it facilitates, it would certainly want to incentivize the trading activity of all NFTs listed on its platform, lest it cause ImmutableX to be over-reliant on a single NFT project for its revenue.

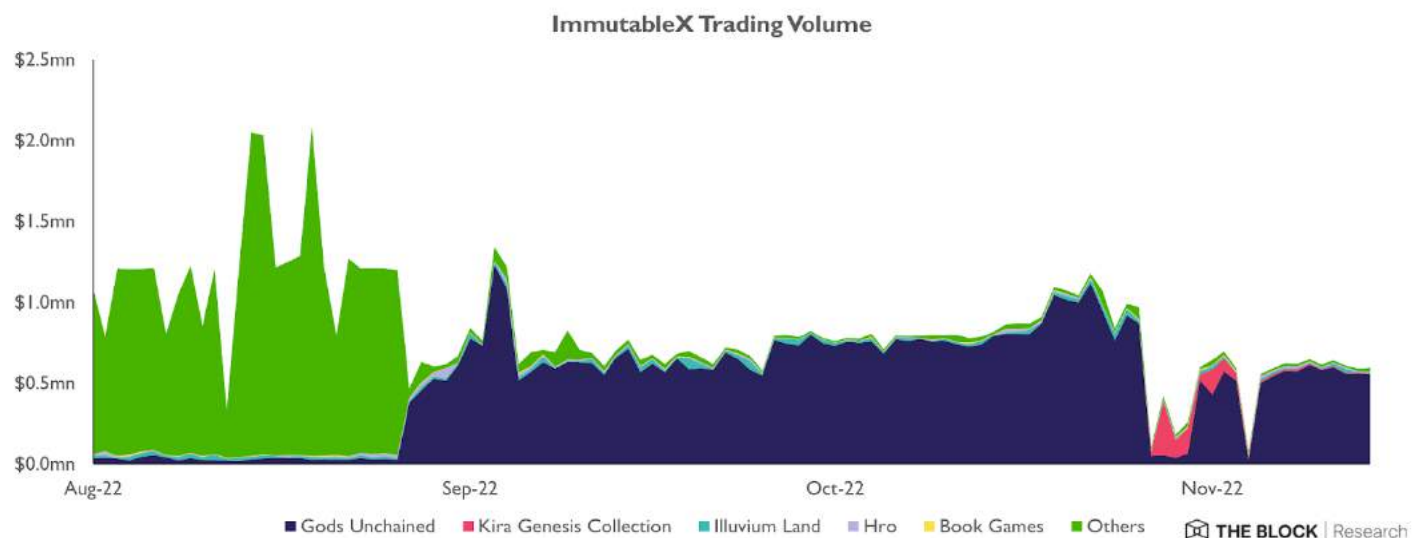


Figure 128: ImmutableX trading volume in 2022

Source: Immutascan

zkSync

zkSync experienced significant growth in TVL in Q1 2022 which declined afterward, likely caused by falling ETH prices rather than users' withdrawals, as the amounts of stablecoins on zkSync remained relatively unchanged. zkSync's TVL is largely dominated by ETH, a likely consequence of the lack of dapps on zkSync, which provides zero incentives for bridging altcoin liquidity to zkSync.

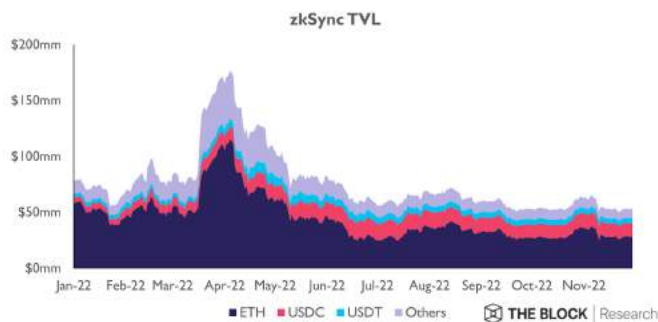


Figure 129: Value locked in zkSync in 2022

Source: L2Beat

The reason for the lack of dapps on zkSync 1.0 is that zkSync 1.0 does not have a generalizable framework for applications to be built on top of zkSync 1.0, making it hard for it to scale in terms of dapp development. However, with zkSync 2.0's zkEVM, it will likely resolve this issue as dapp developers can use Solidity as the framework for building dapps.

zkSync announced the launch of their baby Alpha on October 29, which comes with on-chain proof generation and verification. However, their mainnet block explorer indicates that L2 blocks are being generated intermittently, with only [14 blocks being validated](#) since its launch. According to Matter Labs, the full public launch will only come in early 2023. Another advancement that zkSync 2.0 intends to introduce is [Layer-3 \(L3\) Fractal Hyperchains](#). The main gist of L3s is that they offer a customizable execution

environment and leverages recursive proofs, where the validity proofs of L3 are combined into a single L2 validity proof, which is posted on Ethereum mainnet itself, which allows the L3 to inherit some of Ethereum's security. However, L3s are merely an extension of L2 and this concept can be abstracted infinitely, though the computational overhead increases with every additional layer.

It should be noted that this concept was [first introduced by StarkWare](#), which was followed by their [launch of recursive proofs](#) on StarkNet a year later.

ZKSpace

ZKSpace saw a relatively similar trend in TVL to zkSync, with a spike in Q1 2022, followed by a decline throughout the rest of the year. It should be noted that most of ZKSpace's TVL is made up of WBTC, ETH and ZKS, their own governance token. More notably, ZKS makes up an average of 28% of ZKSpace's TVL throughout the year, meaning that ZKSpace's TVL has a sizable composition of an endogenous asset as well, similar to Loopring.

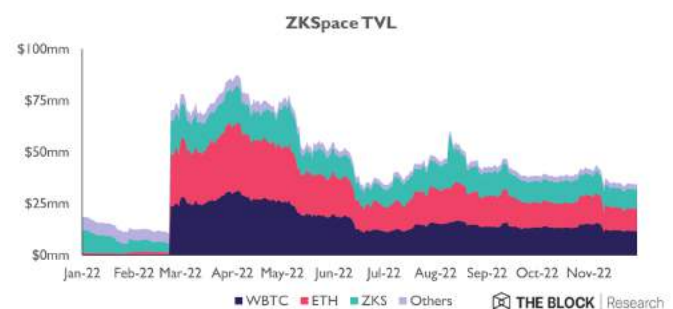


Figure 130: Value locked in ZKSpace in 2022

Source: L2Beat

It should be noted that ZKSpace currently comprises three products: ZKSwap, an AMM; ZKSea, an NFT marketplace; and ZNS, a domain name service.

However, most of ZKSpace's on-chain activity stems primarily from ZKSwap.

In terms of trading volume, ZKSwap is a far cry from Loopring's AMM, averaging only \$200,000 in daily volume over the past month. Interestingly, it saw the same spike in trading volume over the same period as Loopring, which corroborates the theory that crypto users were using alternative trading avenues post-FTX collapse amidst a volatile trading environment.

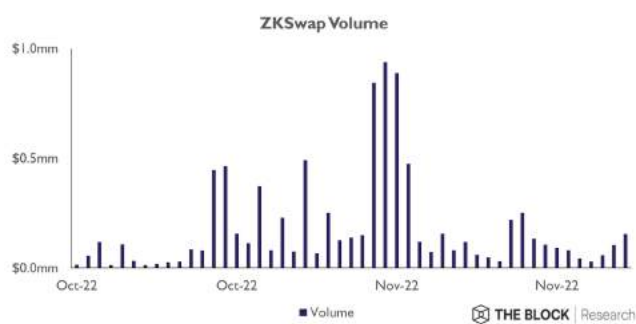


Figure 131: ZKSwap trading volume in 2022

Source: ZKSpace

Rhino.fi

Previously DeversiFi, Rhino.fi is another Validium that was developed by StarkWare that provides DeFi capacity. Rhino.fi's TVL generally declined throughout 2022, despite a short spike in April 2022. In terms of TVL composition, DVF, Rhino.fi's governance token, reduced in weightage throughout 2022, falling from an average of 52% in January to 20% in November. This highlights that while Rhino.fi's initial TVL was substantially bootstrapped by DVF, it managed to attract liquidity for other assets such that its TVL is not primarily backed by endogenous assets.

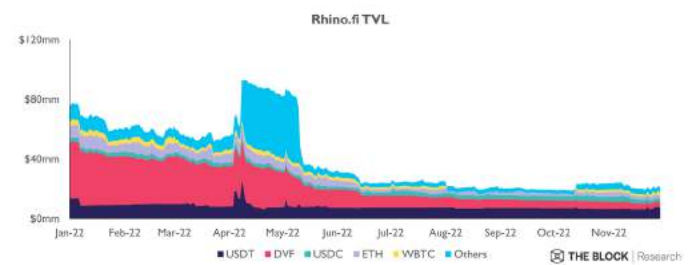


Figure 132: Value locked in Rhino.fi in 2022

Source: L2Beat

Despite Rhino.fi's decent TVL growth, it had lower trading activity, averaging \$235,000 in daily volume over the past 30 days. Similar to Loopring's and ZKSpace's AMM, Rhino.fi saw a spike in volumes from November 8 to November 10. More notably, there was another spike on November 25 and 28, though it seems to be spontaneous rather than event-specific.

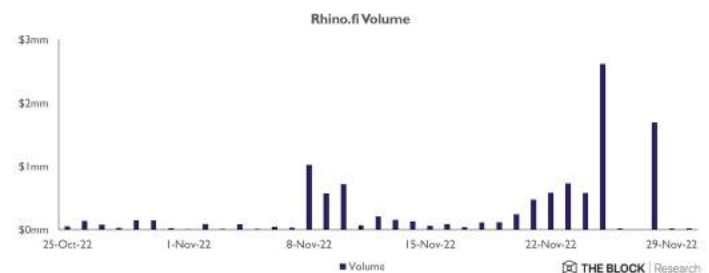


Figure 133: Rhino.fi volume in 2022

Source: L2Beat

Sorare

Sorare is another Validium solution developed by StarkWare that primarily serves as an NFT marketplace where users can trade NFTs related to Sorare's fantasy sports games. Sorare started out with only a single collection of soccer-related NFTs, but quickly expanded into the baseball and basketball domains as well. That said, Sorare has yet to see a significant surge in its TVL. This is likely attributed to the ongoing bear market, which would likely negatively impact the adoption of NFT-based games as well.



Figure 134: Value locked in Sorare in 2022

Source: L2Beat

APEX

APEX is another Validium solution by StarkWare. Similar to dYdX, APEX offers a perpetuals trading experience, albeit for fewer pairs and lower order-book depth. However, the use of off-chain data availability will likely allow APEX to charge significantly lower fees than dYdX. The growth in APEX's TVL in November is likely attributed to the earlier conjecture that crypto users are looking for decentralized alternatives to trade after FTX's collapse.

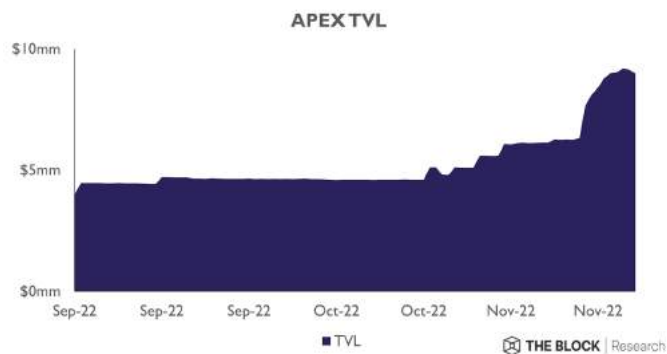


Figure 135: Value locked in APEX in 2022

Source: L2Beat

However, it remains to be seen if APEX can truly become a perpetuals exchange that rivals dYdX's liquidity and order-book depth. As mentioned earlier in dYdX's subsection, some users choose dYdX because it inherits Ethereum's security. An off-chain DAC may not ever be a substitute for that.

Aztec

Aztec is a privacy-focused ZKR that currently provides private DeFi yield aggregation on Ethereum. In 2021, Aztec launched zk.money, an application that allows users to shield transactions on L2. However, that has been deprecated with the launch of Aztec Connect, as the new zk.money now allows users to interact with Ethereum's DeFi ecosystem from L2.

This is a remarkable feat, considering that users can now access Ethereum native DeFi apps while maintaining their privacy. As a result, Aztec's TVL remained relatively consistent throughout 2022, even with the declining asset prices. There was a migration process in June 2022, where we saw a fall in Aztec's TVL, only to return back to Aztec Connect two months later.

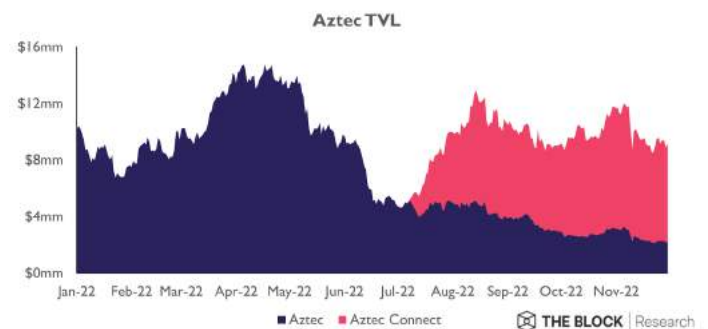


Figure 136: Value locked in Aztec in 2022

Source: L2Beat

Aside from the initially supported assets of ETH, DAI, and renBTC, Aztec Connect also started supporting wstETH as it is commonly used as collateral in Ethereum DeFi applications. Overall, Aztec's TVL still largely comprises ETH and DAI.

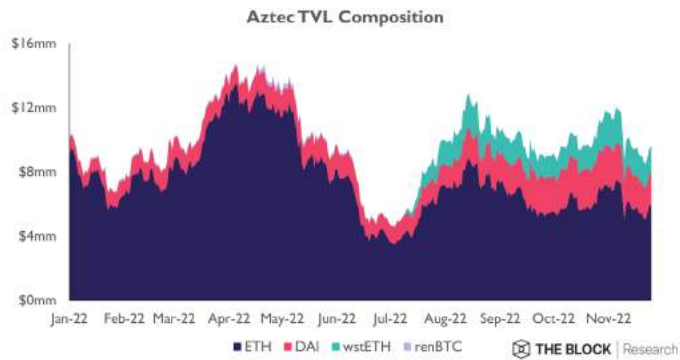


Figure 137: Value locked in Aztec in 2022 by asset

Source: L2Beat

While Aztec made significant headway in providing privacy for DeFi on Ethereum, it remains to be seen if such privacy layers will eventually become the target for regulators. Just like how [OFAC sanctions suddenly hit Tornado.cash](#), Aztec's zk.money may one day become a similar target for regulators.

StarkNet

StarkNet is StarkWare's generalizable ZKR. While StarkNet Alpha launched on the Ethereum mainnet in November 2021, it only started accepting deposits in May 2022. Since then, its TVL has been increasing steadily, causing StarkWare to continuously raise the cap it had initially placed on StarkNet's TVL.

It is clear that ETH dominates most of StarkNet's TVL, though it has a marginal amount of USDC and DAI. It is peculiar that StarkNet attracts this level of liquidity when there are no applications that are production-ready on StarkNet just yet. This is likely due to speculations that bridging liquidity to StarkNet is one of the potential criteria for the STARK token airdrop.

While there is a substantial level of speculation on the STARK token airdrop, it remains to be seen if the [STARK token](#) will be well distributed. Though there are a handful of precedents for StarkWare to learn from, optimal tokenomics has always been relatively challenging to attain, given the unpredictability of the stakeholders' actions. Nonetheless, StarkWare has mentioned that the current tokenomics are not finalized and will likely consider the feedback from the community and relevant stakeholders before making a final decision.

In terms of technological developments, the most notable one would be the use of Cairo, a programming language that optimizes the generation of validity proofs.

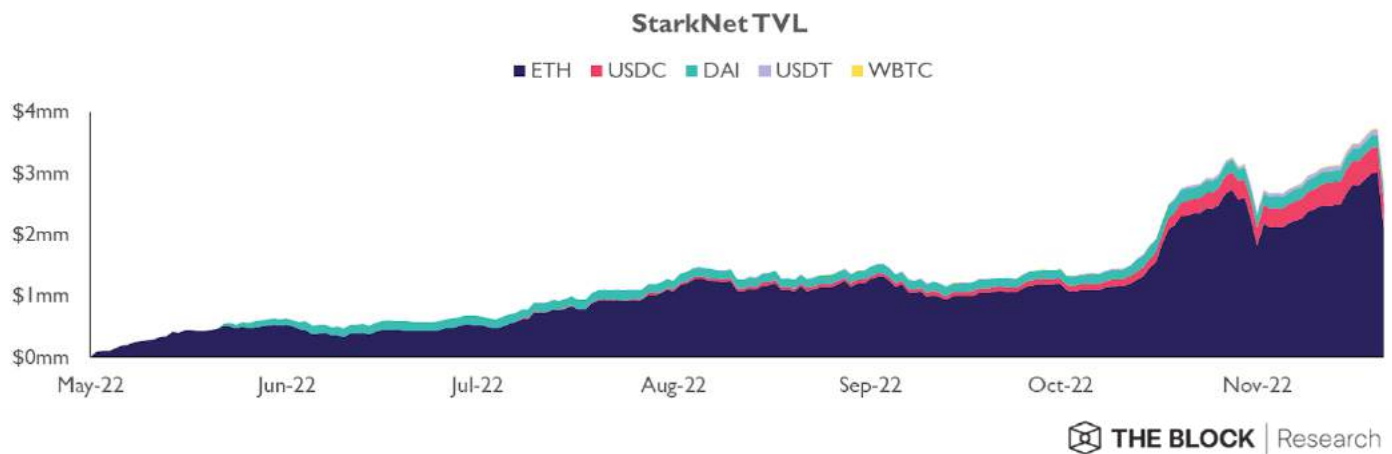


Figure 138: Value locked in StarkNet in 2022

Source: L2Beat

Polygon

Polygon forayed into the ZKR domain in 2022, acquiring multiple ZKR teams, such as Hermez and Mir (now Polygon Zero). Polygon also experimented with zk-STARKs with its own initiative, Polygon Miden. To date, none of Polygon's ZKR has been launched on the Ethereum mainnet, though Polygon Hermez is allegedly the closest.

Hermez saw its TVL declining steadily throughout the year, as it announced that it would no longer be developing its ZKR but instead, contribute to Polygon's ZKR efforts. Naturally, users would likely withdraw their assets from Hermez to repurpose their capital elsewhere. However, it would appear that some liquidity has remained even up till today. Given that there are hardly any transactions on Hermez, it would stand to reason that the zkEVM version of Polygon Hermez will likely be on a different platform from the existing Hermez ZKR.

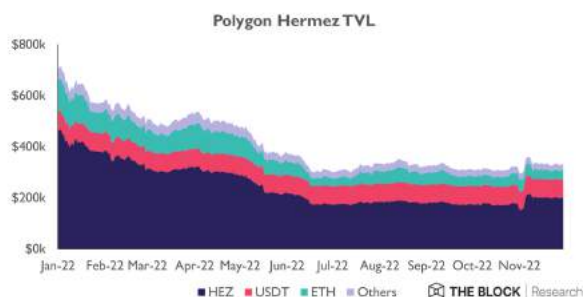


Figure 139: Value locked in Polygon Hermez in 2022

Source: L2Beat

One of Polygon's other ZKR efforts, Polygon Zero, is focused on creating SNARK proofs which has been claimed to have the [fastest proof generation and verification times](#). Polygon Miden, on the other hand, is a Polygon initiative that focuses on creating a STARK-based zkEVM rollup that would provide significant scaling advantages for applications.

Regardless, all of Polygon's ZKR efforts seem to coalesce towards a zkEVM solution that will utilize both STARKs and SNARKs. The main idea is to combine multiple fast-generating SNARKs into a single STARK, which is conceptually identical to proof recursion. Only time will tell if Polygon's foray into the ZKR space is successful.

Outlook on Rollups

Overall, the outlook for rollups remains ever-positive, owing to the fact that rollups generally have an optimal trade-off between security and costs. After all, gas costs on rollups are amortized over all transactions.

However, at current ETH prices, it would appear that the difference in costs across rollups makes marginal differences. This will not be the case in a bull market should ETH trade at higher prices, where the minute difference of cents today can become a stark difference of dollars. Essentially, this means that over the long run, only the most gas-efficient rollups will outcompete the others.

Rollup	Cost to send ETH	Cost for a token swap
Ethereum	\$0.40	\$2
Arbitrum	\$0.02	\$0.06
Optimism	\$0.05	\$0.08
Loopring	\$0.01	\$0.30
zkSync	\$0.02	\$0.04
Boba	\$0.06	\$0.18

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Figure 140: Gas cost to send ETH or a token swap

Source: L2Beat

It also remains a question if rollups can attract liquidity on a comparable scale to Ethereum, with one of the major concerns being that many rollups today are still centrally operated. Moreover, there is no incentive for rollup operators to decentralize their current role

anytime soon. As such, centralization concerns for rollups will likely remain for the foreseeable future, at least, until one major rollup starts decentralizing its operator nodes.

In terms of increasing adoption, one of the most significant ways to bootstrap liquidity and incentive on-chain activity is through a token. With some of the major rollups, such as Arbitrum, zkSync, and StarkNet, that have yet to launch their token, it will be interesting to see how the respective teams will utilize token incentives to drive adoption.

Overall, rollups are becoming quintessential for Ethereum users, as it provides an Ethereum-like experience with near-Ethereum-level security, at a fraction of the costs of Ethereum. As Ethereum adopts danksharding in the foreseeable future, rollup technology will only stand to gain from building on top of Ethereum – a synergistic harmony between ecosystems.

Data Availability Solutions

Data availability refers to the ability to ensure that all required data can be made available to a party at any point in time, should it be requested.

In the context of rollups, the cost savings are generally either from posting transaction data as calldata so as to save on computation costs, or posting transaction data off-chain and only post it on-chain when necessary. The former is the approach by ORs and ZKRs while the latter is the approach by Validiums.

We will first look into Validiums and their cost savings, followed by diving into the trade-offs made by utilizing an off-chain DAC. Thereafter, we will look at Celestia, a DA-focused scaling solution.

Validiums

The existing Validiums today offer significantly lower fees than ZKRs like dYdX and Loopring, and even ORs like Arbitrum and Optimism. This is because the gas costs of a rollup are essentially passed on from the gas costs incurred on Ethereum itself. Thus, the gas that a rollup charges is a function of the volume of data it posts to Ethereum, as well as the level of computation it requires. Both ZKRs and ORs offload computation from Ethereum to their respective layers, and Validiums go one step further by offloading data from Ethereum to an offchain data committee as well. As such, Validiums typically consume far less gas on Ethereum than ORs and ZKRs.

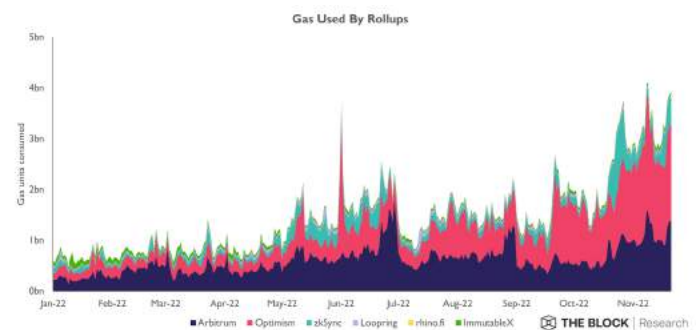


Figure 141: Gas used by rollups in 2022

Source: Dune Analytics (@funnyking)

At first glance, it would seem that ZKRs consume much less gas than ORs. However, existing ZKRs are usually far more specific, whereas ORs are usually generalizable. As a result, there are far more complex interactions that ORs can support as opposed to ZKRs. Not only that, but the gas consumption of a rollup is also dependent on the volume of transactions on the rollup itself. As such, a more relevant metric for rollups' gas consumption would be the average gas consumed per transaction.

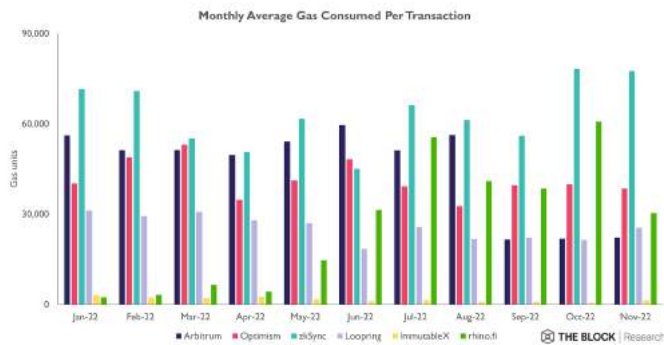


Figure 142: Monthly average gas consumed per transaction by rollups in 2022

Source: Dune Analytics (@funnyking)

When comparing the average gas consumption per transaction, it becomes clear that ZKRs are not significantly outperforming ORs. In fact, in 2022, ORs gas consumed per transaction fell with improved technology, namely in calldata compression methods. For example, Optimism launched its calldata compression in March 2022 and Arbitrum launched Arbitrum Nitro, with calldata compression, in August 2022, evidenced by the relative decrease in gas consumed per transaction during those periods.

Calldata compression sacrifices computation overhead for using lesser block space but the relative trade-off varies with the compression method used.

Validiums save on the gas required for posting transaction data on-chain by having an off-chain data committee post a data availability attestation, which is essentially a new Merkle root agreed upon by the majority of the DAC. In Figure 142, it would appear that rhino.fi is becoming increasingly inefficient but this stems from the main flaw of ZKRs, especially for those using STARKs, where posting and verifying a validity proof on-chain costs a fixed, significant amount of gas. As such, ZKRs are susceptible to becoming inefficient if the transaction count begins to drop, as the fixed amount of gas consumed by the validity proof is no longer amortized over as many transactions as before. In rhino.fi's case, as DeFi activity tapered off in the bear market, the transaction volume on rhino.fi fell off, which consequently caused gas consumed per transaction to spike.

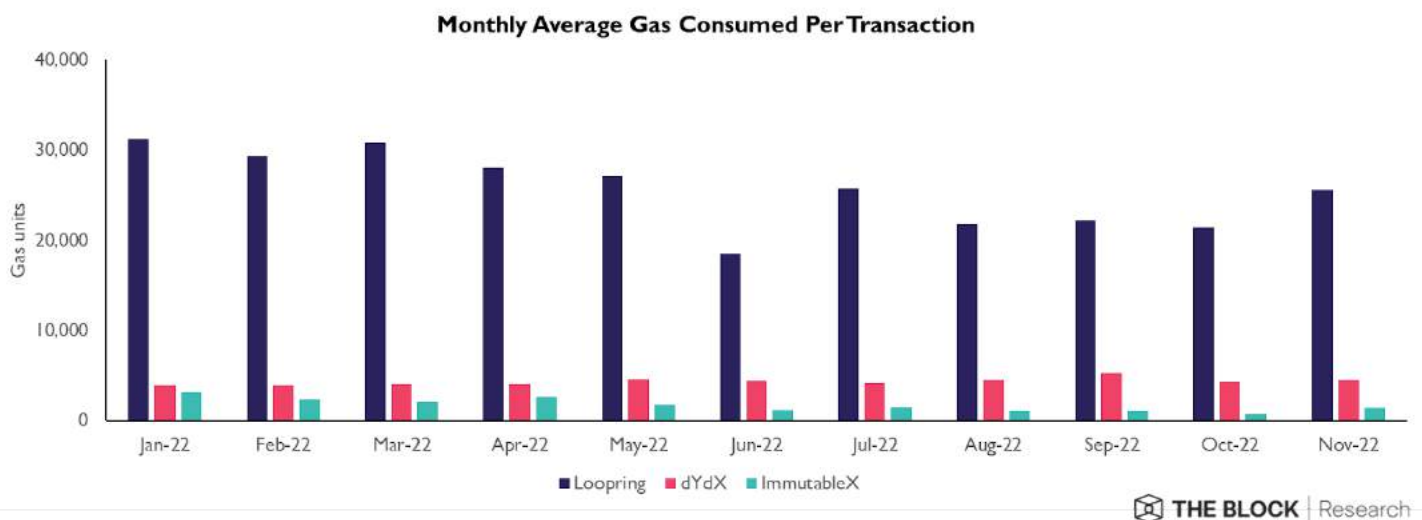


Figure 143: Monthly averaged gas consumed per transaction for Loopring, dYdX, and ImmutableX in 2022

Source: Dune Analytics @funnyking)

However, if one were to simply compare rollups with relatively stable growth trends, it becomes apparent that a ZKR with a much higher transaction count can amortize gas costs more efficiently, whereas a Validium is almost always certainly more performant in gas costs, albeit at the cost of data availability. This is pertinent because the DAC is the users' last line of defense against a malicious Validium operator. Without the transaction data to create a valid Merkle proof, users' funds can be held hostage indefinitely by the operator. That said, it should be noted that at no point can the operator direct users' funds to any arbitrary address, which eliminates the incentive for the operator to misbehave.

The identities of DAC members are usually kept private, such as that for ImmutableX, which uses a 5-of-7 multisig, and Sorare, which uses an unverified smart contract for data availability attestation. Such obscurity might protect these entities from being targets of cyber-attacks but also forces users to blindly trust the DAC without knowing their identities. Thus, some Validium protocols, such as rhino.fi, chose to publicly announce the identities of the DAC members instead.



Figure 144: Entities in Rhino.fi's DAC in 2022

Source: Rhino.fi

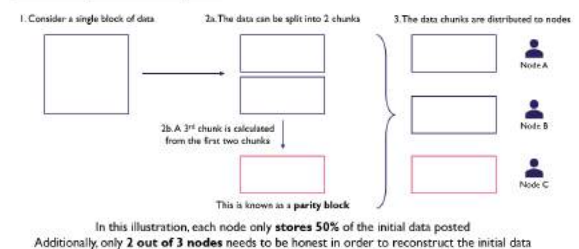
The conclusion on Validiums is that they will generally out-scale ZKRs and ORs because they reap the benefits of more efficient scaling by leveraging validity proofs

and also the advantage of reduced block space usage by posting data off-chain.

Celestia

In the domain of data availability, other solutions such as Celestia sprung up to serve as a specialized data availability layer. Such a layer holds the attestations of block data except, instead of utilizing a DAC, it is a permissionless layer where anyone can stake tokens (TIA for Celestia testnet) to participate in the network as one of the attesters. Celestia is able to provide scalable data availability because it uses Reed-Solomon (RS) erasure coding, a technique that has been used in various consumer technologies. Implementing the RS algorithm in the blockchain context requires some parameterization, such as the minimum number of nodes as well as the maximum number of bad actors.

Erasure coding in blockchain explained:



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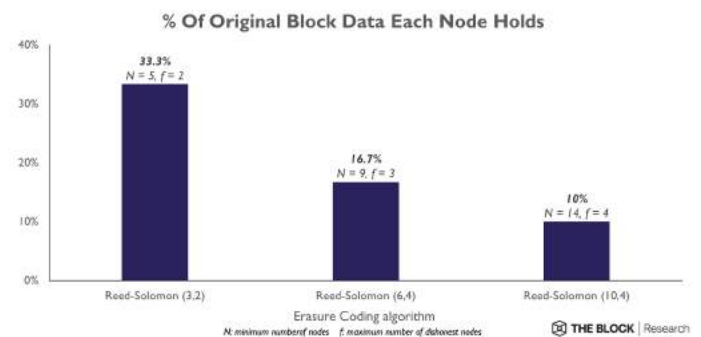


Figure 145: Visualization of Celestia's Reed-Solomon algorithm

Source: The Block Research

The more nodes there are in the network, the less data each node has to store to reconstruct the entire

database, as illustrated in Figure 145. Additionally, a higher degree of RS algorithm can be used to lower the percentage of dishonest nodes required to compromise the network, on the condition that there are sufficient nodes in the network.

All of Celestia's nodes essentially play the role of a DAC, that is, posting attestations for the availability of data on-chain. Celestia's documentation specified that it implements the [2D RS encoding scheme](#), an optimized adaptation of the RS algorithm for Celestia's block data structure.

Celestia is also able to act as a consensus layer as its nodes will be putting up an economic stake when Celestia moves to mainnet. This will allow any sovereign rollup to utilize Celestia as a consensus and data availability layer, though it remains a question if rollups will choose to use Celestia over Ethereum as a consensus layer.

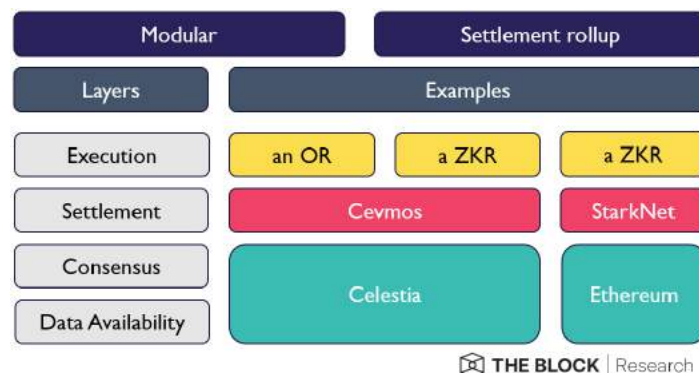


Figure 147: Visualization of Cevmos's and StarkNet's modularization
Source: The Block Research

Celestia testnet's adoption metrics are currently the best proxy for the mainnet's adoption, though it will likely vary, depending on the state of the markets. Moreover, a testnet has limited functionality whereas a mainnet will very likely see EVM-compatible applications migrating over to capitalize on potential incentives that may come with Celestia's mainnet launch.

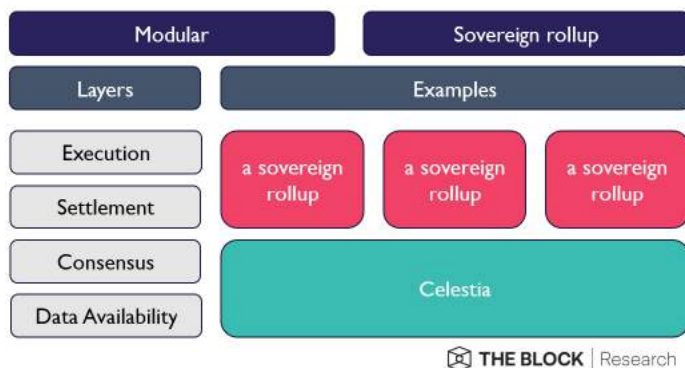


Figure 146: Visualization of Celestia's modularization
Source: The Block Research

Celestia secured partnerships with L1s like Cosmos, to launch joint efforts such as [Cevmos](#), a settlement layer built on top of Celestia that connects multiple EVM rollups. This architecture is similar to L3s built on top of L2 ZKRs.

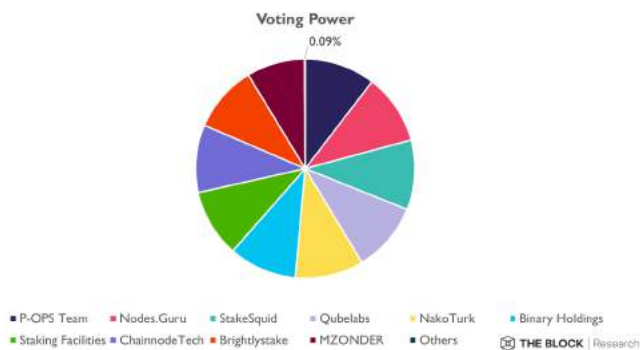


Figure 148: Distribution of voting power on Celestia testnet
Source: Celestia testnet explorer

It is apparent that most of the testnet activity stems from 10 entities, though there are a total of [150 active validators](#). The top 10 entities hold over 99.9% of the voting power on Celestia, which would be a concerning centralization problem on mainnet. That said, most protocols are usually highly centralized when they are first launched, as they usually require a vigil watch over

potential bugs. It would only be a significant concern if Celestia starts amassing a sizable TVL while maintaining a relatively similar distribution of voting power depicted above.

With the rollup space becoming increasingly competitive, Celestia may offer rollups a cheaper alternative for data availability instead of Ethereum. Though this narrative will allow Celestia to boost its adoption, it should be noted that Celestia's main revenue stream will come from rollup operators who are willing to pay for the data availability attestation that Celestia provides. This means that Celestia's long-term sustainability is dependent on rollups using it, not to mention competing with potential competitors in the future, such as Polygon Avail.

Outlook on Blockchain Scaling

While Ethereum-based scaling technology saw many developments, there are also many noteworthy efforts beyond the Ethereum ecosystem that made significant headway. From the Cosmos ecosystem to sharding technology to zkEVM, many of these developments are also pertinent to blockchain scaling.

Cosmos-based scaling

As discussed in [Layer-1 section](#), one of Cosmos's main scaling efforts is the development of application-specific chains. An example of an app-specific chain is Osmosis with a native DEX that offers advanced features such as bonding curves, dynamic fee swaps, and multi-token liquidity pools. Another example would be Sei Network, a DeFi-specific chain that seeks to share liquidity across all applications built on it. This should grant users access to the deepest liquidity regardless of which application they use, thereby solving the problem of fragmented liquidity. Naturally, offloading each unique use case to

a specific chain, it would allow each chain to optimize its performance for the use case it handles, not to mention reduce the bloat that would come from handling multiple use cases in a single environment.

Another notable effort is Dymension, a framework for modularizing Cosmos-based rollups. Any arbitrary application can build its own customized rollup (RollApp) on top of Dymension while Dymension serves as the settlement and consensus layer. As such, every RollApp would have the choice of its own DA layer (such as a Cosmos-based chain or Celestia), or even its own external DAC if it prefers to. This would effectively allow any application built on Cosmos to have full customizability of its settlement, consensus, and data availability layer, thereby granting developers great versatility with the extent of modularity and choice of layers they wish to use.

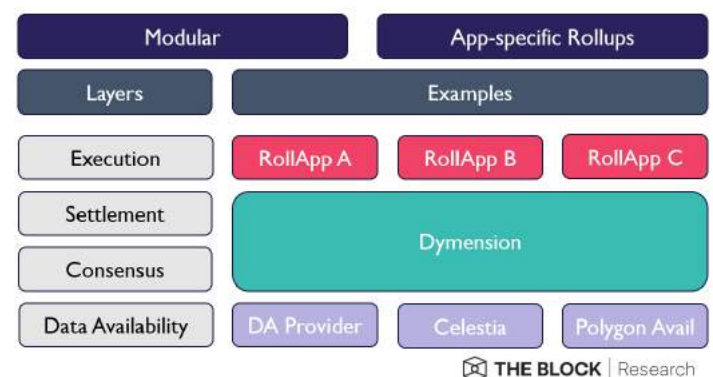


Figure 149: Visualization of Dymension's modularization
Source: The Block Research

Enshrined rollups

Enshrined rollups are blockchains with a modular architecture that is enshrined natively in the protocol, presumably to maximize long-term stability.

We first look at Polkadot's architecture, where it uses the relay chain as the settlement and data availability

layer, while parachains are expected to handle state execution as well as consensus.

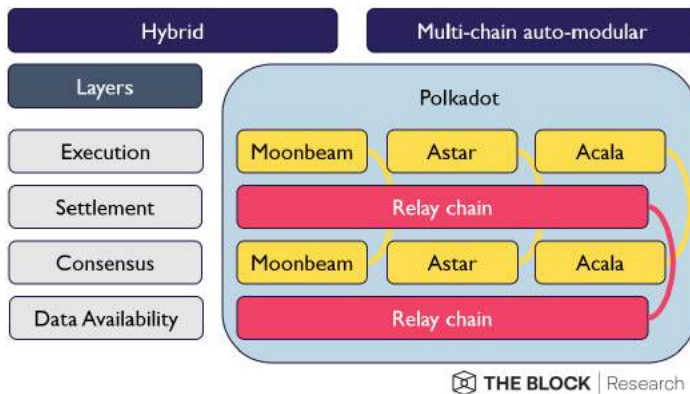


Figure 150: Visualization of Polkadot's modularization
Source: The Block Research

Various other architectures exist, such as the four data shards that Near uses, the transactional OR mechanism that Tezos uses, and the validity-proof-settled Mina.

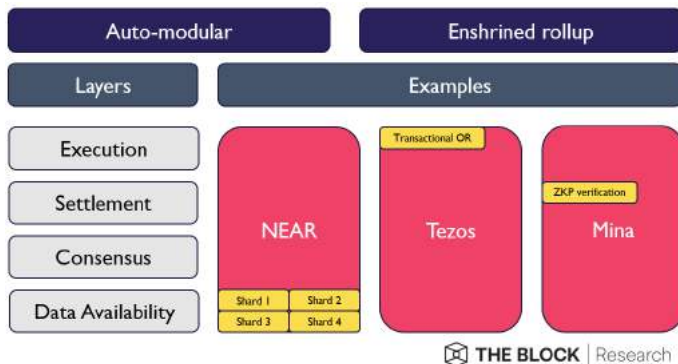


Figure 151: Visualization of hybrid modularization architecture
Source: The Block Research

As the blockchain space continues to grow, it is likely that we will see more unique architectures with different optimizations. However, every additional siloed ecosystem fragments both liquidity and adoption further, so it may not necessarily be in the best interest of the crypto space to be headed in that direction.

Layer-3s

L3s are an abstraction from ZKRs, where an additional layer can be built on top of the existing L2s, only for the L3's validity proof to be combined into the L2's validity proof that is submitted to L1 (typically Ethereum). However, this concept can be abstracted arbitrarily many times, making layer numbers relatively meaningless. It would be less confusing to refer to such layers as customizable execution layers. This classification would include Cosmos' RollApps together with zkSync's Fractal Hyperchains.

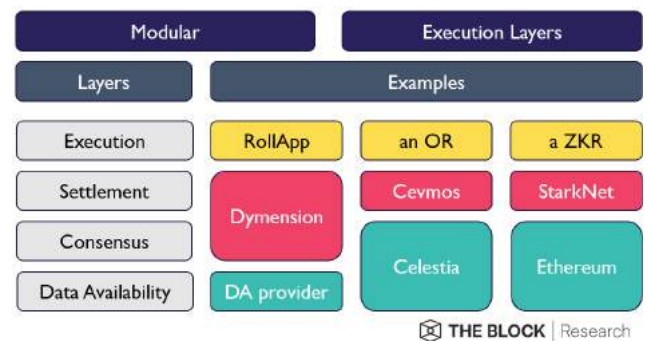


Figure 152: Visualization of execution layers in modularization
Source: The Block

Regardless of nomenclature, L3s do bring great flexibility in optimizing an existing settlement layer for a specific application. For example, [zkSync's L3 effort](#), [Opportunity](#), is meant for public experimentation.



Figure 153: Visualization of zkSync's Fractal Hyperchains
Source: Matter Labs Medium

Another notable effort in the L3 domain is Slush, which aims to build an SDK that allows L3s to leverage the Tendermint consensus mechanism. Theoretically,

Slush could work for any ecosystem, but it is currently focusing on StarkNet mainly due to StarkWare's shared prover (SHARP) technology, as parallel Cairo program executions can be verified with a single validity proof. That said, Slush needs to address the challenges of being able to run a Tendermint light client in Cairo as well as ensuring Tendermint's compatibility with StarkNet.

Sharding

Of the four main shard chains that exist today, namely Elrond, Near, Harmony, and Zilliqa, only Elrond and Aurora, an EVM emulator on one of Near's shards, managed to retain a notable fraction of their liquidity and users in 2022. Zilliqa's liquidity appears to fell along with the bear market, while most of Harmony's liquidity was drained as a result of the Harmony Horizon Bridge hack in June 2022.



Figure 154: TVL of shard chains in 2022

Source: DeFiLlama

On November 4, 2022, Elrond rebranded itself to MultiversX at its XDay Conference. This rebranding also indicates MultiversX's shift in focus from developing DeFi to Metaverse applications. With a shift in focus, it remains a question for MultiversX's existing community if DeFi development would be neglected. As it has only been a month since the rebranding, there has not been any significant change to the liquidity on MultiversX and the only DEX in its ecosystem, Maiar. On the other hand, transaction count declined in November, despite the rebranding.

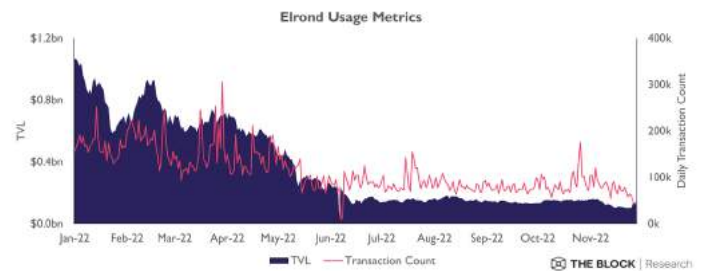


Figure 155: Elrond usage metrics in 2022

Source: Elrond explorer

For Aurora, it remains relatively vibrant, with new dapps surfacing in 2022, such as Bastion, a lending protocol, and Aurora Plus, a staking service. While the main DEX on Aurora, Trisolaris, retained a significant market share, the aforementioned applications saw considerable growth in TVL as well.

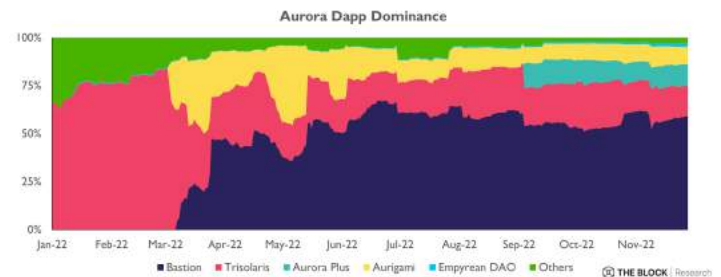


Figure 156: Dapp dominance on Aurora in 2022

Source: DeFiLlama

Harmony's main activity has always been dominated by DeFi Kingdoms, a popular blockchain game. This is in spite of DeFi Kingdoms' cross-chain expansion to Avalanche with its own subnet. However, as liquidity gets pulled from Harmony's ecosystem from June 2022 onwards, DeFi Kingdoms' relative dominance shrank and SushiSwap rose instead. This is because a P2E game such as DeFi Kingdom loses profitability once the liquidity of the overall ecosystem has been impacted. Not only that, the fact that no substantial liquidity has returned to Harmony post-hack implies lowered expectations for Harmony's recovery. Consequently, other Harmony-based dapps dwindled as well.

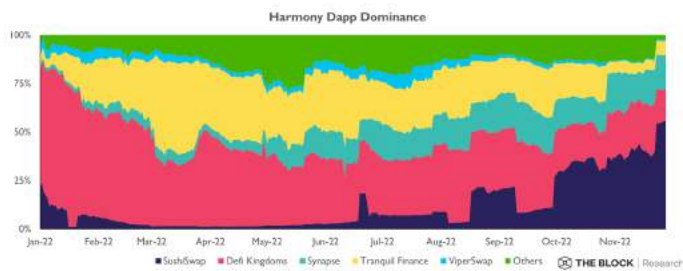


Figure 157: Dapp dominance on Harmony in 2022

Source: DeFillama

While the development of shard chains has not been promising, it does show that having cross-shard state execution capabilities is extremely difficult to achieve. More notably, none of the above shard chains came close to implementing cross-shard atomic transactions. This suggests that it may be extremely difficult for Ethereum shard chains to ever implement state execution capabilities. Thus, it has been proposed to use [danksharding](#) instead.

Danksharding allows more space for data to be posted on Ethereum, without needing to be interpreted. These “data blobs” are only checked if they are available, that is, if they can be downloaded from the Ethereum network. This additional space will allow Ethereum to serve as a data availability layer for rollups more cost-effectively. Essentially, these data shards are just meant to hold “data blobs” cheaply, which rollups can reference, while the state execution remains on a single chain.

zkEVM

The zkEVM narrative grew with Polygon’s announcement of the [Polygon zkEVM launch](#). Though Polygon zkEVM was more accurately a rebranding of Polygon Hermez, it sparked much discussion on what constitutes zkEVM. More importantly, which of the current efforts were focused on building a workaround

and which were actually focused on building an optimized zkVM that could support EVM toolings.

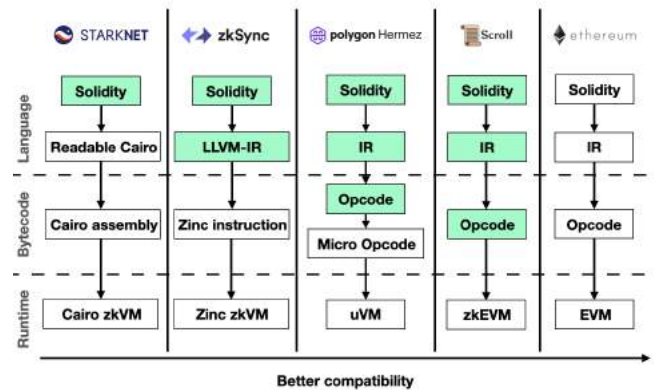


Figure 158: Visualization of zkEVM

Source: Foresight Venture

Protocols such as Scroll and Polygon Hermez were much more suited to be EVM-compatible, as they aimed to support EVM at the opcode-level, which would allow their native VM to carry out instructions almost identical to the EVM. However, the extent of EVM-compatibility is not inversely correlated to the VM's performance. There is no data to corroborate that but it is clear from zkSync’s 2.0, Polygon Hermez, and Scroll that zkEVM definitions and designs can differ significantly at the zk-circuit implementation aspect and yet, have a similar approach towards conferring EVM-compatibility.

More notably, ZKRs like StarkNet are choosing to adopt a different programming language instead, Cairo. However, there are efforts to either transpile Solidity to Cairo using Warp developed by Nethermind, or run a zkEVM within StarkNet’s Cairo VM itself such as Kakarot.

Blockchain Interoperability Solutions

Cross-chain Activity

Cross-chain interactions are becoming an integral part of the blockchain space, stemming from the various siloed ecosystems proliferating. This calls for interoperability frameworks that would allow individual blockchains to interact with one another. However, interoperability necessitates trade-offs, such as those introduced by the [Interoperability Trilemma](#), coined by Arjun Bhuptani, the founder of Connex. Generally, the more chains an interoperability protocol supports, the more trust is required.

The most common interoperability protocol today would be a liquidity bridge, as liquidity has been fragmented across multiple siloed chains. Fragmentation of liquidity causes higher slippages for DEX trades and higher costs of borrowing from lending protocols. As such, transferring tokens across chains became one of the commonly used solutions for traders. However, most of these bridges are Arbitrary Messaging Bridges (AMBs) that are capable of transferring arbitrary data across chains.

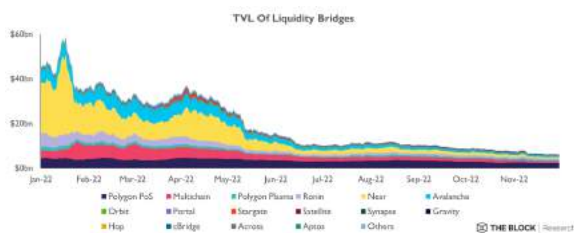


Figure 159: Value locked in cross-chain bridges in 2022
Source: L2Beat

The TVL of cross-chain bridges fell significantly in 2022, peaking at over \$58 billion in January and declining

~90% to \$6 billion as of this writing. While this is largely due to the majority of assets on bridges falling in price, there were also numerous bridge hacks in 2022, such as the \$600 million Ronin hack and the \$323 million Portal hack, as discussed in the [DeFi Exploits subsection](#).

Multi-chain Bridges

Multi-chain bridges, as the name suggests, are capable of supporting multiple blockchains and their assets. Competition is generally stiff as users are usually not privy to the trust and security trade-offs made, and opt for the cheapest alternative instead.

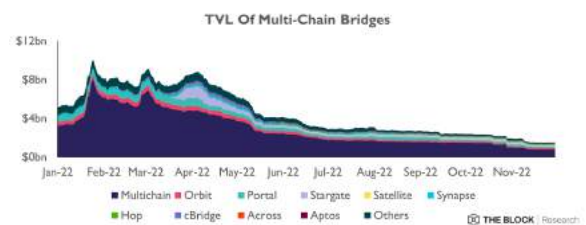


Figure 160: Value locked in multi-chain bridges in 2022
Source: L2Beat

Multichain

Multichain is the leading multi-chain bridge by TVL, which mostly comprises USDC, WBTC, and ETH. Thus, it stands to reason that Multichain would facilitate the largest bridging volumes as compared to other bridges from this category. Multichain facilitated over \$60 million in daily average volume over the past 30 days to at least 70 different chains.

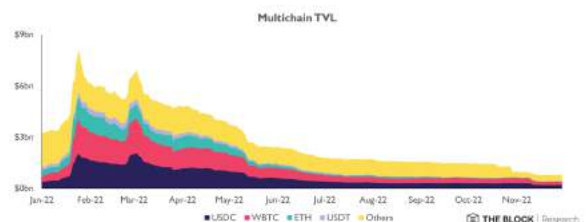


Figure 161: Value locked in Multichain in 2022
Source: L2Beat

Currently, there are 21 nodes on the Multichain network, which receive and validate cross-chain messages. This poses some extent of centralization risks as the existing Multichain nodes have the ability to censor cross-chain interactions.

Orbit

Orbit is another multi-chain bridge that supports 12 blockchains, with Ethereum, BNB Chain, and Polygon as the most notable ones. Orbit facilitated slightly over \$4 million in daily volume on average over the past 30 days.

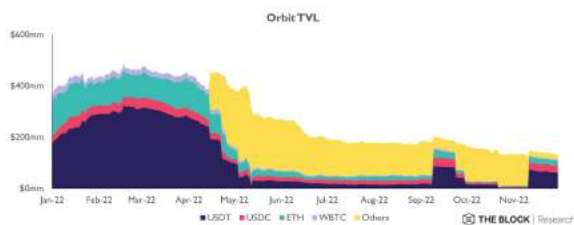


Figure 162: Value locked in Orbit in 2022

Source: L2Beat

Portal by Wormhole

Portal by Wormhole is a multi-chain bridge that was primarily meant to bridge liquidity across Ethereum, Solana, and Terra blockchains. However, after Terra crumbled in May 2022, Wormhole was facilitating mostly Solana-Ethereum transfers.

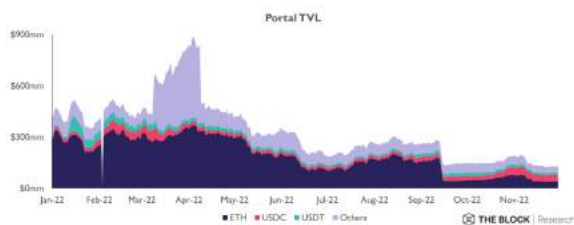


Figure 163: Value locked in Portal in 2022

Source: L2Beat

The sharp dip in TVL in February 2022 was the result of the \$323 million Portal hack that depleted all of its

liquidity until [Jump Crypto intervened](#) by replenishing funds on Portal.

Satellite by Axelar

Satellite is another multi-chain bridge that supports 22 different blockchains, with a focus on blockchains in the Cosmos ecosystem, such as Osmosis and Secret Network. In terms of TVL growth, Satellite is one the few bridges that managed to retain most of its TVL throughout 2022, which is a positive indicator for the bridge's growth.

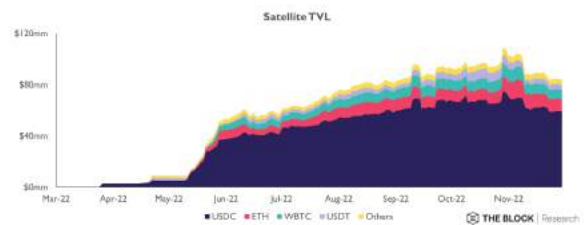


Figure 164: Value locked in Satellite in 2022

Source: L2Beat

Stargate

Stargate is a multi-chain bridge for stablecoins, and most of its TVL comprises USDC and USDT. It currently supports 7 different blockchains, averaging roughly \$25 million in daily bridging volume over the past 30 days. For a bridge that was launched in March 2022, it certainly saw a relatively high growth in its TVL and usage.

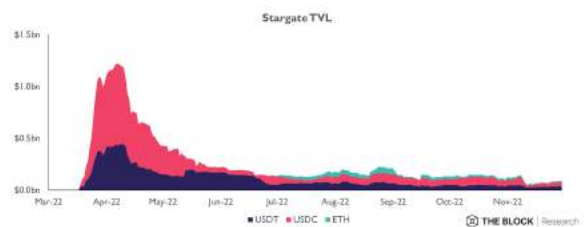


Figure 165: Value locked in Stargate in 2022

Source: L2Beat

Synapse

Synapse supports 19 different blockchains and has facilitated \$4.8 million in daily average volume over the past 30 days. In terms of TVL, Synapse experienced the same generic decline as most other bridges. Synapse holds a large majority of its TVL in stablecoins and ETH.

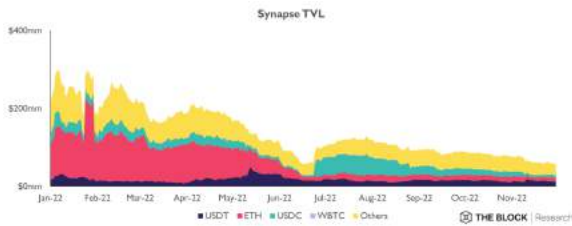


Figure 166: Value locked in Synapse in 2022
Source: L2Beat

Hop

Hop Protocol is an Ethereum-focused bridge, as it only supports chains such as Polygon, Gnosis, Arbitrum and Optimism. Hop airdropped its governance token, HOP, to users and LPs in June 2022, which might explain the small spike in TVL shortly after. However, its TVL has since plateaued.



Figure 167: Value locked in Hop in 2022
Source: L2Beat

cBridge

cBridge currently supports 36 different blockchains and averages a daily volume of roughly \$15 million over the past 30 days. Similar to most other bridges, most of cBridge's TVL stems from stablecoins and ETH, though there is a significant amount of WBTC as well.

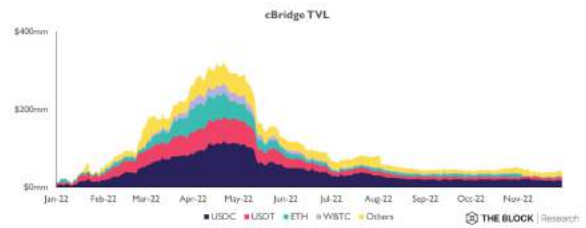


Figure 168: Value locked in cBridge in 2022
Source: L2Beat

Aptos Bridge by LayerZero

Aptos Bridge was recently launched and it aims to bridge liquidity between existing blockchains and the new Aptos chain. As Aptos uses a different architecture relative to other chains, LayerZero has built the Aptos bridge to handle these differences. Currently, the bridge liquidity is limited to \$1 million per 24 hours after its launch for security reasons but it will be lifted over time.

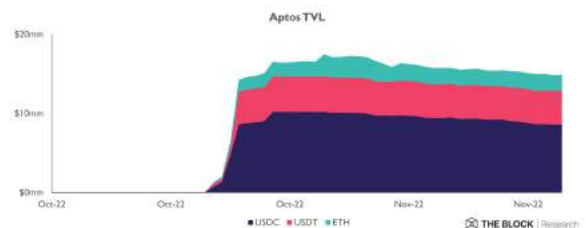


Figure 169: Value locked in Aptos Bridge in 2022
Source: L2Beat

Across

Across is an Ethereum-focused bridge, supporting only ORs and sidechains on Ethereum, namely Arbitrum, Optimism, Boba and Polygon. Its TVL has been plateauing since June 2022 and even with the recent ACX token airdrop, it did not see a significant uptick in its TVL. This is a concern as a token launch is typically one of the best tools for incentivizing usage and liquidity. Only time will tell if the ACX token can bring sustained growth for the Across bridge.

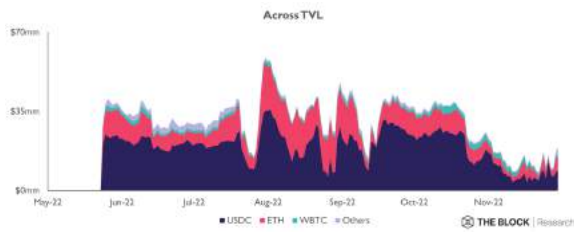


Figure 170: Value locked in Across in 2022

Source: L2Beat

Two-chain Bridges

Two-chain bridges typically facilitate transfer between two chains only. Examples include canonical rollup bridges such as Arbitrum and dYdX, and L1 native bridges, such as the Polygon and Avalanche bridges.

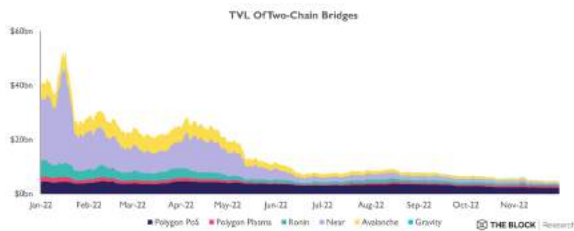


Figure 171: Value locked in two-chain bridges in 2022

Source: L2Beat

Polygon PoS & Plasma

Polygon is an Ethereum sidechain that offers cheaper and faster transactions. The Polygon team has been actively developing a ZKR for Polygon, though none of their ZKR efforts are production-ready just yet. That said, its PoS chain and Plasma chain have accrued significant TVL. The Polygon PoS bridge accounts for more than 75% of Polygon's TVL throughout 2022, which corroborates the fact that most of Polygon's dapps and transactions occur on the PoS chain.

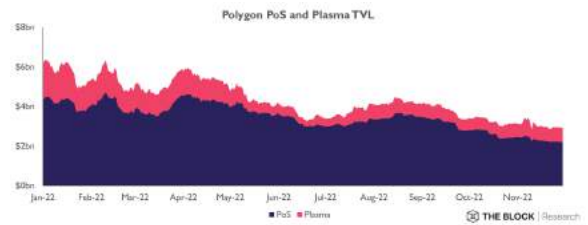


Figure 172: Value locked in Polygon PoS and Plasma in 2022

Source: L2Beat

Polygon PoS chain holds various assets, though it comprises mainly stablecoins as well as ETH and WBTC. This is expected, since these are the most liquid assets and would be necessary to support Polygon's DeFi ecosystem.

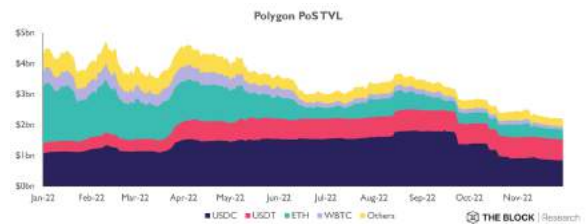


Figure 173: Value locked in Polygon PoS by token in 2022

Source: L2Beat

Most of Polygon's MATIC tokens are held on the Plasma bridge, which holds nearly 99% of its TVL in MATIC.

Ronin

The Ronin bridge facilitates transfers between Ethereum and the Ronin sidechain, where the popular P2E game, Axie Infinity, is built on. As such, it stands to reason that most of Ronin's TVL comprises AXS, the governance token for Axie Infinity as well as an in-game utility token. Ronin experienced a \$600 million hack in March 2022, where Ronin's TVL subsequently declined and flatlined thereafter. Given that Axie Infinity players are [struggling to breakeven](#) from their investment in the game, it remains to be seen if Axie Infinity can return to its former glory, much less surpass its ATHs both in terms of users, as well as price.

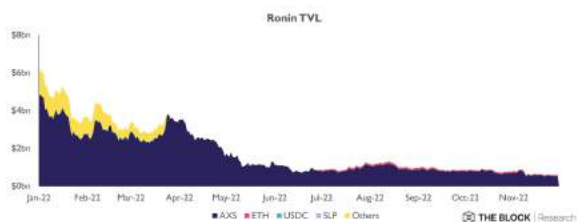


Figure 174: Value locked in Ronin bridge in 2022

Source: L2Beat

Rainbow

Rainbow bridge is the bridge that facilitates transfers between Aurora, Near's EVM emulator, and Ethereum. Most of Rainbow bridge's TVL is in AURORA, the governance token of Aurora, which is a concerning trend, since it means that most of Aurora's TVL is that of an endogenous asset. As the relative composition of other assets has not grown over time, it might mean that the Aurora bridge was not able to bootstrap liquidity from Ethereum. That said, Rainbow's TVL of \$55 million is \$20 million short of Aurora's TVL of \$75 million. This indicates that a substantial portion of the liquidity on Aurora is bridged in from Near.

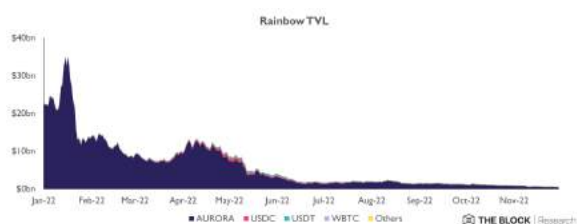


Figure 176: Value locked in Rainbow in 2022

Source: L2Beat

Avalanche

The Avalanche bridge only facilitates interactions between Avalanche and Ethereum or Bitcoin. As such, it is expected that the bulk of Avalanche bridge's TVL is made up of stablecoins, ETH and WBTC. However, Avalanche bridge's TVL generally declined throughout

2022, likely due to the ongoing bear market, which has taken a toll on Avalanche's DeFi ecosystem as well.

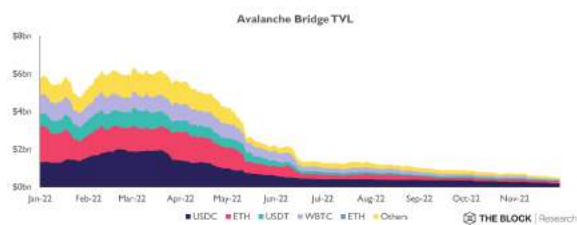


Figure 175: Value locked in Avalanche bridge in 2022

Source: L2Beat

Gravity

The Gravity bridge is technically a "multi-chain" bridge, as it bridges Ethereum to multiple Cosmos app chains. However, the Gravity bridge is classified here as a two-chain bridge as it facilitates cross-chain interactions only between the Cosmos ecosystem and Ethereum. Gravity's TVL grew slightly in the past three months, which might indicate a growing interest in the Cosmos ecosystem.



Figure 177: Value locked in Gravity in 2022

Source: L2Beat

6

Decentralized Finance: 2022 Overview, 2023 Outlook

Eden Au



Decentralized Finance: 2022 Overview, 2023 Outlook

Eden Au

A look at decentralized finance, including: lending, decentralized exchanges, derivatives, decentralized stablecoins, exploits, and more.

Quick Take

- The DeFi space contracted in 2022 as metrics including total value locked, volume, and revenue dwindled. The collapse of a flawed algorithmic stablecoin had a ripple effect throughout the crypto industry.
- The amount of funds stolen in DeFi exploits increased by half in 2022, with more cross-chain bridges getting attacked. Most stolen funds were unable to be recovered.
- Regularity clarity will expand the total addressable market for DeFi, but certain parts of DeFi could be marginalized, such as privacy-preserving protocols.

State of DeFi in 2022

DeFi refers to the open and composable financial system facilitated by immutable public ledgers and smart contracts, acting as an alternative to the traditional opaque financial system. It gives users permissionless and borderless access to financial instruments without relinquishing asset custody to centralized intermediaries.

While the DeFi space experienced an expansionary phase in 2021, TVL in DeFi contracted throughout 2022 from \$166 billion to \$42.1 billion, which corresponded to a 74.6% decline. DEXs and lending platforms remained two of the most popular venues in DeFi by TVL.

The most drastic plunge in TVL was recorded in May when the entirety of the Terra ecosystem collapsed within days, as discussed in the [Algorithmic Stablecoins subsection](#). Smaller scales of decline were also witnessed in June and November, seemingly driven by the fallout of Celsius Network and FTX, respectively, as discussed in the [State of the Market section](#).

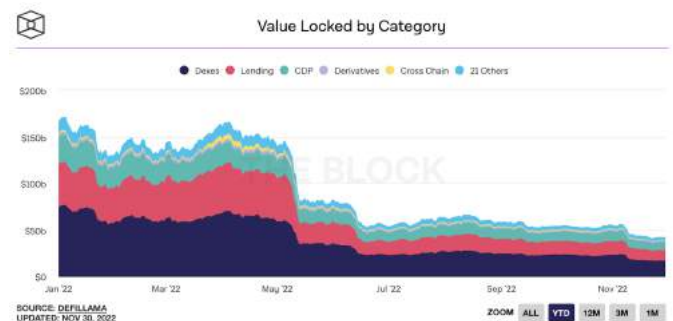


Figure 178: Value locked in DeFi by categories in 2022

Source: The Block Data Dashboard

Using DEX trading activities as a proxy for DeFi activities, DeFi users were less active in 2022. DEXs monthly active addresses and the ratio of that to Ethereum active addresses were both in decline in H1 2022 before a partial recovery in the second half. 8.9% of Ethereum transactions were DEX trades in November, up from 5.6% in July but down from 11.5% in January.

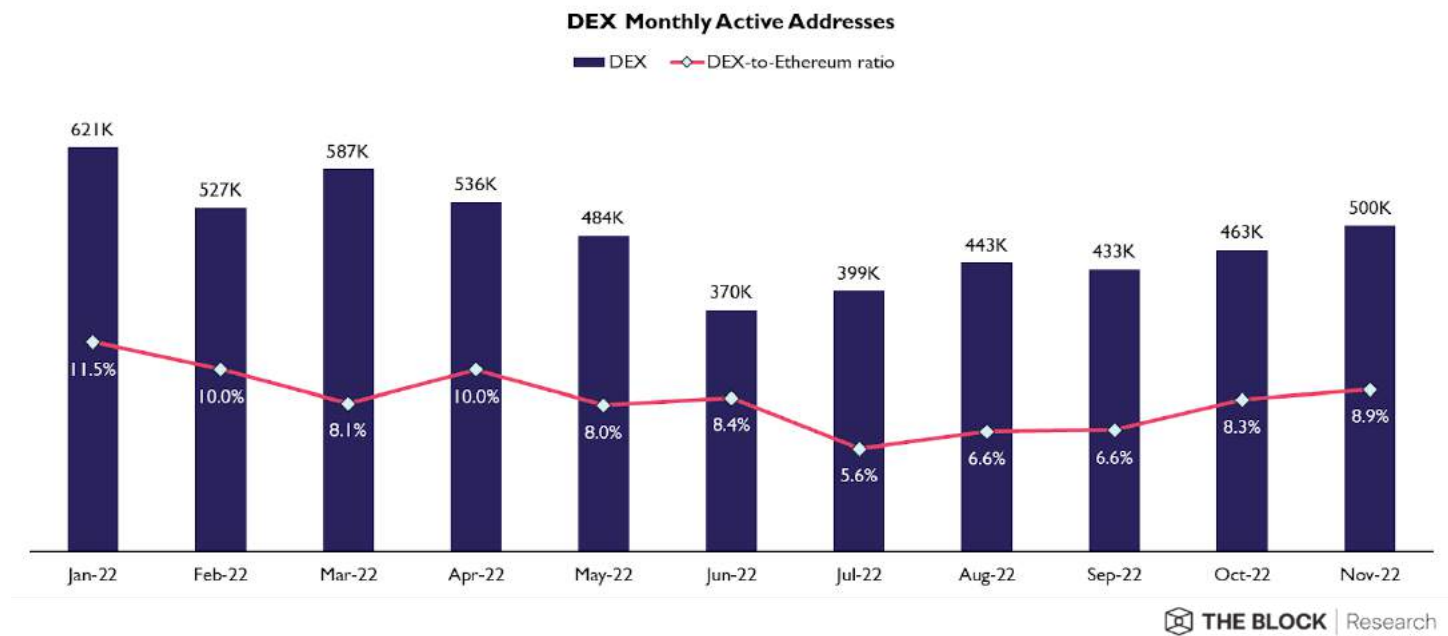


Figure 179: DEX monthly active addresses in 2022
Source: Dune Analytics (@drod729)

The dominance of DeFi tokens in the crypto market cap revealed a similar pattern as it bled in H1 2022, before bottoming at 0.78% in mid-June and slowly ascending back to pre-Terra collapse levels. Its dominance currently sits at 1.11%, down from 1.47% at the beginning of the year.



Figure 180: DeFi dominance in 2022
Source: The Block Data Dashboard

Revenue generated by DeFi protocols also took a massive hit amid a more challenging economic environment. While Uniswap remained the leading protocol by revenue, with an annual revenue of \$792

million in 2022, its monthly revenue sank from \$134 million in January to \$53.3 million in November.

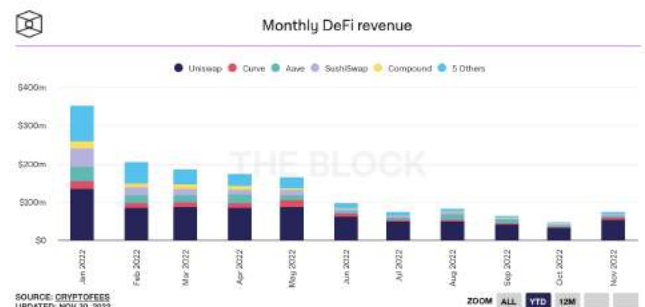


Figure 181: Monthly DeFi revenue in 2022
Source: The Block Data Dashboard

Nevertheless, Uniswap's revenue was supply-side captured by LPs, while the protocol captured none. Curve generated the most protocol-side revenue with an annualized protocol revenue of \$36.5 million despite only cornering 9.6% of the DEX market by volume. Unlike Uniswap, Curve's gross revenue is equally split between protocol token holders with tokens in escrow (protocol) and LPs (supply-side).

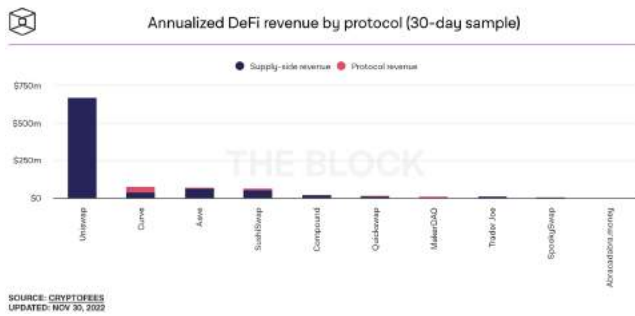


Figure 182: Annualized DeFi revenue by protocol (30-day sample) in 2022
Source: The Block Data Dashboard

Decentralized Exchanges

Despite a revenue drop, decentralized spot exchanges generated a total of \$1.1 trillion volume from January to November 2022, corresponding to a mere 8.2% decrease compared to the same period in 2021. DEX volume was more concentrated in the first five months of the year. BNB chain-based PancakeSwap was the second most popular DEX by volume in 2022, behind the Ethereum-based Uniswap v3.

The extent of the decline in volume in H2 2022 was more significant on PancakeSwap than on Uniswap.

Uniswap v3 demonstrated resilience during the bear market and consolidated a DEX market share of 59.0% by volume, growing from 43.2% in January.

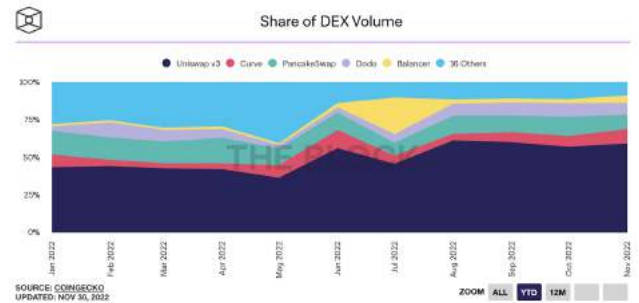


Figure 183: Share of DEX volume in 2022
Source: The Block Data Dashboard

AMMs continued to be the prevalent DEX mechanism, as the most common decentralized trading venues on most blockchains are forks of Uniswap, a constant-product market maker. The volume share of order book-based DEXs dropped from 4.1% to 0.48% in 2022.

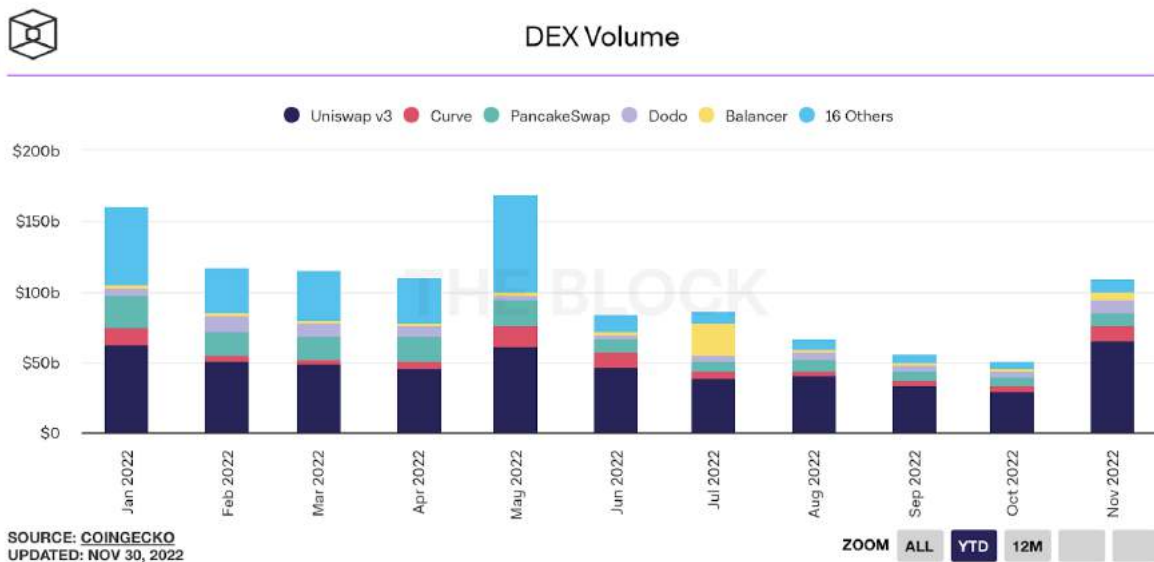


Figure 184: DEX volume in 2022
Source: The Block Data Dashboard

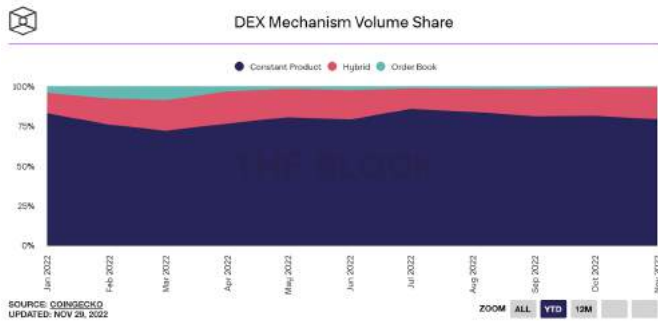


Figure 185: DEX mechanism volume share in 2022
Source: The Block Data Dashboard

As the largest DEX by volume extended its dominance in 2022, the demand for DEX aggregators reduced. Looking into Uniswap's volume, the share of traffic originating from aggregators dropped from 42.1% in January to 19.5% in November. 1inch surpassed 0x API in the DEX aggregator space with a current market share of 49.4% in November, rising from 33.3% in January.

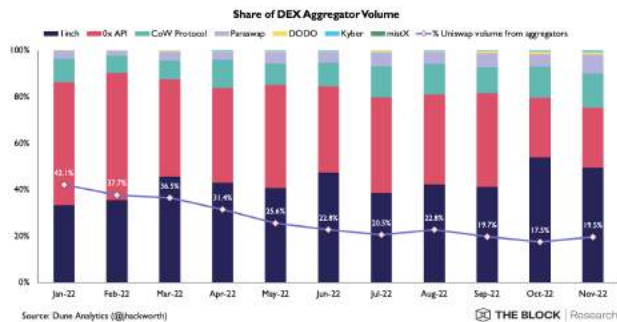


Figure 186: Share of DEX aggregator volume in 2022
Source: Dune Analytics (@jhackworth)

The DEX-to-CEX spot volume ratio seeped throughout most of 2022 until showing signs of recovery from Q4 2022, reaching a high of 25.5% in February and a low of 10.8% in September. The collapses of multiple centralized custodians might have driven the potential resurgence of DEX trading activities in the final quarter.



Figure 187: Ratio of DEX to CEX spot trade volume in 2022
Source: The Block Data Dashboard

In terms of TVL, Uniswap v3 had less TVL than PancakeSwap in most of 2022 despite generating more than triple volume, as it enables LPs to provide concentrated liquidity that significantly improves capital efficiency.

Curve, a stableswap exchange, remained the most popular venue for LPs since providing liquidity to assets pegged to the same underlying index incurs a minimal impermanent loss. Still, its TVL shrunk from \$23.3 billion to \$3.7 billion, a staggering 84.2% decrease in a year. The de-pegging of UST, Terra's native algorithmic stablecoin, as discussed in the [Algorithmic Stablecoins subsection](#), had an enormous direct impact on Curve's TVL in May.

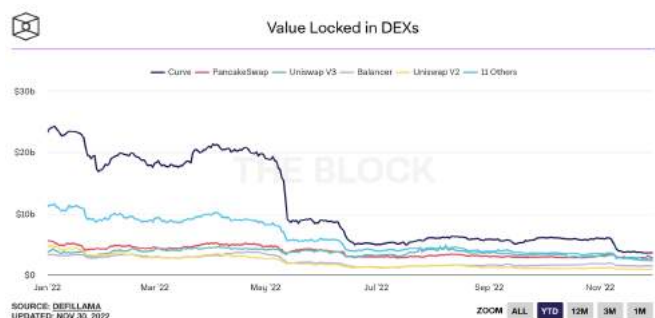


Figure 188: Value locked in DEXs in 2022
Source: The Block Data Dashboard

The UST-USDC/USDT/DAI pool on Curve became one of the primary means for UST holders to exit in size as the

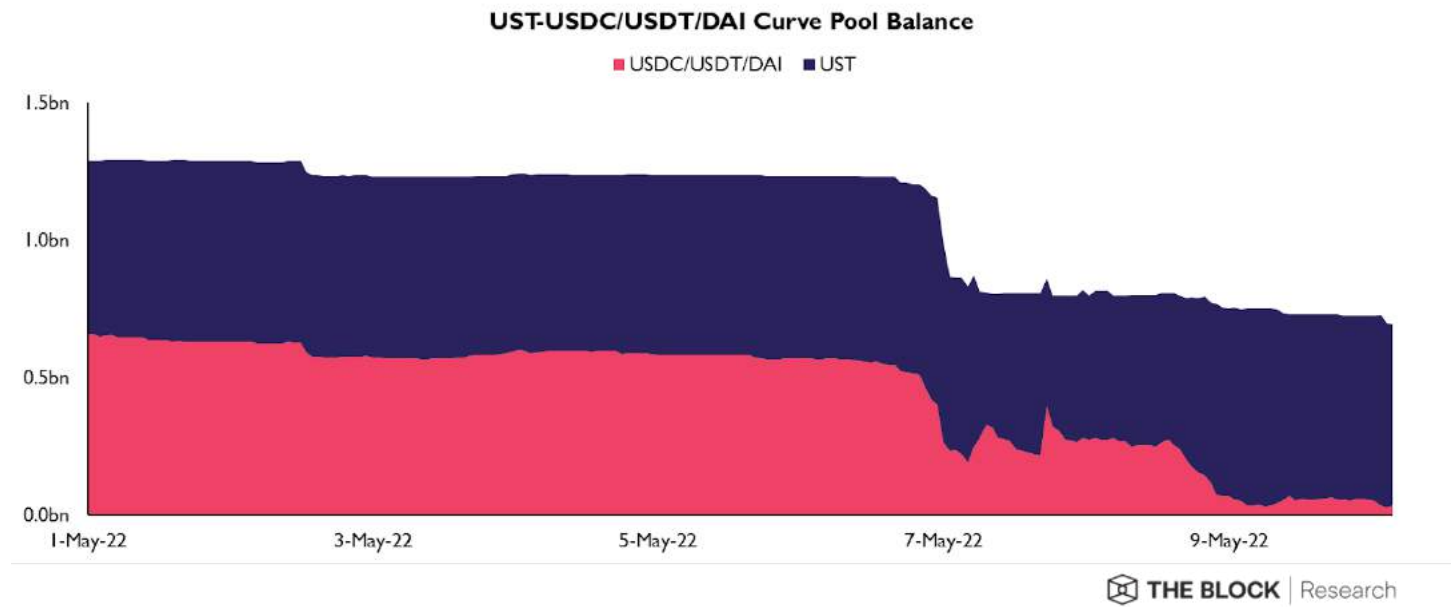


Figure 189: UST-USDC/USDT/DAI Curve pool balance in 2022
Source: Dune Analytics (@mhonkasalo)

algorithmic stablecoin became worthless. Over \$600 million worth of other stablecoins in the pool was depleted by UST sellers in a matter of days, leaving LPs with huge losses.

Lending

TVL in over-collateralized lending protocols had a trend similar to DEXs as crypto assets depreciated throughout 2022. Aave v2 remained the top lending protocol despite a 76.4% reduction in TVL, shrinking from \$14.0 billion to \$3.3 billion in a year. Aave v3 did not take off as it has yet to be deployed on Ethereum, where most liquidity resides.

The only major over-collateralized lending protocol that defied this downward trend in TVL was JustLend, a Tron-based lending protocol that benefited from the creation of USDD, a Tron-native algorithmic stablecoin, which will be discussed in the [Algorithmic Stablecoins subsection](#). JustLend currently ranks second in TVL

among lending protocols, with a TVL of \$2.8 billion, up from \$1.8 billion in 2022.

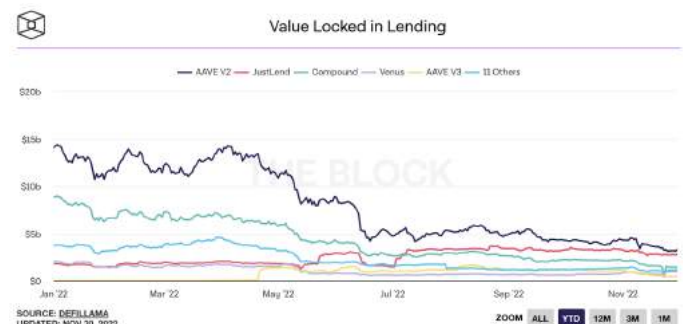


Figure 190: Value locked in lending in 2022
Source: The Block Data Dashboard

The evolution of Aave's outstanding debt paints a picture of a shift in market sentiment. The borrowing demand for stablecoins, including USDC, USDT, and DAI, plunged from \$5.61 billion to a mere \$779 million in a year. In contrast, such demand for ETH soared from \$105 million to \$581 million suggesting users seeking leverage had gradually turned bearish throughout 2022.

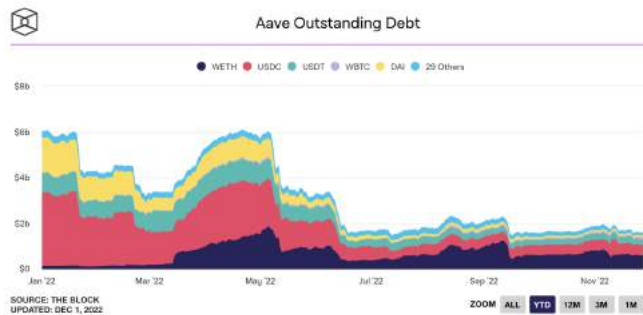


Figure 191: Aave outstanding debt in 2022
Source: The Block Data Dashboard

On the other hand, the total outstanding debt of under-collateralized lending protocols took a slightly different trajectory, plateauing in Q2 2022 before facing its eventual reality of a credit crunch in H2 2022. While it registered a YoY decline of 68.5% in outstanding debt, it marginally outperformed its over-collateralized lending counterpart, which had a staggering plunge of 74.1% in outstanding debt in 2022.

TrueFi conceded its top position to Maple, as the latter currently possesses a market share of 30.8% with an outstanding debt of \$107.9 million. Both protocols

suffered numerous loan defaults amid a distressed economic environment, and it is unclear when or if lenders will be fully compensated. That said, the advantage of under-collateralized lending in capital efficiency cannot be understated.

NFT lending is a new entrant in the lending space due to the persistent hype around NFTs. NFT lending refers to utilizing NFTs as collateral in securing a loan, usually denominated in a more liquid asset.

The main challenge of NFT lending is the inherent illiquid nature of NFTs, such that liquidating debt positions that are about to go under-collateralized can be difficult. With the reduction of trading fees and the removal of mandatory royalty payments enforced on most NFT marketplaces due to a more competitive landscape, liquidity in major NFTs is expected to improve gradually, which can mitigate the existing challenges faced by NFT lending protocols.

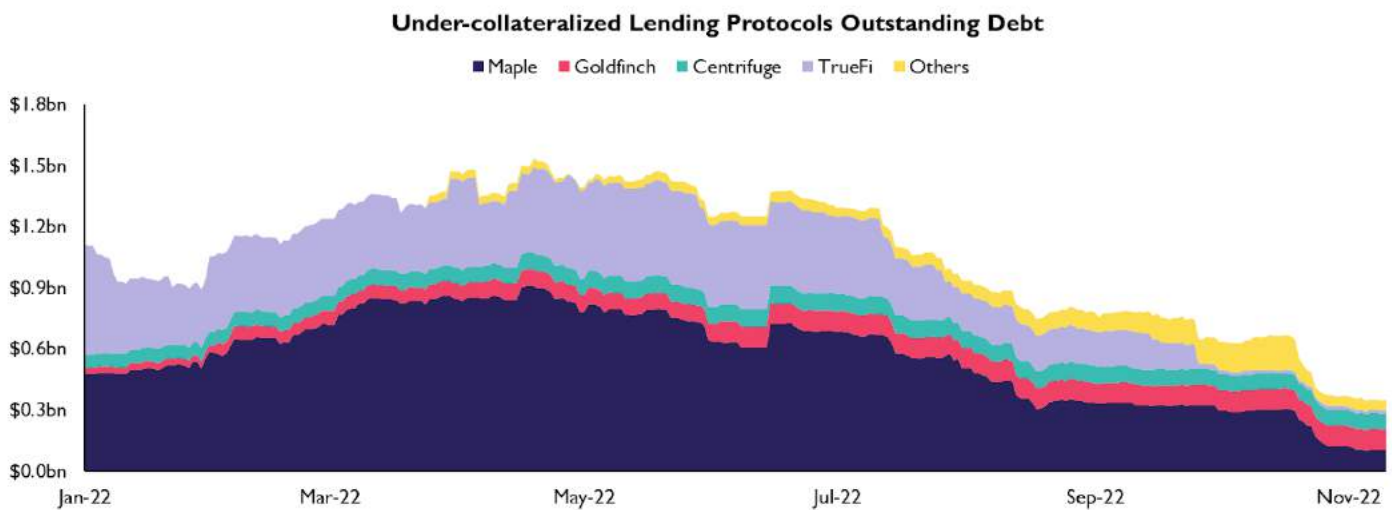


Figure 192: Under-collateralized lending protocols outstanding debt in 2022
Source: DefiLlama

Crypto-backed Stablecoins

Crypto-backed stablecoins, also known as “exogenously collateralized stablecoins,” refer to decentralized stablecoins that are over-collateralized by assets that derive value external to the stablecoins in question.

Maker’s DAI remained the largest crypto-backed stablecoin, although its market cap shrunk from \$8.95 billion to \$5.18 billion in 2022. It now has a near-monopoly in the crypto-backed stablecoin space with a dominance of 90.5%, up from 60.4% a year ago. In contrast, Abracadabra’s MIM, the second-largest crypto-backed stablecoin in January, lost 98.1% of its market cap within a year.

Despite DAI’s superiority within the decentralized stablecoin territory, its share in the total Ethereum stablecoin supply diminished from 8.03% to 5.03%, as users increasingly favored centralized stablecoins with deeper liquidity.

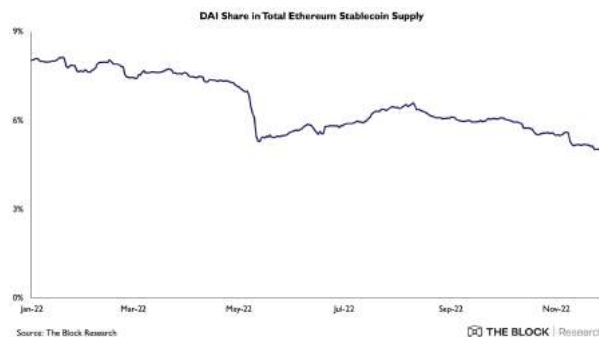


Figure 193: DAI share in total Ethereum stablecoin supply in 2022
Source: The Block Data Dashboard

DAI’s collateralization ratio decreased from 195% to 128%. Such an improvement in capital efficiency came with the cost of worsened censorship resistance, as the protocol increasingly relies on other centrally-issued assets for collateralization. 68.8% of DAI generated is collateralized by centralized stablecoins, including USDC, GUSD, and USDP, whereas another 9.5% is collateralized by tokenized real-world assets (RWAs).

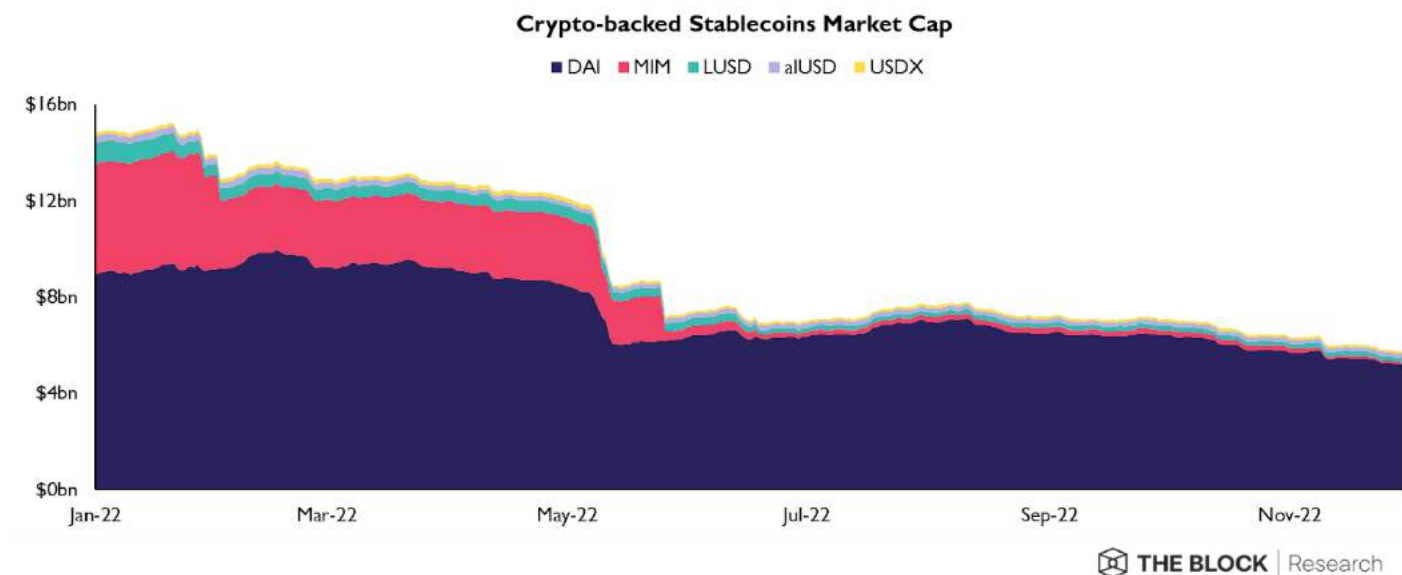


Figure 194: Market cap of crypto-backed stablecoins in 2022
Source: CoinGecko

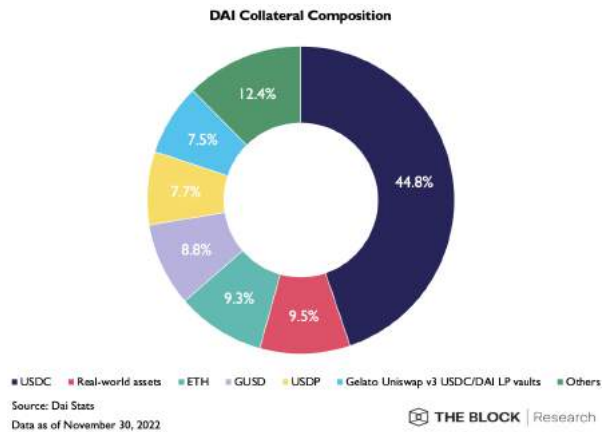


Figure 195: DAI collateral composition as of November 30, 2022
Source: Dai Stats

TVL in Maker dwindled from \$17.5 billion to \$6.7 billion due to the reduction in DAI demand and the improvement in capital efficiency, as mentioned above. Even so, it stands as the largest DeFi protocol by TVL.



Figure 196: Value locked in Maker in 2022
Source: DefiLlama, The Block Research

Algorithmic Stablecoins

2022 was a defining moment for algorithmic stablecoins that experienced rapid growth followed by catastrophic destruction, with contagion still rippling through every corner of the crypto space. Algorithmic stablecoins, also known as “endogenously collateralized stablecoins,” are assets reliant on endogenous collateral to maintain their peg to a fixed value. Endogenous collateral refers to assets that derive value primarily from the stablecoins they back.

UST, now known as USTC, was the largest algorithmic stablecoin before its collapse, with a market cap of \$10.1 billion in January and \$18.8 billion at its peak in May. UST operated with an “elastic seigniorage” model where 1 UST could be created (or destroyed) by burning (or minting) \$1 worth of LUNA, which was UST’s endogenous collateral.

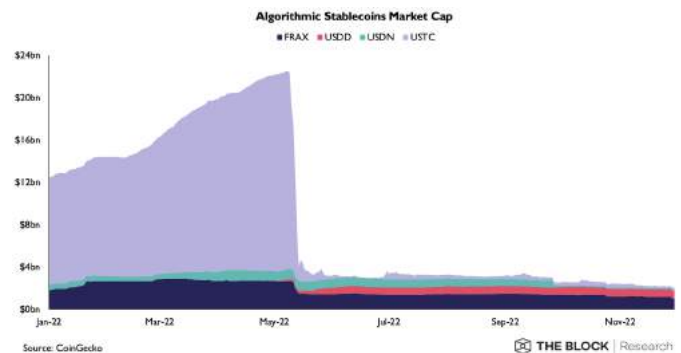


Figure 197: Algorithmic stablecoins market cap in 2022
Source: CoinGecko

The rise of UST was fueled by the unsustainable yield on Anchor, a Terra-based lending protocol. UST depositors on Anchor could earn up to 19.5% annualized yield, which was heavily subsidized by Terraform Labs. Such a high-yield product on a seemingly “stable” asset incentivized many retail and institutional participants to be exposed to UST prior to the catastrophe.

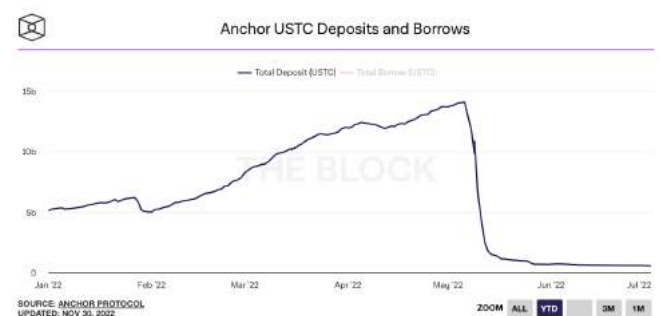


Figure 198: Anchor total deposits in 2022
Source: The Block Data Dashboard

This seigniorage mechanism was tested to an extreme degree from May 9 when the UST selling pressure

started to mount. While the system allowed the redemption of UST for LUNA without slippage, a redemption threshold was in place that restricted the amount of LUNA that could be created within a time window, intending to flatten the selling pressure of LUNA. Ironically, such limitation intermittently halted the redemption process designed to stabilize the UST price, which meant that the only way to offload UST was to sell it on the secondary market, causing UST to de-peg.

As the market lost confidence in UST's seigniorage mechanism in light of its de-pegging, more UST holders rushed to exit, causing a death spiral where LUNA was hyperinflated more than 20,000x to fulfill constant streams of redemption requests. Such an extent of inflation over a short time undoubtedly crashed LUNA's and, subsequently, UST's valuation as LUNA no longer carried sufficient economic value to back UST.



Figure 199: LUNA price and supply
Source: CoinGecko, The Block Research

The price of UST never recovered from the flash crash, and the Terra ecosystem had moved on to Terra 2.0, a new blockchain without a native algorithmic stablecoin, as mentioned in the [Layer-1 section](#). See the [Macro section](#) for a detailed timeline of events pre- and post-UST collapse.

Other algorithmic stablecoins with similar designs, such as USDD and USDN, also experienced occasional de-pegging, albeit in smaller amplitude. It is likely due to their smaller sizes in market cap where their pegs were much easier to defend in a capital sense, but they could face the same scaling issue in the future.

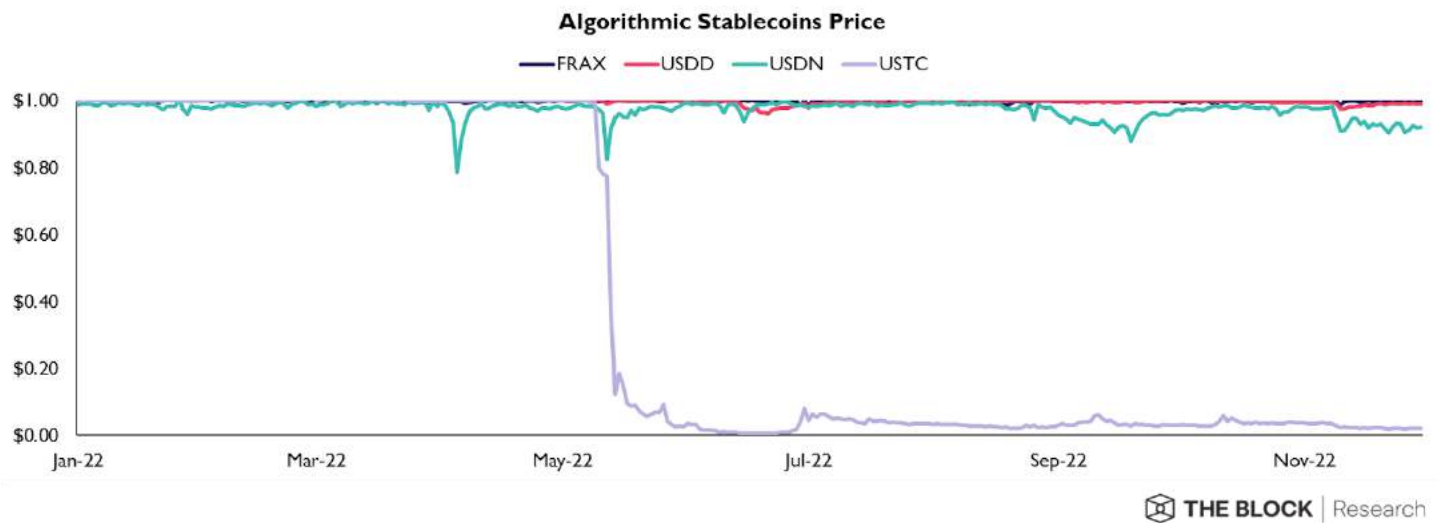


Figure 200: Algorithmic stablecoins price in 2022
Source: CoinGecko

[The latest draft stablecoin bill](#) in the US House proposed a two-year ban on the issuance of new algorithmic stablecoins, which, if passed, could introduce further obstacles in the development and adoption of such capital-efficient decentralized stablecoins.

FRAX is the biggest algorithmic stablecoin after the collapse of UST, with a current market cap of \$1.0 billion. Its price action was relatively more stable than others because FRAX is also fractionally backed by exogenous collateral such as USDC. Its exogenous collateral ratio currently sits at 93.3%.

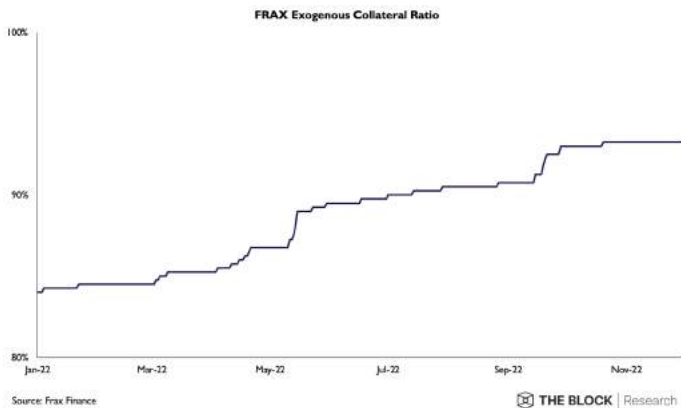


Figure 201: FRAX exogenous collateral ratio
Source: Frax Finance

Liquid Staking

PoS consensus has become a widely adopted mechanism for decentralized blockchains to achieve distributed consensus, following Ethereum's successful transition toward PoS during The Merge, as discussed in the [Layer-1 section](#).

Validators in PoS blockchains stake native tokens to participate in validating transactions and, in return, receive a higher share of said tokens when they behave honestly. While staking can be a lucrative business,

running validator nodes requires sufficient technical know-how and upfront capital.

Liquid staking facilitates the tokenization and "liquidization" of staked tokens, with liquid-staked tokens acting as a tokenized representation of the underlying stake. Token holders can utilize them in other DeFi protocols while simultaneously earning staking yield and delegating the responsibility of node running to token issuers.

Lido is the largest liquid staking protocol on Ethereum with a TVL of 4.77 million ETH, almost a threefold increase since the beginning of the year. It is also the second-largest DeFi protocol by TVL, just behind Maker. Lido's dominance in Ethereum liquid staking hovered around the 90% mark in 2022 until Coinbase entered the market in late August. Lido now has a market share of 76.1%, whereas Coinbase is at 6.1%.

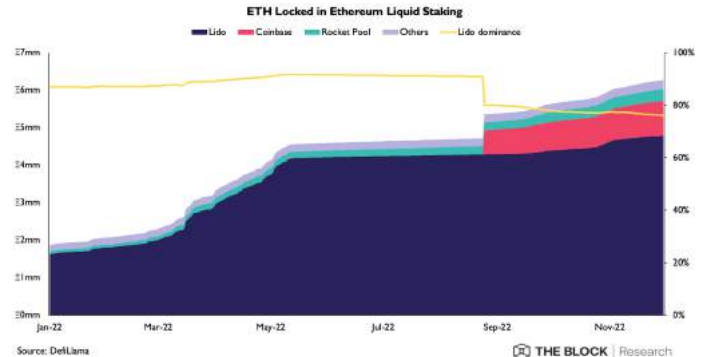


Figure 202: Ether locked in Ethereum liquid staking in 2022
Source: DefiLlama

Lido controls 30.9% of all ETH staked, which concerns some decentralization advocates as it might bring systemic risks to the network and enables the protocol to monopolize and cartelize MEV extraction.

However, since liquidity begets liquidity, some might believe that a monopoly (or a duopoly) in the liquid staking field is inevitable. It could be a lesser evil to

tolerate such dominance by a transparent, decentralized organization than to empower a centralized actor. Lido is controlled by decentralized governance and comprises multiple independent validators.

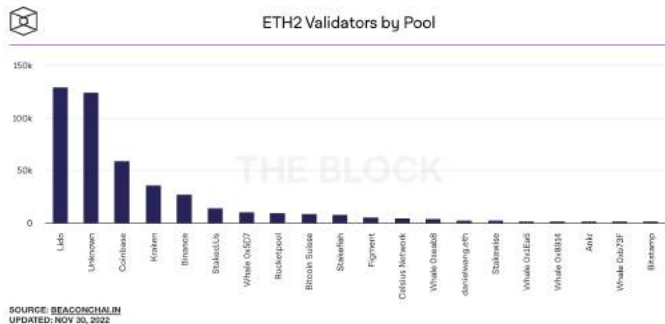


Figure 203: Ethereum validators by pool as of November 30, 2022

Source: The Block Data Dashboard

Lido also operates on Solana, albeit dwarfed by Marinade in TVL. Other notable liquid staking solutions on other networks include Benqi on Avalanche, Ankr on BNB chain, and Folks on Algorand, all with no less than \$30 million in TVL.

On the other hand, various Polkadot parachains have native liquid crowdloan tokens. Crowdloans on Polkadot enable blockchains to crowdsource DOT for bidding parachain slots on the Polkadot relay chain. Parachains that won the slot auctions would have their crowdsourced DOT locked until the slot leases expire. Liquid crowdloan DOT tokens represent the underlying crowdsourced DOT and are redeemable after the leasing period.

Parallel and Acala both have their own versions of liquid crowdloan DOT tokens, with a TVL of \$157 million and \$132 million, respectively.

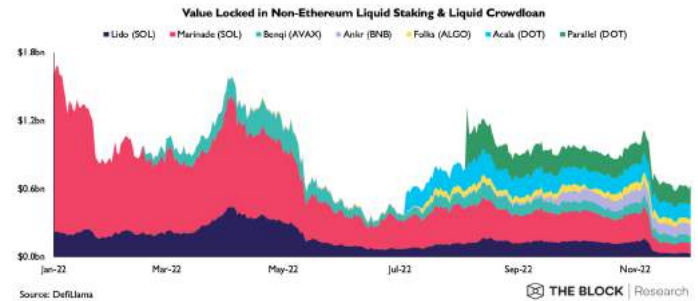


Figure 204: Value locked in non-Ethereum liquid staking and liquid crowdloan in 2022

Source: DefiLlama

Derivatives

The volume generated by decentralized perpetual futures exchanges mostly followed the movement of the overall crypto market. StarkEx-based dYdX has been the kingpin of decentralized perpetuals exchanges as it generated \$446 billion of volume in 2022, although much of it was heavily incentivized by token rewards. Meanwhile, Arbitrum- and Avalanche-based GMX, as well as Ethereum- and Optimism-powered Synthetix, produced \$62.6 billion and \$7.7 billion in annual volume, respectively.



Figure 205: Decentralized perpetuals exchanges monthly volume in 2022

Source: CoinGecko, GMX, Synthetix

GMX was one of the outperformers in DeFi with positive growth in TVL, amassing \$445 million worth of assets and up from \$108 million at the beginning of the year. It surpassed dYdX and Synthetix, which have a TVL of \$416 million and \$295 million, respectively.

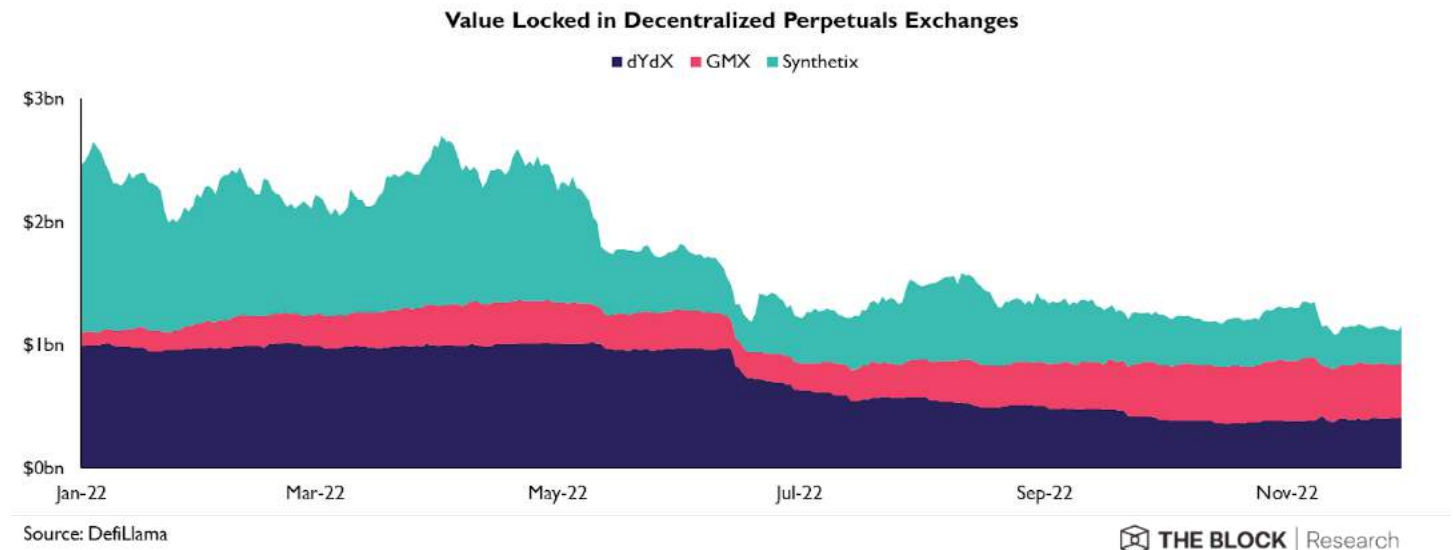


Figure 206: Value locked in decentralized perpetuals exchanges in 2022
Source: DefiLlama

Note that TVL across various perpetuals exchanges does not indicate their relative performance as they have vastly different mechanisms. dYdX is order book-based (i.e., peer-to-peer) and is, therefore, more capital efficient but requires active market-making participants to maintain deep liquidity.

In contrast, GMX is pool-based (i.e., peer-to-pool), meaning it leverages idle liquidity as the counterparty of all trades and is, therefore, relatively more liquidity-hungry. Being the counterparty of GMX traders, GMX LPs had an outstanding year as traders as a whole had a net loss of \$31.8 million. Nonetheless, it is unclear how GMX could scale without being impeded by the toxicity of informed flow, which would take advantage of GMX's low-slippage design at the expense of LPs.

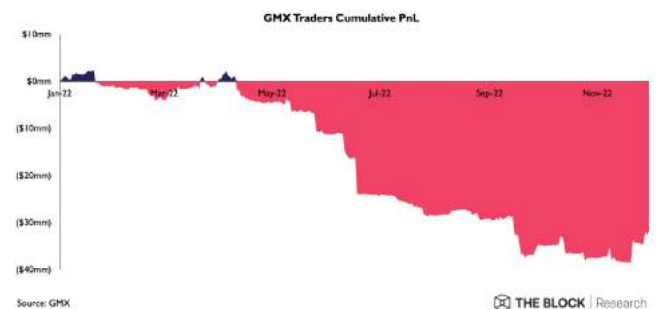


Figure 207: GMX traders cumulative profit and loss in 2022
Source: GMX

Synthetix is a debt pool-based synthetic asset issuance protocol, whereas Kwenta builds atop Synthetix to facilitate perpetuals trading with account margin management. 50% of synthetic assets issued are in sUSD, the base asset for trading synthetic assets on the Synthetix platform. Besides USD and major cryptocurrencies such as ETH and BTC, many synthetic assets are pegged to non-dollar fiat currencies, such as EUR, JPY, and CHF, filling the void of the lack of forex trading in DeFi.

Synthetix Synthetic Assets Dominance

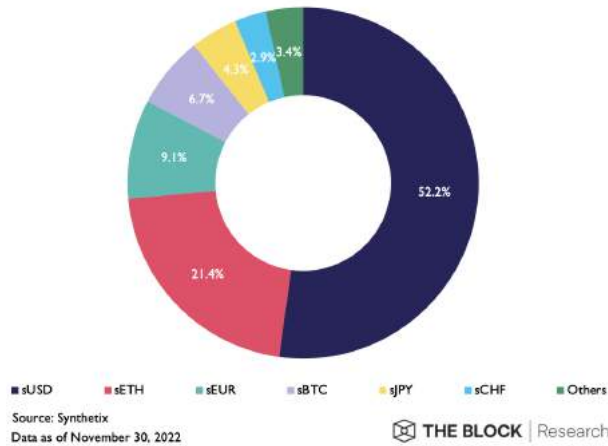


Figure 208: Synthetix synthetic assets dominance as of November 30, 2022
Source: Synthetix

2022 also saw the advancement of some decentralized exotic derivatives. Power perpetuals provide options-like leveraged exposure without the need for strikes or expiries, thus consolidating market liquidity into a single instrument. Opyn Squeeth is a power perpetual contract that tracks the square of the price performance of ETH, which has a cumulative volume of \$447 million since its inception in January.

On the other hand, Lyra is an options protocol that relies on Synthetix for settlement and delta hedging purposes. Lyra generated \$13.2 million in premium volume and \$295 million in notional volume since its latest upgrade six months ago.

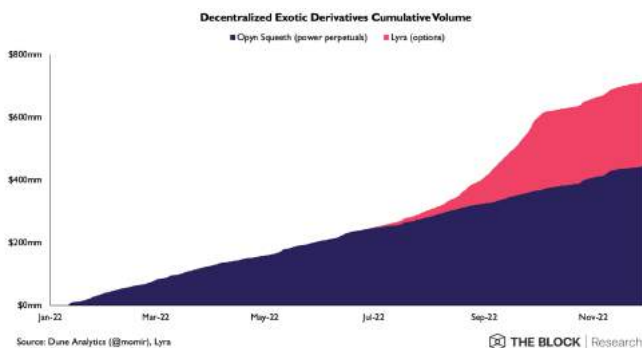


Figure 209: Decentralized exotic derivatives cumulative volume in 2022
Source: Dune Analytics (@momir), Lyra

Structured Products

DeFi has become increasingly sophisticated, with complex instruments emerging on a regular basis. Numerous structured products have sprung up that abstract away the complexity to maximize risk-adjusted returns while minimizing the time and effort required in portfolio management.

Yield optimizers are the most popular type of structured products in DeFi. They sort to maximize yield with minimal loss of principal and usually come with an auto-compounding feature. There are three types of yield optimizers, and the earliest iteration is aggregators that tap into multiple principal-protected yield venues and adjust positions frequently to maximize yield.

Yearn is the biggest yield aggregator with a TVL of \$372 million, down 91.0% in 2022, which made it one of the worst-performing DeFi protocols with a significant TVL. Other notable aggregators include Beefy and CoinWind, with a TVL of \$235 million and \$192 million, respectively.

The most popular sort of yield optimizers is yield-boosting protocols. Some DeFi protocols reward LPs with a higher share of revenue or token reward if they lock up a sufficient amount of the protocol token. However, token lockers are exposed to the token's long-term price risk. Yield-boosting protocols match two groups of participants, loss-averse LPs with no tokens locked and non-LP token lockers, to maximize and split the boosted reward between these two groups.

Convex is the largest yield-boosting protocol that increases the capturable yield for Curve LPs, whereas Aura and Wombex operate in a similar fashion for

Balancer and Wombat LPs, respectively. Convex's TVL was down from \$19.9 billion to \$3.04 billion in 2022, whereas Aura was launched mid-year and amassed \$353 million in TVL.

There are also variants of yield optimizers that provide leverage to depositors with higher risk tolerance, meaning depositors could earn a higher yield by risking a portion of their principal. Notable examples include Alpaca and Alpha Homora, with a TVL of \$279 million and \$59.2 million, respectively.

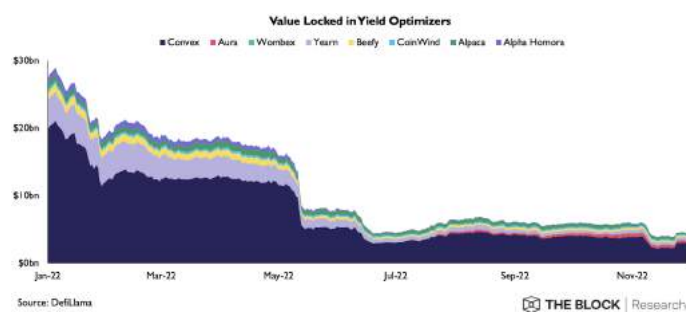


Figure 210: Value Locked in Yield Optimizers in 2022
Source: DefiLlama

Another type of structured products is automated strategy vaults which blossomed in 2022. They are smart contracts that employ specific transparent trading strategies, and depositors can select whichever suit their risk appetite and market view. Vaults would actively manage positions on behalf of depositors for a fee.

For example, the invention of concentrated liquidity by Uniswap v3 gave birth to protocols specializing in liquidity provisioning management. While concentrated liquidity gives LPs flexibility in fine-tuning parameters of market-making strategies, passive LPs lose their edges to those actively rebalancing their narrow liquidity positions. LP vault managers aim to maximize LP earnings by automatically adjusting liquidity positions and widths when certain market

conditions are satisfied. The biggest LP manager is Arrakis, with a TVL of \$505 million.

Another type of strategy vaults emerging is options vaults. Options are relatively complex financial instruments to some retail participants, and these vaults aim to simplify and streamline the process of getting continuous options-like exposure with curated strike prices and automatic rollover. Ribbon is the largest options-related strategy vaults protocol with a TVL of \$48.1 million.

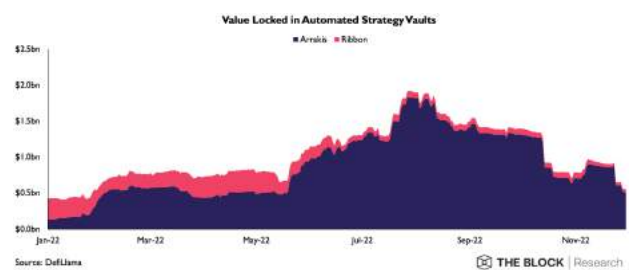


Figure 211: Value Locked in Automated Strategy Vaults in 2022
Source: DefiLlama

Nonetheless, many other structured products have fallen out of favor, including indices and yield tranching protocols. They could make a comeback in the foreseeable future when DeFi matures and attracts institutional capital.

Privacy

2022 was a critical juncture for privacy protocols. OFAC-sanctioned cryptocurrency mixers such as Bitcoin-based [Blender.io](#) and Ethereum-based [Tornado Cash](#) for their roles in allegedly facilitating money laundering for North Korean-linked Lazarus Group. This hacking organization was allegedly the culprit behind the \$600 million thievery on Axie Infinity's Ronin sidechain in March, the joint-largest DeFi exploit to date, as stated in the [DeFi Exploits subsection](#).

The Tornado Cash sanction in early August marked a local top in TVL as depositors fled shortly after the announcement. It currently has a TVL of \$111 million, a whopping 78.0% decrease within a year.

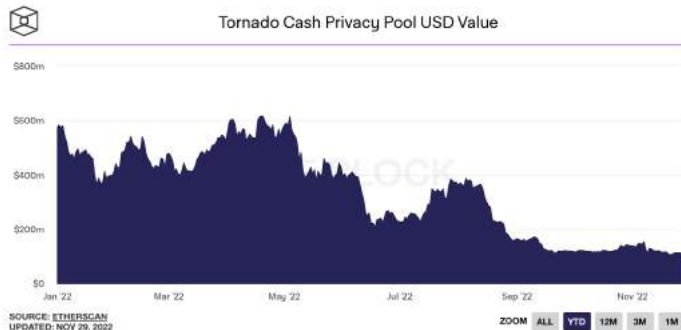


Figure 212: Value locked in Tornado Cash in 2022
Source: The Block Data Dashboard

Metrics such as monthly active addresses also indicated the effectiveness of the sanction against the largest privacy protocol.

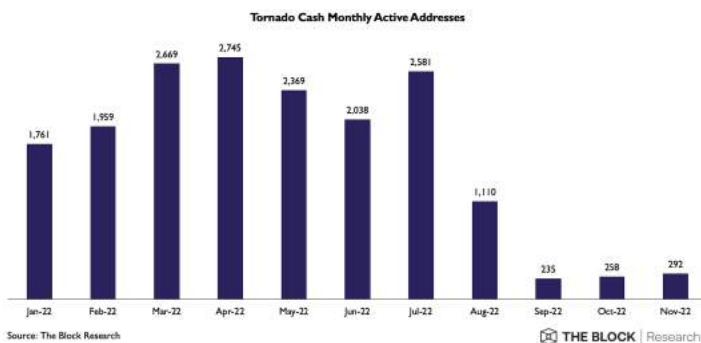


Figure 213: Tornado Cash monthly active addresses in 2022
Source: The Block Research

Insurance Coverage

While most DeFi sectors flourished in 2021, DeFi insurance coverage was one of the very few categories that diminished. This downfall carried on throughout 2022 with no signs of recovery. Nexus Mutual, the leading insurance coverage protocol, saw active coverage bleed from \$393 million to \$168 million.

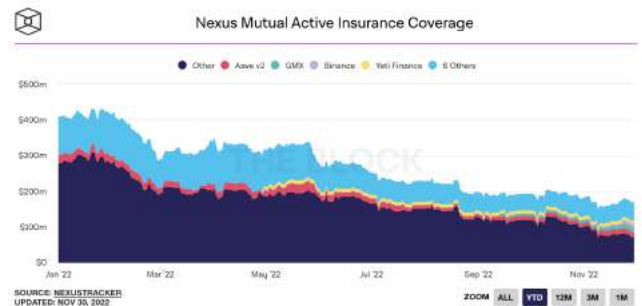


Figure 214: Nexus Mutual active insurance coverage in 2022
Source: The Block Data Dashboard

DeFi Exploits in 2022

Hacks and exploits continued to plague DeFi participants as protocols became increasingly complex and composable. The total amount of funds stolen from DeFi exploits in 2022 reached \$2.05 billion, a 48.1% YoY increase. Only 7.6% of funds stolen were able to be recovered.

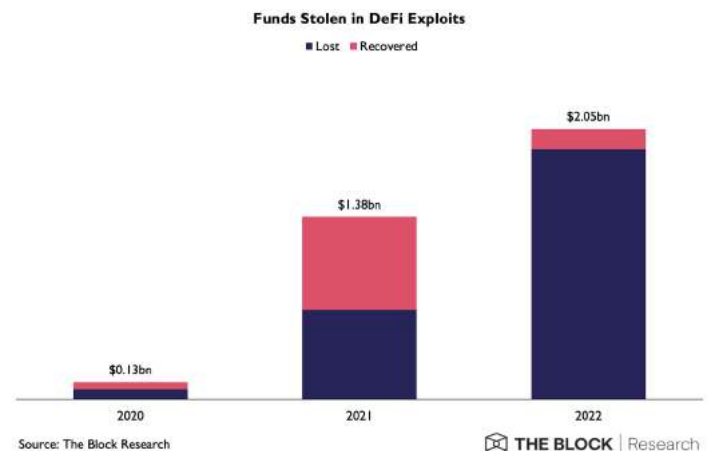


Figure 215: Funds stolen in DeFi exploits 2020 - 2022
Source: The Block Research

Out of the ten largest exploits in 2022, six were bridge-related amid growing cross-chain activities, as bridges became the custodians of huge sums of assets, as shown in the [Layer-1 section](#). Surprisingly, none of these exploits were caused by faulty middleware

infrastructure but rather by software bugs or human errors.

In general, most exploits were caused by faulty codes that created backdoors for exploiters to bypass certain essential verifications. Other causes include compromised private keys, governance attacks, price manipulation, etc. While stolen funds were usually unable to be recovered, a few landmark projects with tremendous venture capital backing were able to make victims whole.

Axie Infinity, raised \$150 million from venture capital firms in April, and the capital was used to reimburse the victims in June. The bridge has since re-opened, and the number of validators increased from 9 to 17.

It was believed that the North Korean-linked Lazarus Group was behind the attack, which ultimately led to the sanction of Tornado Cash mentioned in the [Privacy subsection](#), which was one of the tools used by the hacker to launder stolen funds.

[Wormhole Portal Bridge](#)

Wormhole Portal bridge was the de facto Solana bridge that ported Ethereum-based assets into the Solana ecosystem. The bridge program failed to conduct proper signature verification due to the use of a deprecated function, which allowed an attacker to spoof guardian signatures and mint 120 thousand unbacked Wormhole-wrapped ETH on Solana in February, worth \$320 million at the time, which was used subsequently to steal 93.75 thousand ETH on Ethereum.

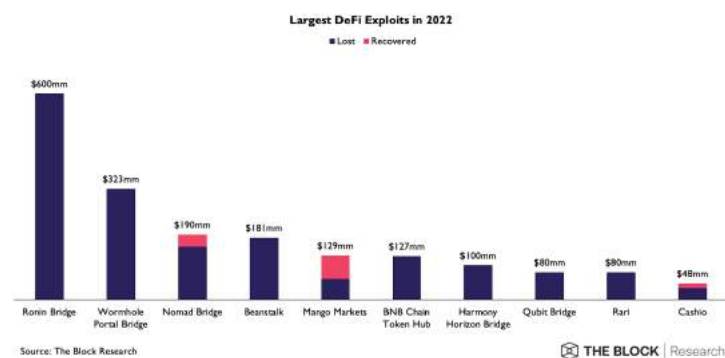


Figure 216: Largest DeFi exploits in 2022
Source: The Block Research

[Ronin Bridge](#)

The Ronin bridge exploit in March marked the largest exploit in 2022. The bridge wrapped Ethereum-native assets to Axie Infinity's Ronin sidechain and was secured by nine selected validators. Any bridging transaction required approval by at least five of these nodes. A hacker managed to gain control of five of them and stole 173.6 thousand ETH and 25.5 million USDC, worth around \$600 million at the time.

Despite being the joint-largest DeFi exploit in history, the other being the [Poly Network exploit](#) in 2021, the attack went under the radar until a user attempted but failed to withdraw 5 thousand ETH from the bridge six days later. Sky Mavis, the developer behind Ronin and

Jump Crypto later replenished the deficit to make victims whole after the vulnerability had been patched. Jump is the parent company of Certus One, the developer behind Wormhole.

[Nomad Bridge](#)

A bug was introduced in a routine smart contract update in June with an improper initialization, which bypassed the essential measures of proving the validity of messages before processing withdrawals from the Nomad bridge. Anyone could fabricate a bogus withdrawal request, and the message would be erroneously accepted as valid.

The vulnerability remained undetected until August. Unlike most other exploits, it was exploited by hundreds of lone wolves seemingly imitating one another by sending messages in similar formats to the Nomad contract. It resulted in a loss of \$190 million worth of assets, \$35 million of which was later recovered from whitehat exploiters. It was theorized that many exploiters returned the funds because their addresses involved had transactions linked to withdrawals from CEXs that likely possessed their personal information from their know-your-client (KYC) onboarding processes.

The recovery process is ongoing, and victims could soon claim the recovered funds pro-rata after completing KYC checks. Unlike previous bridge exploits where institutions backstopped the bridges and made users whole, victims in the Nomad bridge exploit would take a sizeable haircut.

[Beanstalk](#)

Beanstalk was an Ethereum-native algorithmic stablecoin with on-chain governance. It was exploited in April when an attacker managed to leverage flash loan to swap a significant amount of BEAN tokens. It temporarily granted the attacker over two-thirds of voting power, which was sufficient to unilaterally approve and immediately execute a malicious emergency governance proposal that drained the protocol.

\$181 million worth of assets were stolen, \$105 million of which were donated to the Ukraine donation address. Beanstalk was relaunched in August.

[Mango Markets](#)

Mango was a Solana-based perpetuals exchange with lending and borrowing capabilities. In October, a group

led by Avraham Eisenberg manipulated the price of MNGO, Mango's native token, on Mango's illiquid books and artificially inflated MNGO's valuation. It allowed them to use MNGO as collateral and borrow an abnormally large amount of other crypto assets on another account, leaving the protocol with a deficit of \$129 million.

Eisenberg asserted that he operated a "highly profitable trading strategy" where no foul play was involved. The community voted to allow Eisenberg to return \$67 million while keeping the rest, which he accepted on the condition that the returned funds would be used to pay back users affected.

[BNB Chain Token Hub](#)

BNB chain token hub was a bridge between BNB beacon chain and BNB smart chain. In October, an attacker forged arbitrary messages and maliciously minted 2 million BNB into circulation by exploiting a bug within a module of the bridge contract. The attacker managed to withdraw \$127 million of non-BNB assets out of the BNB chain by tapping into multiple liquidity venues before chain validators agreed to pause the chain until the vulnerability was patched via a hard fork.

The faulty module was also used by numerous Cosmos sidechains as part of the IBC implementation. All affected chains have since fixed the bug.

[Harmony Horizon Bridge](#)

Harmony Horizon bridge was the official bridge for porting assets elsewhere to Harmony, and was secured by a 2-of-5 multi-sig. A hacker gained illegal access to two of them and stole \$100 million worth of assets in June. The team has since revised the multi-signature

scheme required to approve transactions to a 4-of-5 setting.

The team proposed minting additional ONE, Harmony's native token, to compensate the victims, which the community generally opposed. The new plan suggested utilizing funds from Harmony Foundation to make victims whole.

Qubit Bridge

Qubit was a BNB chain-based lending protocol with a native bridge that enabled users to deposit assets into lending pools directly from Ethereum. A legacy function remained in the smart contract even when its functionality was replaced by a new function. Obsolete parameters relating to the legacy function were initialized, which unknowingly created a vulnerability where Qubit-wrapped ETH could be minted out of thin air by calling the legacy function that was supposed to be made unavailable.

It was exploited in January when an exploiter minted unbacked Qubit-wrapped ETH and used it as collateral to borrow \$80 million worth of assets. Protocol profits were used to compensate the victims, but only 2% of their losses were covered. The team left the project and transferred control to decentralized governance a month after the incident.

Rari

Rari Fuse was a fork of Compound, a lending protocol, but with more customizability attached by having multiple lending pools with different risk parameters. Re-entrancy attacks have plagued numerous Compound forks that adopted the old version of Compound smart contracts.

This vulnerability was spotted in March, but the patch did not cover all impacted functions on Rari. In April, an exploiter was able to use flash loan to post collateral on Rari lending pools, borrowed assets, and made a re-entrant call to withdraw the collateral before their borrowing record was reflected in the contract. \$80 million worth of assets were stolen and victims were fully compensated in FEI, a decentralized stablecoin issued by Fei, which merged with Rari in 2021.

Cashio

Cashio was a Solana-native decentralized stablecoin protocol that suffered from an infinite mint exploit in March. An exploiter was able to mint 2 billion CASH, Cashio's stablecoin, by supplying fake collateral. The unbacked CASH was sold on the market for \$48 million worth of assets. The exploiter returned 29% of the funds stolen to holders of less than 100 thousand CASH and selected victims at their discretion.

Outlook on DeFi in 2023

DeFi-optimized Blockchains

While having DeFi applications deployed on the same chain is advantageous for composability, blockspace-demanding applications would degrade the user experience for every user on the chain. DeFi application-specific blockchains can enhance user experience as protocol users do not have to compete in blockspace with other users on the same generic chain.

For example, a perpetuals exchange on an application-specific blockchain can be customized with high speed, throughput, and liveness so as to enable low-fee, high-frequency trading and proper account margin management. Besides, it can enable affordable,

high-granularity, and low-latency price feeds from oracle networks such that liquidation is timely executed to avoid bad debts.

Another example is Sei, a DeFi-focused Cosmos sidechain with optimistic block processing, a native order-matching engine, and a canonical liquidity aggregator. These features would ensure that order matching can be finalized quickly and securely via a canonical platform connecting to multiple liquidity venues on Sei.

On the other hand, DeFi-focused blockchains can create synergies between DeFi applications and the base layer with optimizing capital efficiency in mind. Berachain adopts a proof-of-liquidity consensus where the validators' stake is simultaneously deployed into providing liquidity in the native DEX and lending market, as well as maintaining the peg of the native stablecoin. Such a design makes DeFi an integral part of the base layer, drawing stark contrast from Ethereum's neutral and minimal narrative.

Liquidity Bootstrapping Structured Products

Methods for bootstrapping passive liquidity have constantly been evolving, from classical liquidity mining programs to novel concepts like protocol-owned liquidity. However, how to effectively bootstrap active liquidity remains an open question.

Directly incentivizing trading and market-making activities with token rewards can be ineffective and unsustainable as it often leads to wash trading by a few opportunistic individuals. On the other hand, many retail participants have limited spare time and suboptimal execution abilities in actively managing their positions, leading many to shy away from deploying capital into complex products.

Therefore, protocols that require deep active liquidity need to attract capital by abstracting away complexity and avoiding being too reliant on token incentives. Structured products can remove some barriers for retail participants and potentially provide more sustainable returns.

For instance, Oryn Squeeth is a power perpetual contract that tracks the square of the price performance of ETH, as explained in the [Derivatives subsection](#). Squeeth strategy vaults are a collection of automated trading strategies for trading the Squeeth contract. Different vaults enable users to bet on different market conditions. Users can simply deposit funds into a vault which automatically executes a predetermined trading strategy on behalf of all depositors.

For example, the crab strategy vault on Oryn lets users bet on a sideways price movement of ETH. This is done by simultaneously shorting Squeeth and longing ETH to create almost delta-neutral positions to the ETH price and collect funding payments made by long positions of the Squeeth contract. The vault algorithmically deals with leverage management and position rebalancing such that depositors do not need to manage their positions actively.

Asset Tokenization

Crypto, as an emerging asset class, remains disconnected from other traditional markets with total addressable markets (TAMs) in trillions. As the token-based economy advances, there is rising interest in leveraging existing blockchain and DeFi technology to enhance the supply chain visibility of RWAs and provide a variety of businesses with easier access to credit.

The nascent RWA market currently has a gross value locked (including the amount borrowed) of \$193 million. Centrifuge Tinklake is the leading RWA tokenization protocol where real-world financial instruments such as invoices and mortgages are tokenized. Some of these tokenized instruments are currently deployed as collateral to borrow DAI on Aave RWA market and Maker.

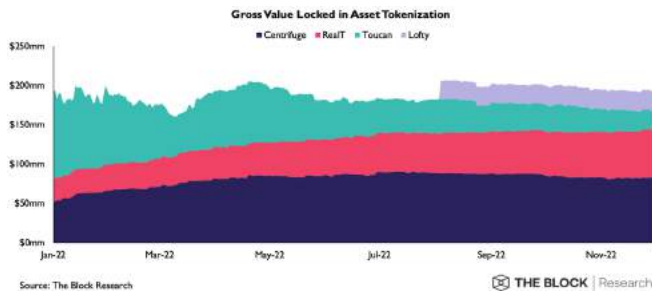


Figure 217: Gross value locked in asset tokenization in 2022

Source: DefiLlama

Other RWA tokenization protocols include RealT which fractionalizes real estate and unlocks similar DeFi use cases; Toucan which tokenizes carbon credits; etc. By tokenizing physical assets and IPs that carry significant financial value, it can foster organic growth and immensely expand the TAM for DeFi.

Non-dollar Stablecoins

Fiat-backed stablecoins are technically the most successful example of asset tokenization so far, with solid demand both off-chain and on-chain. Most existing stablecoins are pegged to USD as they are popular choices for trading and cross-border settlement purposes. Fiat-backed USD stablecoins are the base assets for most significant trading pairs on CEXs, whereas their on-chain volume remained stable throughout the bear market in 2022 with an average monthly volume of \$565 billion.

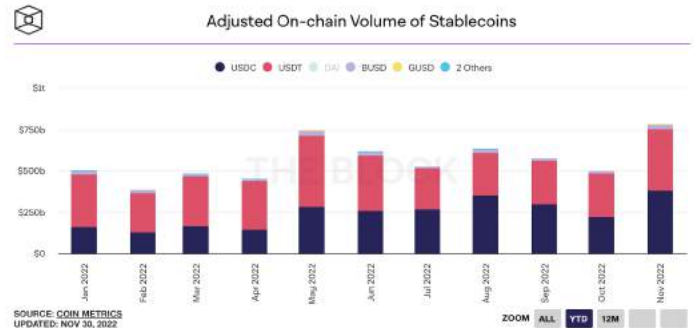


Figure 218: Adjusted on-chain volume of stablecoins in 2022

Source: The Block Data Dashboard

Stablecoins pegged to non-USD fiat currencies remained niche. The largest group of non-USD stablecoins is Euro-pegged, with a total market cap of €581 million (~\$605 million). Nevertheless, with regulatory clarity, non-USD stablecoins will likely gain adoption in the coming years.

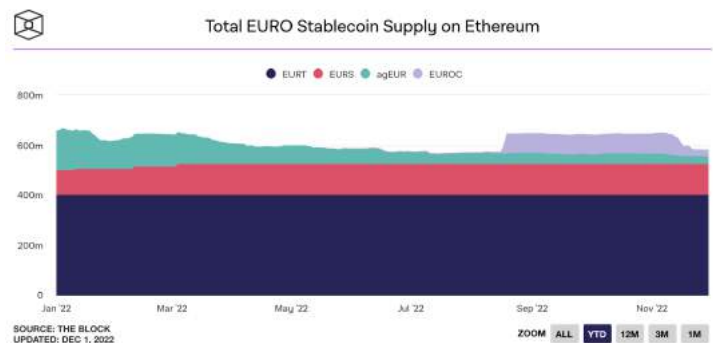


Figure 219: Total Euro stablecoin supply on Ethereum in 2022

Source: The Block Data Dashboard

Material efforts have been made in 2022 to establish reasonable regulatory frameworks for fiat-backed stablecoins in multiple jurisdictions outside the United States. The European Union's [Markets in Crypto Assets](#) bill has passed most legislative processes and is expected to be approved by the European Parliament and take effect in 2024. The bill places a daily transaction cap on non-Euro-denominated stablecoins within the Union, intending to protect Euro's monetary sovereignty.

On the other hand, the United Kingdom's [Financial Services and Markets](#) bill would grant the Financial Conduct Authority powers to regulate stablecoins. Authorities in [Singapore](#) and [Hong Kong](#) also published consultation papers on stablecoin regulation proposals and are seeking input from the public.

Institutional DeFi

Institutions are still hesitant to embrace distributed ledger technology due to compliance and regulatory uncertainties. Some advocates are cultivating the notion of “permissioned DeFi,” while oxymoronic, could overcome such regulatory barriers.

Even though permissioned DeFi is not decentralized by any means, it can usher in a new era of open finance that facilitates industry-grade, near-instant, cross-border settlement and brings more transparency to all parties involved. Business logic can be codified in the form of smart contracts that automate settlement and enforce adherence to rules, reducing the cost of doing business through clearing intermediaries.

In November, DBS Bank, J.P. Morgan, and SBI Digital Asset Holdings conducted [foreign exchange and government bond transactions](#) on Polygon under the pilot scheme supervised by the Monetary Authority of Singapore. A modified version of Aave Arc was utilized that allowed finer control over parameters and supported on-chain verifiable credentials.

This event was believed to be the first time a major bank had tokenized deposits on a public blockchain. We can expect to see an increasing number of government-led initiatives collaborating with industry giants to explore the potential of adopting DeFi and blockchain technology on a broader scale in the coming years.

7

Web3: 2022 Overview

Hiroki Kotabe

Web3: 2022 Overview, 2023 Outlook

Hiroki Kotabe

A look at Web3, the technology driving an inflection point in the web's evolution and explore the latest data to see where we might be headed.

Quick Take

- “Web3” has come a long way since last year, when it was still a fuzzy concept with varying definitions focusing to varying degrees on its technological or social aspects.
- Since then, there has been some convergence in definitions, with most agreeing that Web3 refers collectively to the dapps it is composed of. But, it may still be hard to see how Web3 is more than the sum of its parts.
- Here, we discuss a holistic framework of Web3 infrastructure that shows how dapps are constructed and accessed. We also look at some of the latest figures behind the Web3 economy to get a sense of how activity within Web3 has changed over the last year, both overall and in its subcategories.

State of Web3 in 2022

The buzz around “Web3” did not enter the mainstream until late last year, around the time we published last year's [2022 Digital Asset Outlook](#). At that time, Web3 was still a very fuzzy concept. Our main focus in that report was on how Web3 and Web2 differ at the level of client-server relationships and how differences in Web3's underlying data structures give rise to new user

experiences related to decentralization, ownership, verifiability, and execution (DOVE framework).

A year has passed, and Web3 has developed along with our understanding of it. Here, we present the doors-applications-primitives-protocols (DAPP) framework of the Web3 stack to put it all together. The DAPP framework illustrates how Web3 is built, from the basic protocol layer up to the access layer. Web3's use of open and interoperable blockchain protocols and task-specific primitives set the foundation for use cases that could be considered uniquely “Web3,” including NFTs, the metaverse, decentralized autonomous organizations (DAOs), and DeFi.

The DAPP framework highlights the importance of diverse infrastructure providers collectively supporting the various blockchain and peer-to-peer (P2P) networks underpinning Web3. In the near to medium term, these infrastructure providers will likely be vital for maintaining Web3 architecture, given the complexities and costs of self-operated infrastructure for both developers and regular users. This is evidenced by the prolific development of the infrastructure provider ecosystem, where we see significant traction and funding of both “traditional” hosted node networks and novel P2P node networks.

In this report, we first conduct a general survey of the Web3 economy. Then, we focus on the infrastructure and infrastructure providers of the Web3 stack, pointing to various challenges and opportunities moving forward.

The Web3 Economy

We take a look at the latest data on a few of the most pertinent metrics of the Web3 economy, starting at general figures and then specifically at NFTs, the

metaverse, and DAOs. Note that while we exclude DeFi here, many consider it part of Web3. For details regarding the DeFi economy, see the [DeFi section](#).

General Overview

First, let's look at Google search volume for the term "Web3." Search interest can be a useful way to track real-time economic activity across various sectors, which can be used for immediate forecasting or "nowcasting." As such, Google Trends data for Web3-related terms can give us some insight into the general Web3 economy by specific geographies.

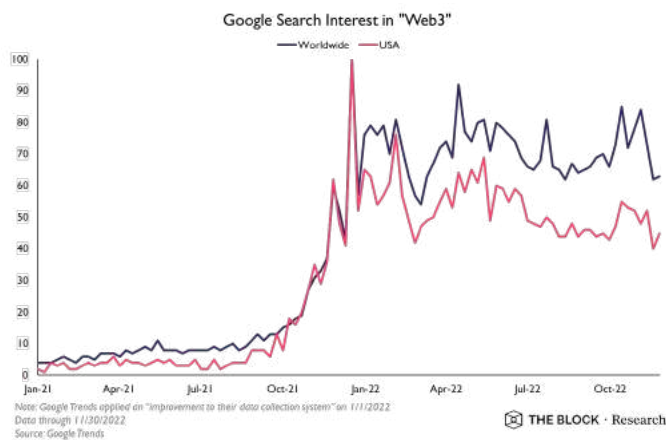


Figure 220: Google search interest in "Web3" 2021 - 2022

Source: Google Trends

We can also look at active Ethereum addresses (i.e., count of unique sending and receiving addresses per day) as the Ethereum network generates most Web3-related revenue. Active Ethereum addresses give us insight into the Web3 economy as a whole insofar as it explains variance in other Web3 activity over time (e.g., on other blockchains and dapps). The main observation here is that active addresses on Ethereum have generally increased and steadied in recent years.

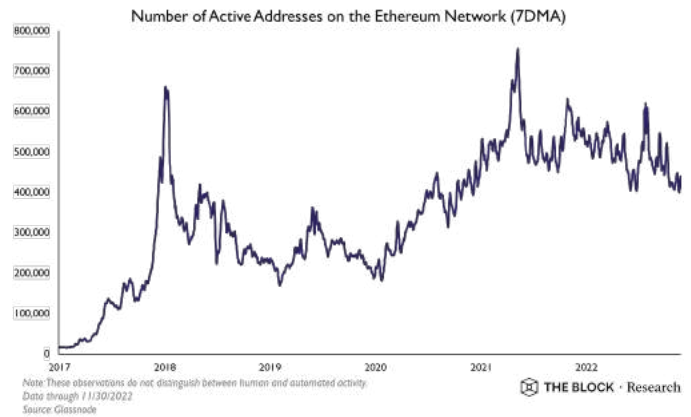


Figure 221: Active addresses on the Ethereum Network (7DMA) 2017 - 2022

Source: Glassnode

NFTs

NFTs representing unique digital collectibles, art, and profile pictures – as well as NFT marketplaces like OpenSea – are major drivers of Web3 economic activity. In 2021, news of celebrities purchasing NFTs and skyrocketing valuations of some NFT projects also drew much attention to this emerging Web3 space. Since then, many NFT applications were developed and diversified, with the potential to disrupt various sectors, including ticketing, monetization, music, domain names, and fashion/luxury goods.

While NFT trade volumes dropped significantly this year, weekly trade volumes are still in the order of \$50 million per week.

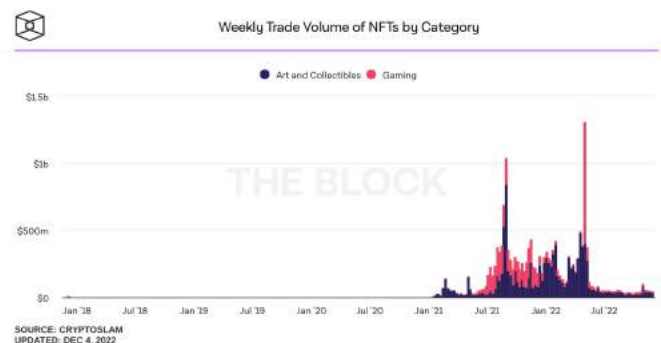


Figure 222: Weekly NFTs trade volume by category

Source: The Block Data Dashboard

Metaverse

NFTs also play an important role in the “metaverse” – an online world composed of various interconnected and persistent virtual spaces where people can meet, socialize, play, and work together much as they can do in the offline world. For example, in the two leading metaverse worlds – Decentraland and The Sandbox – people can buy pieces of these worlds as NFTs to create and monetize virtual experiences.

To get a sense of how the metaverse economy is doing, we can look at floor prices for the digital real estate of Decentraland and Sandbox. Here, we see that these prices peaked around the same time as NFT trade volumes, with Sandbox floor prices surging more than Decentraland. As of this writing, Sandbox floor prices are only slightly lower than that of Decentraland despite the relative scarcity of Decentraland land (90,000 LAND) compared to Sandbox land (166,464 LAND).

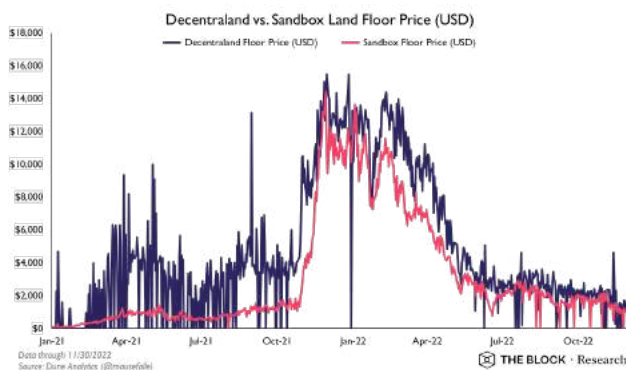


Figure 223: Decentraland vs. The Sandbox land floor price 2021 - 2022
Source: Data Analytics (@mausefalle)

Decentralized Autonomous Organizations

DAOs are also commonly associated with Web3. A DAO can be defined as a “collectively-owned, blockchain-governed organization working towards a shared mission.” The backbone of a DAO is its smart contract which defines the organization's rules and

holds the group's treasury. People can “own” a piece of a DAO by purchasing a piece of its governance power, much like they can own a piece of the metaverse by purchasing a piece of its land. Those with more governance power have more sway in collective decisions made through proposals and polling (e.g., decisions about how to use the DAO's treasury).

Figure 224 illustrates the total assets under management (AUM) controlled by DAO treasuries and DAO member counts, collectively. What is notable here is that, unlike the NFT and metaverse figures, DAO traction increased in 2022, with AUM holding around \$10 billion and member counts rising more than threefold.

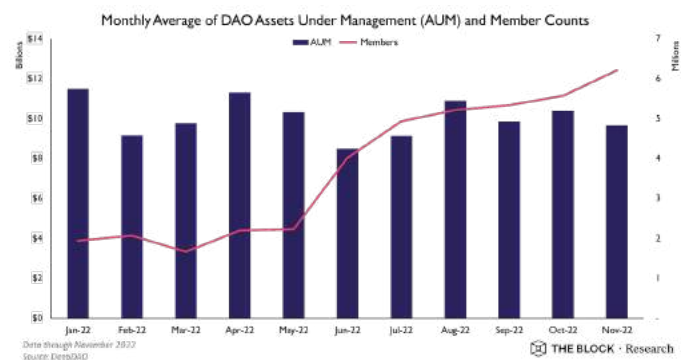


Figure 224: Monthly averages of DAO AUM and member counts in 2022
Source: DeepDAO

The DAPP Framework

The app categories discussed in the previous section collectively shape what is becoming known as “Web3.” Web3 is an idea born of the dapps it is composed of. What makes Web3 unique is that it uses smart contract platforms to allow anyone to participate without monetizing their data. Moreover, smart contract platforms allow something that Web2 lost as it became dominated by companies providing services in exchange for personal data: decentralization.

While centralization helped onboard billions of people to the web, it also resulted in a handful of large companies having a stronghold on large swathes of the web with unilateral decision-making power. Web3 tries to solve this dilemma by embracing a decentralized ecosystem of apps that are built, operated, and owned by its users. As such, sometimes Web3 is called the “read-write-own” in contrast to Web2 (read-write) and Web1 (read-only).

The evolution of dapps is bringing new infrastructure requirements to the dapp development space. There are increasing demands for scalability, security, and decentralization, as well as a growing awareness to access, operate, and store both on-chain and off-chain data in a decentralized and trustless way.

However, while decentralization infrastructure to support next-generation dapps is developing at a rapid clip, there is still an over-reliance on centralized infrastructure. At one level or another of the Web3 stack, this presents centralization concerns that proponents of Web3 eschew in favor of decentralized and permissionless systems born from P2P and cryptographic technologies. It is only through these latter technologies that Web3 can be built, operated, and owned by its users – the hallmark of decentralization.

In light of the current situation, there are many opportunities for infrastructure providers in the near future. It is currently a technical and financial burden for developers and users to set up and run their own blockchain infrastructure. Developers would rather focus on building and shipping their products, and users prefer to avoid technical complexities when possible.

Here, we present the doors-applications-primitives-protocols (DAPP) framework of the Web3 stack to illustrate where and how dapps can decentralize their infrastructure, and the various opportunities for Web3 infrastructure providers to contribute to operations at each level of the stack. The DAPP framework is broken down into four major layers – starting from top to bottom:

- **Doors** – Enable users to access and interact with Web3
- **Applications** – Connect users with Primitives and Protocols via a user interface and experience
- **Primitives** – The task-specific, interoperable building blocks for dapps
- **Protocols** – Construct the foundational blockchain architecture of Web3

In this report, we dive into each layer and focus on prominent projects building at each layer to highlight how Web3 operates today, where the limitations and opportunities are for infrastructure providers, and what the Web3 of tomorrow may look like.

The DAPP Framework

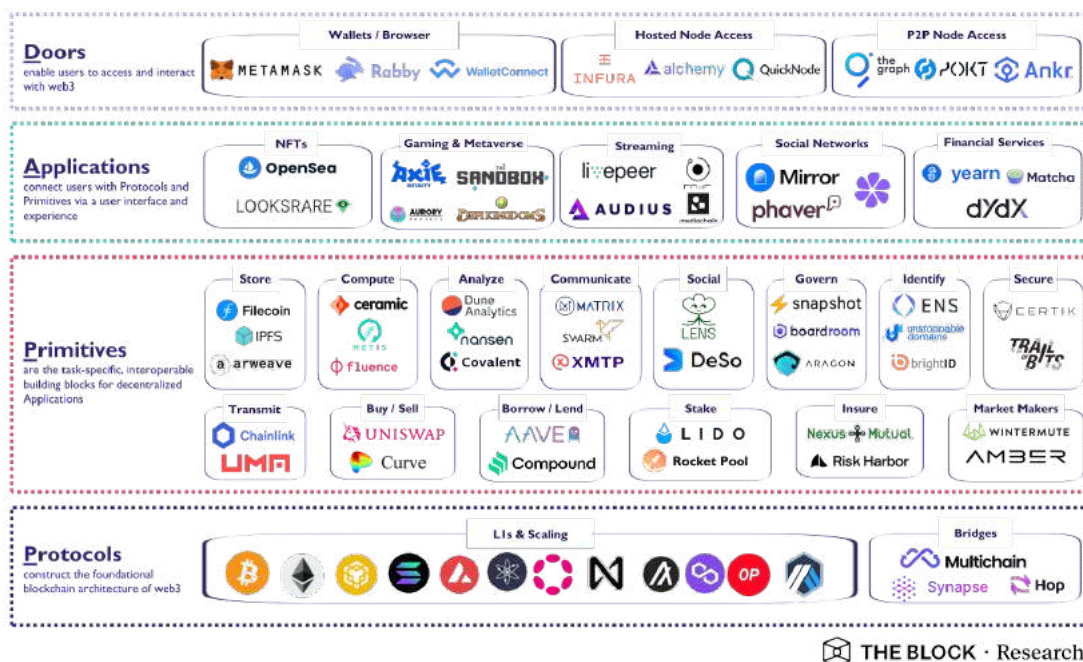


Figure 225: The DAPP framework of the Web3 stack

Source: The Block Research

Protocols



Figure 226: Protocol layer under the DAPP framework of the Web3 stack

Source: The Block Research

Starting at the bottom, the protocol layer comprises the blockchain architecture on which all Web3 applications are built. It includes L1s like Bitcoin, Ethereum, Solana, Avalanche, and BNB Chain; scaling solutions like Optimism and Arbitrum; and cross-chain bridge protocols such as Synapse and Multichain.

Base layer L1s may have additional protocols built on top of them that expand their capabilities. For example, Bitcoin's Lightning Network is a L2 payment channel network that enables faster and cheaper Bitcoin transactions. Ethereum also utilizes multiple scaling solutions, including rollups (e.g., Optimism, Arbitrum)

and sidechains (e.g., Polygon) to offload execution from the Ethereum mainnet to faster and lower-cost environments, reducing congestion on the main chain. Polygon's general-purpose sidechain has become industry-leading, with over \$1 billion TVL in over 300 apps in DeFi, gaming, and more.

Interoperability

With the rise of many L1, L2, and sidechain networks, there is a growing need for cross-chain communication and interoperability to bridge value across the composite network space. Cross-chain bridges aim to serve this purpose by enabling users to move value from one chain to another.

The most popular bridge implementation is the lock-and-mint design. In this design, the original assets are locked in a smart contract on the sending side (e.g., Ethereum), while the receiving network (e.g., Solana)

mints a replica of the original token on the other side. Note that this means that ETH bridged to Solana via a lock-and-mint bridge is only a “wrapped” representation of ETH, not ETH itself.

The TVL in Ethereum L1 bridges bootstrapping liquidity on Ethereum alone reached over \$55 billion early this year. Though, that value has since declined along with the value of assets held.

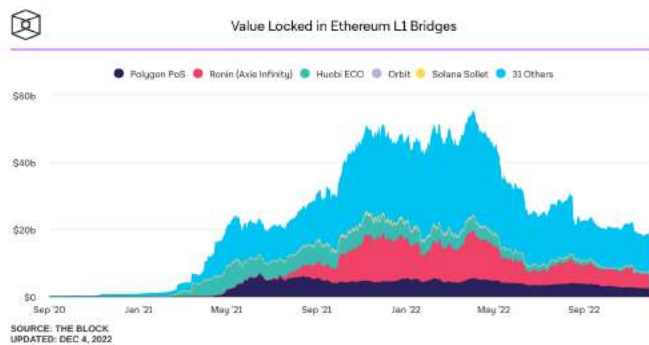


Figure 227: Value Locked in Ethereum L1 Bridges
Source: The Block Data Dashboard

Furthermore, while the interoperability market has shown promise, it's not without its growing pains. Bridges introduce another layer of [systemic complexity](#) to blockchain architecture and introduce points of centralization where assets are bridged from one chain to another. Both technical vulnerabilities and centralized control over bridged funds led to several high-profile bridge exploits totaling over \$1 billion cumulatively in the last year alone. Bridges are thus currently a major area of weakness for Web3 infrastructure, where there is a lot of room for improvement. See the [Blockchain Interoperability Solutions subsection](#) of this report for further detail.

Protocol Layer Interoperability vs. Modularity

As the protocol layer ecosystem develops, there has been a shift not only toward interoperability between chains, but also modularity, with different chains

delegating different tasks. One of the big remaining questions about the future of Web3 is whether the protocol layer will be more about monolithic-and-interoperable blockchains vs. modular-and-stacked blockchains.

We present an example of a monolithic-and-interoperable Web3 where monolithic chains like Ethereum, Solana, or Tron handle the four major blockchain operations – execution, settlement, consensus, and data availability:

- **Execution** – Execute transactions and produce new state commitments
- **Settlement** – Establish transaction correctness and finality; facilitate cross-execution layer communication
- **Consensus** – Reach agreement on transaction ordering
- **Data Availability** – Attest to availability of transaction data and provide transaction data on demand

Example of Monolithic Blockchain Architecture

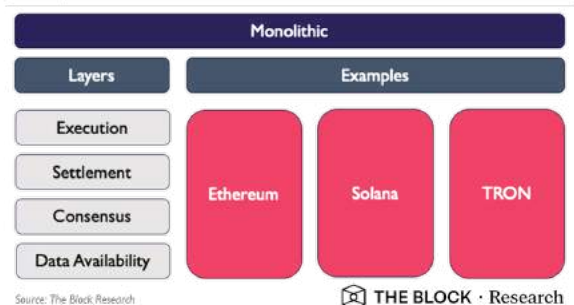


Figure 228: Example of monolithic blockchain architecture
Source: The Block Research

In the monolithic model, chains talk to each other through communication hubs, but a single blockchain protocol handles the four core blockchain functions. Scalability may be achieved via advanced communications protocols (at “Layer-0;” L0) or sharding (at L1).

Next, we present an example of a modular-and-stacked blockchain system where different protocols handle different components and blockchain operations.

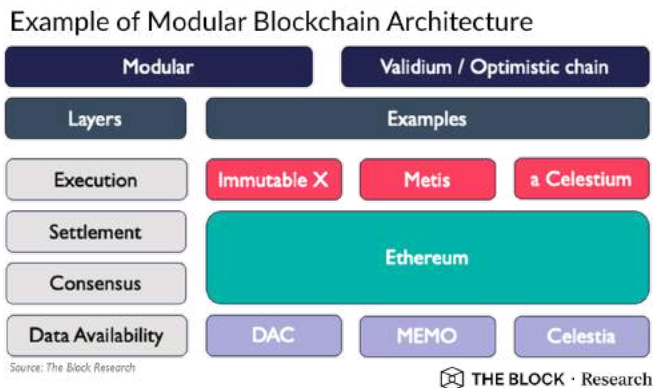


Figure 229: Example of modular blockchain architecture

Source: The Block Research

In the modular model, different chains are responsible for different blockchain functions. For example, Ethereum may be responsible for settlement and consensus while “outsourcing” data availability to chains like Celestia and execution to chains like Metis.

The monolithic-versus-modular debate is central to predictions about which blockchains will have the most demand in terms of access and usage. For example, in a modular future where the primary data network and execution environment is Celestia and a Celestium, respectively, instead of Ethereum, there would be more need for Celestia infrastructure. To learn more about modular blockchains, see [Blockchain Scaling Solutions section](#).

Primitives



Figure 230: Primitive layer under the DAPP framework of the Web3 stack

Source: The Block Research

On top of the protocol layer is the primitive layer, comprising interoperable tools and building blocks that are designed for accomplishing specific tasks. These specific task domains already diversified from transactions to security, storage, computation, analysis, communication, social functions, governance, identification, and more.

Primitives have limited use on their own, but when combined, they act like LEGO blocks that a developer can use to build all sorts of potentially novel and useful user-facing Web3 applications. For example, the creation of Chainlink oracles brought about the possibility of lending and borrowing platforms like Aave and Compound that depend on high-quality, real-world data about asset prices. All three of these protocols are built on audited Ethereum smart contracts. These DeFi platforms allowed crypto investors to leverage their holdings to generate interest via lending, as well as to borrow collateralized stablecoins instead of selling their holdings and incurring a taxable event.

Next, we describe prominent businesses from each category:

Transactions. These tools are the financial primitives enabling various DeFi functions, including buying/selling, borrowing/lending, staking, insurance, and more. So far, in terms of the value held in smart contracts, the leading financial primitives in the Web3 application space center around the first three categories listed here.

- **Buy/Sell.** Uniswap is a DEX built on Ethereum that utilizes AMM technology instead of a traditional order book where individual buy and sell orders are matched. Instead, users pool together two assets and trade them

against the pool, with the price determined by the constant product market maker model, $X * Y = K$, where X and Y are the reserve quantities of two tokens and K is the constant product invariance that must be maintained.

- **Borrow/Lend.** Aave is an open-source and non-custodial platform for users to earn interest on deposits and borrow assets with variable or fixed interest rates. Unlike its main competitor, Compound, Aave also supports flash loans which enable smart contracts of external apps to borrow assets without collateral as long as the liquidity is returned to the protocol within one block transaction.
- **Stake.** Lido is a liquid staking solution for Ethereum that allows users to stake their ETH without having to lock assets or maintain staking infrastructure. It does this by exchanging staking derivative tokens representing the staked token at a 1:1 ratio while also providing daily rewards in those derivative tokens.

Transmission. Smart contracts cannot access information stored outside of the blockchain, so they must rely on “oracles” like Chainlink to bring off-chain data on-chain for smart contracts to use. One of Chainlink’s main uses is providing price feeds for smart contracts to access real-world market prices of assets.

Security. Crypto and exploits have gone hand in hand since crypto’s inception with no sign of slowing. As such, the Web3 stack needs to include a robust security infrastructure. Trail of Bits is one of the leading blockchain security firms, offering code analysis and recommendations, verification of code correctness, and code analysis tools. Other firms offer on-chain

monitoring, identity verification, attack simulations, wallet tracing, and more. See the [DeFi Exploits subsection](#) to read more on DeFi-related hacks.

Storage. The metadata and hypermedia associated with NFTs (e.g., JPEGs, GIFs) have set a new precedent for [storage requirements](#) that typical blockchains are not built for. Consequently, a new generation of cooperative storage clouds emerged to meet the storage requirements of new Web3 applications. Filecoin and its complementary protocol InterPlanetary File System (IPFS) lead this space and utilize *contract-based* storage where buyers and sellers negotiate temporary storage deals in open markets. These protocols power NFT.Storage and Web3.Storage, popular options for storing the NFT metadata/hypermedia and Web3 files, respectively.

Compute. Ceramic Network builds on IPFS and other open storage standards to create a general-purpose protocol for computing and processing data. While persistence networks like Filecoin ensure data availability at addressing layers like IPFS, they lack advanced database-like features such as mutability, version control, access control, and programmable logic that enable the computation and state management capacities. Ceramic aims to provide developers with such advanced database-like functionality to complement their existing blockchain infrastructure.

Analysis. As dapps evolve, it is important to keep track of data-driven insights and current market trends. Dune Analytics allows anyone to create SQL queries on blockchain data and visualize the results in charts. Charts are assembled into dashboards that provide an overview of a project’s key metrics. Dune users can then explore and share others’ queries and

dashboards, creating networked crypto analytics by and for the community.

Communication. Matrix is an open standard for interoperable, decentralized, real-time-time communication. It supports chat, Voice over Internet Protocol (VoIP), IoT, VR, augmented reality (AR), social, and more applications. Matrix is evolving to support more P2P functionalities, empowering users to have more autonomy and privacy over their data. For example, users can store their data in IPFS by embedding their own servers into their Matrix client. Matrix powers Element, a Matrix-based messaging app.

Social Networking. Lens Protocol is a composable and decentralized social graph, designed for “plugging in” social networking functions into Web3 applications. It defines core aspects of social networking platforms like users, followers, posts, comments, likes, and so forth for social media apps the next layer up to build on top of. The result is an open social graph on top of which various user interfaces and algorithms can be built. The vertices in this graph are users who mint a Lens profile NFT, while the edges are the social primitive functions. Lens is built on Polygon and was spun out of Aave development.

Governance. Voting is one of the core functions of organizations and governance in Web3, and Snapshot is a popular voting tool for Web3 apps. Most Web3 apps still use a form of coin voting governance – despite its [limitations](#) – for “vote signaling,” the process of querying what a DAO’s community thinks about a given proposal. However, signaling preference using tokens on-chain can incur prohibitive gas fees. Snapshot solves this by utilizing IPFS for off-chain, token-based vote signaling. By recording user votes on IPFS, vote data is stored and shared in a decentralized P2P

network while avoiding the gas costs associated with on-chain voting.

Identification. There are promising beginnings of identity systems in Web3, such as the Ethereum Name Service (ENS) – a distributed, open, and extensible naming system based on the Ethereum blockchain. ENS maps human-readable names like “johndoe.eth” to machine-readable identifiers like cryptocurrency addresses, content hashes, and metadata. As all ENS names are ERC721-compliant NFTs, they are non-fungible but still transferable, limiting their use for trusted identification. To build networks of trust, researchers, including Ethereum co-founder Vitalik Buterin proposed soulbound tokens (SBTs) – non-transferrable attestations of identity information.

The kinds of apps that gain the most traction in Web3 will determine which primitives get the most usage. For example, if NFTs are linked to increasingly larger hypermedia, there will likely be increased demand to access and use the major decentralized storage networks like Filecoin/IPFS. If Web3 social networking apps are adopted by billions of users like current Web2 social networking apps, infrastructure providers will need to meet a massive demand to access the basic protocols (e.g., Polygon POS) on which the social primitives are built (e.g., Lens).

Applications



Figure 231: Application layer under the DAPP framework of the Web3 stack

Source: The Block Research

At the next level up is the applications layer. Here, protocol and infrastructure layers combine into user-facing applications that prioritize user experience.

The Web3 application space is already diverse and expanding, including applications specific to NFTs, gaming, the metaverse, streaming, content, social media, financial services, and more.

Gaming & GameFi

GameFi is a portmanteau of gaming and finance that has rapidly become one of the most talked about application sectors of Web3. While the mechanics and economics of individual GameFi games vary, they do share some common features, including (a) the use of a blockchain, (b) a P2E or play-and-earn (P&E) business model; (c) asset ownership; and (d) DeFi elements such as yield farming, liquidity mining, and staking. GameFi made headlines in 2021 as the adoption of blockchain into gaming progressed rapidly, primarily through the introduction of in-game assets like NFTs and game tokens. These in-game rewards exhibit real utility for gamers and can be traded in free and open marketplaces, which led weekly NFT sales to flip from being dominated by arts and collectibles to gaming. As such, those building and providing Web3 infrastructure should keep apprised of which games are gaining traction, what chains the games use, and where the game's assets are being transacted.

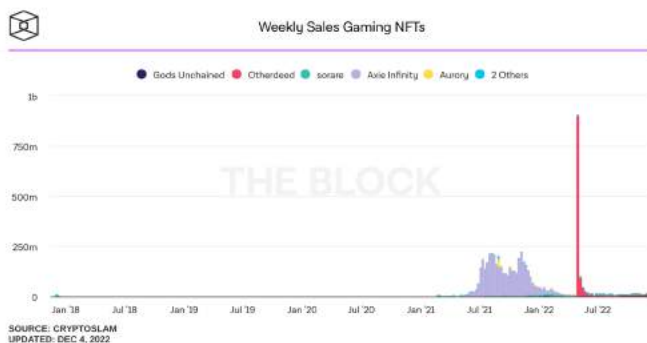


Figure 232: Weekly sales of gaming NFTs
Source: The Block Data Dashboard

Axie Infinity, a turn-based strategy game, was one of the early pioneers of GameFi along with the P2E gaming model. P2E is in many ways the opposite of traditional pay-to-play gaming models, where gamers pay before playing, receive no financial returns, and their in-game assets are controlled by the gaming company. In contrast, in the P2E model, gamers can play without incurring upfront costs (e.g., Axie Infinity Origin) and have ownership and control over their in-game assets, which they can choose to monetize both inside and outside of the game.

However, the P2E gaming model is not without its critics. Many criticize these games as unsustainable, where the profitability of the game centers around new players joining and earlier players cashing out at the expense of those new players. To make such games sustainable (as well as ethical), gamers and developers are advocating a move toward P&E gaming, where the reward of playing is not only profit but entertainment too. Providing real value to users beyond the hope of profit is one step toward solving the problem of retaining players. To know more about the state of the Web3 gaming market, please refer to the [Gaming section](#) of this report.

Metaverse. First mentioned in the novel [Snow Crash](#), the metaverse transcends beyond digital asset ownership, P&E, and GameFi. Cryptocurrencies and other digital assets lend themselves to opening new capacities in the metaverse, such as digital economies and access control. Utility tokens like SAND in The Sandbox drive/underpin its metaverse economy and can be earned through gameplay and spent to play the game, customize avatars, buy land, trade assets, and vote in governance. NFTs like the Otherside NFTs providing claims to land (“Otherdeeds”) in the Otherside metaverse raised over [\\$300 million](#) for the game’s development while providing owners with the

right to sell and rent their digital land. Further information on the metaverse market can be found in the [Metaverse section](#).

NFTs. Buying and selling NFTs typically takes place in marketplaces like OpenSea, LooksRare, and X2Y2. While OpenSea remains the market leader, a new cohort of more decentralized NFT marketplaces like LooksRare and X2Y2 emerged to capitalize on growing discontent with centralization concerns over OpenSea.

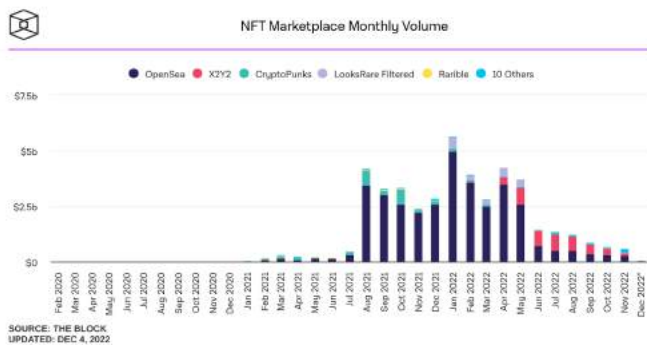


Figure 233: NFT marketplace monthly volumes
Source: The Block Data Dashboard

OpenSea has been criticized for frequent server downtimes, a major [data breach](#), excessive centralization in handling supposedly fraudulent transactions, arbitrarily blocking accounts, [front-running their own users](#), and pocketing all generated trading fees. LooksRare and X2Y2 take a more community-centric approach, handing back trading fees to their token holders and letting their token holders take the helm with governance via token voting.

Looking ahead, these trends highlight the importance of reliability, security, transparency, and censorship-resistance of Web3 platforms and their

websites. Decentralized storage and computing protocols could help with improving uptimes and decentralization. Governance tokens can give users a vested interest in NFT marketplaces and put the future of the product in the hands of the community, supporting Web3 ideals, including censorship resistance and permissionless access. An in-depth look into 2022 trends in the NFT market can be found in the [NFTs section](#).

Decentralized Streaming/Compute. Beyond finance, many expect the next major category for crypto applications to be in decentralizing the compute stack. There are reasons to believe that decentralized compute could see explosive growth in the coming years, as we saw in DeFi in previous years. For reference, DeFi grew from less than \$1 billion to over \$250 billion in value locked in less than two years (May 2020 – Dec 2021).

Furthermore, while some are saying the GPU supply shortage [is over](#), demand is still up since pre-COVID-19 times, and there is a rising demand for GPU-intensive consumer applications like video streaming, and VR/AR, setting the stage for decentralized compute businesses to fill a potentially lucrative demand gap. Even if GPUs are not useful anymore on the Ethereum network following [The Merge](#) – which transitioned Ethereum away from GPU mining – they might be profitably repurposed in a new wave of decentralized compute networks. See [Mining section](#) for further information.

Projects like Livepeer (decentralized video streaming), Audius (decentralized music streaming), RNDR (decentralized GPU rendering), and Mediachain (decentralized data co-op) are leading the development of this emerging sphere of Web3. For example, Livepeer

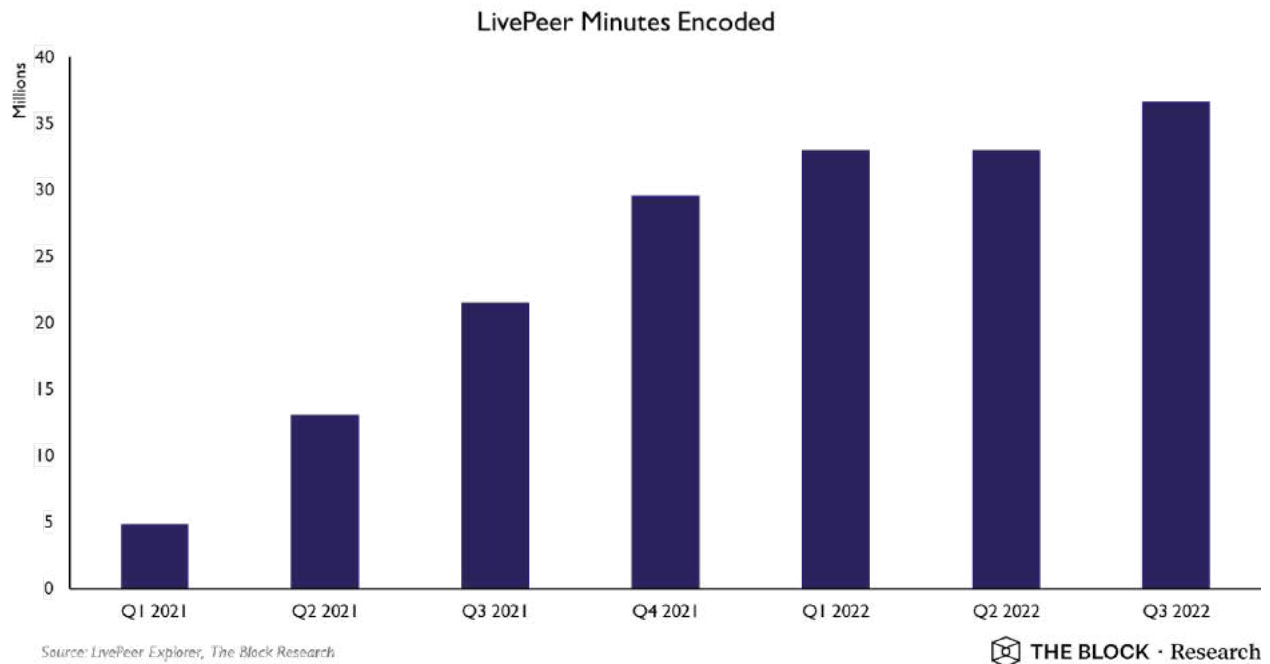


Figure 234: Minutes of video encoded by the Livepeer network
Source: Livepeer Explorer, The Block Research

saw a steady growth in the usage of its video transcoding service – even during this year’s market downturn, Livepeer network usage increased by 12% from Q2 to Q3 2022. Comparing Q1 2021 to Q1 2022, YoY network growth reached ~600%.

There are at least three major arguments for decentralized compute:

1. **Censorship Resistance** – A fully decentralized compute stack, including both file storage and GPU image rendering, does not have single points of control, such as centralized hosting providers that can arbitrarily shut down Internet services.
2. **Economic Opportunity** – Crypto networks can bring more resources (e.g., storage, GPUs) online by tapping into latent supply through P2P economic models like Airbnb or Uber.

3. **Open Composability** – The idea of reusable applications and a single or few global APIs enables mashups and interoperability that Web2 has eschewed. But, open-source code and sharing code freely and publicly has proven effective in making software development [faster and cheaper](#). Rapid innovation is supported by the capacity for anyone able to build applications on top of decentralized compute protocols and improve the core infrastructure.

That said, there is a question about costs, as trust-minimization in decentralization incurs additional overhead costs. For example, reliable storage requires paying for multiple backups, service providers have to post collateral to discourage bad behavior, and scaling transaction throughput while maintaining security and decentralization is [difficult](#). The use of open markets of service providers and network effects (e.g., aggregating

latent GPU capacity) can help drive overhead costs down.

Livepeer has been able to maintain attractive economics while being trust-minimized by focusing on transcoding live and on-demand video. Transcoding – the process of taking a raw video file and reformatting it for different viewing formats and bitrates – uses a [different and mostly idle part of GPUs](#). And currently, there are millions of GPUs already mining that could earn extra revenue from transcoding for Livepeer as well. Open market dynamics help drive Livepeer transcoding fees down [potentially lower](#) than AWS transcoding prices.

As Livepeer and other protocols employ latent GPUs scale, it will be important to track responsiveness and reliability. While Livepeer has seen [steady growth](#), the hours transcoded on its network (roughly ~2 million annually based on Q1 2022 estimates) is still a tiny fraction of the [500+ billion hours](#) of video being transcoded and streamed annually around the world. To increase throughput, Livepeer is working on a [fast verification procedure](#) to increase the efficiency of transcoding verification and dispute resolution over faulty transcoding. Such protocol upgrades and new infrastructure are needed to support a worldwide scale, where apps using Livepeer on the backend comprise potentially billions of users.

Social. This emerging area includes Mirror, a decentralized blogging platform that utilizes Arweave infrastructure to store data. All blog posts are available to access permanently on Arweave and are fully controlled by the author. Their site, Mirror.xyz, is one way to view this data in an organized way. So, if Mirror.xyz censors content or inserts paywalls, pop-ups, and so forth, users can simply switch to another client for viewing Mirror posts. Mirror also utilizes Ethereum

infrastructure, allowing authors to get paid in crypto, often to their ENS domain.

Lenster is a fully open-source social media app built with the Lens Protocol social primitives. Users who minted a Lens profile NFT can comment, like, share (“mirror”), and curate (“collect”) each other’s posts on the Polygon chain that Lens Protocol is built on.

Financial Services. Yearn offers a yield aggregator that channels users’ funds across DeFi protocols, including Compound, Aave, and Curve, to optimize returns. For trading, Matcha utilizes financial primitives, including Uniswap as well as many other DEXs across chains like BNB chain, Avalanche, and more. With smart order routing powered by 0x, Matcha finds the best prices across exchanges and merges them into one trade, helping users save time and reduce slippage costs.

Doors



Figure 235: Door layer under the DAPP framework of the Web3 stack

Source: The Block Research

At the top of the Web3 stack is the door layer – comprising the “connect and ingest” component of the Web3 stack. These are the applications, services, and infrastructure that enable access to Web3 activities. Collectively, they try to solve a three-pronged problem:

- A. How can data be brought efficiently from blockchains to applications?
- B. How can data be conveniently accessed across multiple blockchains?
- C. How to do A and B in a decentralized way?

Without the door layer, there would be no way to engage with any of the aforementioned applications

nor the primitives and protocols that they are built from. This is because a user or dapp must set up a connection to a blockchain network to use any of its data. There are three ways to [connect](#) to any blockchain network:

1. **Via a self-hosted node** – The user or dapp connects to the blockchain network through its own full node. This option requires understanding client software, client settings, and hardware environments (e.g., local or cloud). It also puts maintenance demands in the hands of the user or dapp. However, there are few benefits and many disadvantages for a developer to go this route. The [long-term costs](#) of operating and managing a node may be significant, and then there is the potential for lost revenue (and social capital) in the event of any downtime.
2. **Via a hosted node network** – A third party provides blockchain infrastructure and the know-how regarding access optimizations and security. This option offloads blockchain maintenance to the third party and can benefit from better responsiveness and reliability, but still runs the risk of service failures by that third party. One of the major advantages here is that centralized decision making by the hosting company can bring about faster shipping of advanced prototyping and development tools.
3. **Via a P2P node network** – The newest of the three options, there are now decentralized blockchain infrastructure providers like [Pocket Network](#) and Ankr that incentivize individuals to run full nodes for multiple blockchains. In this way, they can grow large P2P node infrastructure that benefits from increased

decentralization and potentially higher reliability with lower costs, while also offering the convenience and simplicity of hosted node networks.

To access hosted and P2P node networks, one must use remote procedure calls (RPCs) – a communications protocol in distributed computing that enables a procedure call in one place to run in a different place as if it were a local procedure call. RPCs are crucial for Web3 activity as they enable wallets and applications to talk with blockchains, [bridging](#) Web3 architecture with Web2 architecture.

Web2 vs. Web3 Architecture

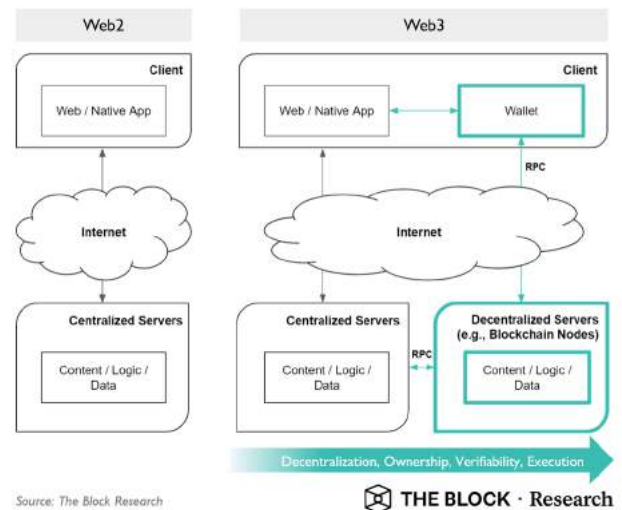


Figure 236: Web2 vs. Web3 architecture

Source: The Block Research

For example, the popular wallet MetaMask acts as a doorway to Web3 by providing a simple way to access the Ethereum network. It does this via RPC calls to an Infura-hosted node by default. Because ConsenSys is the third-party company that owns and operates all Infura nodes, the company could choose to censor this access route to Web3.

However, MetaMask can be set up with a custom network RPC, so if ConsenSys were to force access permissions, for example, the user could choose a relatively decentralized and permissionless network RPC like Pocket Network or Ankr. Nonetheless, note that both Pocket Network's and Ankr's off-chain distributor mechanisms are currently centrally operated.

Figure 237 shows a comparison between hosted networks and P2P node networks. It illustrates how the main difference between these two access configurations is about who owns and operates the blockchain nodes. That is, for hosted node networks, a single company typically controls these nodes, whereas, in a P2P node network, the nodes are controlled by a distributed P2P network of smaller servers.

After establishing a connection, one can start engaging with all sorts of Web3 applications, including DeFi, NFTs, P2E games, and more. If those applications require high bandwidth and frequent interactions with the underlying blockchain (e.g., a high-activity liquid DEX like dYdX or high-volume trading in a game like Axie Infinity), it is important that the infrastructure connecting wallets and application servers to blockchains is fast and reliable.

For example, in GameFi, there are both fully on-chain games like Dark Forest (all app logic kept on-chain), where every action triggers a blockchain transaction, and off-chain games with native exchanges for trading in-game assets like Axie Infinity and Aurory. The on-chain throughput requirements in these web-scale apps can be extremely large, so it is necessary for the access infrastructure handling the API request and responses to be scalable, responsive, and secure.

Furthermore, as P2E games require the player to first connect to a compatible wallet like MetaMask, we can expect that as the GameFi trend picks up speed, so will the adoption of these wallets and the usage of the access infrastructure they are connected to. It is no wonder, then, that the ecosystem of infrastructure providers has been proliferating to capitalize on this new Web3 trend and the opportunities it brings. We briefly touched on [three superapp platforms](#), including wallets, that are working on a better onboarding journey.

Hardware Centralization Issues

We have only seen glimpses of the potentially disastrous effects of hardware infrastructure centralization, where major dapps have gone offline due to outages from cloud service providers. For

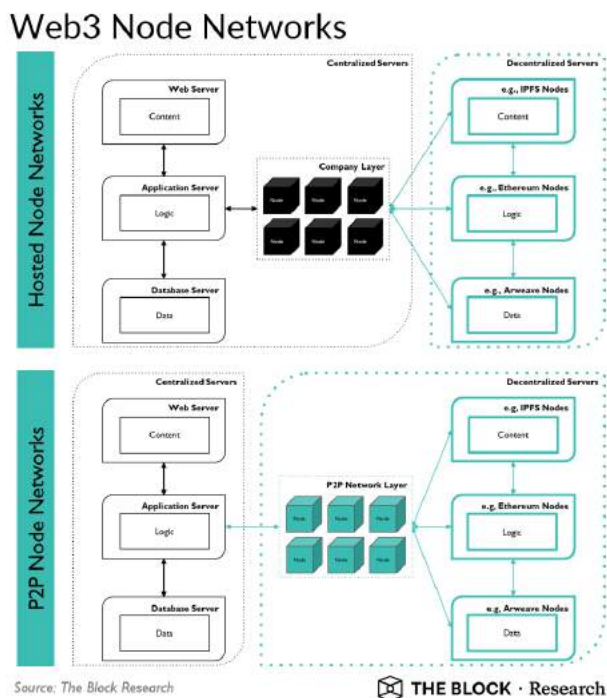


Figure 237: Web3 hosted vs. P2P node networks
Source: The Block Research

example, dYdX stopped working when some parts of its exchange infrastructure went down due to an AWS outage, preventing them from canceling potentially erroneous transactions. Similarly, Infura faced a [major outage](#) that caused delays in price feeds in late 2020, leading Binance and other exchanges to halt ETH withdrawals temporarily.

Nodes hosted by blockchain tooling services are thought to make up an appreciable percentage of all nodes in some networks. For example, a recent [study](#) concluded that three cloud providers (AWS, Hetzner, and OVH) represent nearly two-thirds of hosted nodes for Ethereum and Solana. Also, according to 2018 [estimates](#), Infura operated 5-10% of all Ethereum full nodes, servicing some 13 billion queries per day and supporting ~70% of the top Ethereum dapps.

Such cases highlight the importance of infrastructure distribution in the Web3 space to maintain a secure degree of decentralization, including both hosted and P2P node networks, as well as distributed computing across them. In the ideal case, all vital functions of a dapp would be supported by a distributed infrastructure that is unlikely to stop working all at once for any reason, be it technical failure, censorship, or service closure. In the event of an attack or technical breakdown, dapps would have emergency backup preparations in place to immediately remedy any loss of vital functions.

With regards to censorship resistance, it is also ideal for node infrastructure to be sufficiently decentralized to maintain a permissionless Web3 ecosystem. The RPC layer is particularly at risk of censorship, and therefore, dapps should be built out in a way that protects the RPC layer from any single entity controlling it.

Outlook on Web3 in 2023

The DAPP framework enables one to holistically assess how access to Web3 is instantiated and the variety of factors that impact relative levels of decentralization.

On the one hand, the newest trends in Web3 like gaming, streaming, and social media point to a future where achieving decentralized data access, operation, and storage is more challenging than ever. Decentralized infrastructure requirements for maintaining responsiveness and reliability for such web-scale dapps are a pressing challenge. And for developers, the cons of self-hosting their own infrastructure generally outweigh the pros.

On the other hand, there is a rich and expanding ecosystem of hosted infrastructure providers and P2P infrastructure networks developing to meet the market demand. No solution is perfect, with hosted infrastructure providers potentially creating single points of failure and other centralization concerns and P2P infrastructure networks lacking in terms of devops and tooling. However, both solutions have so far demonstrated excellent reliability under normal conditions.

With massive value stored and transacted in Web3, it is of utmost importance to find ways to ensure security while also maintaining decentralization and scalability – in other words, solving the blockchain trilemma. In the ideal case, the Web3 stack will be supported at all levels by an infrastructure cooperative, where hosted and P2P nodes support each other in blockchain access and operations.

Where infrastructure is most needed will depend entirely on which Web3 applications gain the most traction. For example, if popular Web3 apps demand

data availability and integrity of NFT metadata and hypermedia, there may be a significant increase in demand to access and use Filecoin/IPFS infrastructure and other decentralized storage solutions. If computation-intensive application spaces like GameFi and streaming keep gaining traction, we can expect demand for infrastructure that can handle greater loads responsively and reliably. The value or potential value to secure is also a major factor. For example, frequent low-value transactions of in-game items may prioritize infrastructure providing throughput over security, whereas high-value lending and borrowing transactions may prioritize security over throughput.

Storage and computation requirements will likely keep increasing globally. Current trends indicate accelerating digitalization on the horizon, as well as increased demands for 5G mobile communication, IoT devices and infrastructure, and metaverse and GameFi products. All of this points to a deluge of data with no end in sight that will demand not only more storage but also more and more sophisticated storage infrastructure.

For Web3 to flourish, the importance of meeting infrastructure needs cannot be overstated. While Web3's core activity happens at the level of basic protocols like Ethereum, these protocols need more than developers and crypto enthusiasts to thrive. They also need infrastructure providers to make it easier and more economical for both general consumers and enterprise users to ensure reliable and secure access to dapps.

Beyond providing technological support for foundational protocols, infrastructure providers also support a better Web3 experience. User experience is often seen as the final step for unlocking general mass adoption of Web3. Mass adoption would benefit

consumers and producers alike via increased revenue, liquidity, and networking effects – major drivers of the Web3 economy as a whole.

8

NFTs: 2022 Overview, 2023 Outlook

Thomas Bialek

NFTs: 2022 Overview, 2023 Outlook

Thomas Bialek

A look at the NFT market, its marketplace landscape, as well as the core themes that impacted its overall development.

Quick Take

- 2022 has been a seminal breakthrough year for NFTs that was marked by record-breaking growth rates, as well as devastating crashes.
- The Ethereum ecosystem skyrocketed to a monthly NFT trading volume of \$5.6 billion, while the Solana ecosystem temporarily chipped away at Ethereum's dominance, peaking at 47.2% market share by trading volume.
- The royalties debate unearthed a fundamental predicament for creators and will require major business model pivots.

State of NFTs in 2022

In 2022, the NFT market ran the gamut of emotions, swinging frantically from irrational exuberance to the depths of despair in the span of a few feverish months. Euphoria, greed, and delusion were all part of the explosive cocktail that made 2022 a seminal breakthrough year for the nascent industry.

From being touted as the ultimate safe haven asset class to the Otherdeed making a dent in the Ethereum universe to clashing worldviews in the quest to disentangle the royalties dilemma, NFTs took a

tumultuous rollercoaster ride this year. However, this series of events has only scratched the surface of what might be possible in the future, acting as a dress rehearsal for large-scale adoption on the grand stage of the world.

After the plug was pulled on liquidity in the second half of the year, mainstream adoption was unmasked as a mirage – vestiges of an ideal that appeared tantalizingly close yet eluded the grasp of the industry. Meanwhile, the industry saw a structural metamorphosis unfold in front of its eyes that decisively affected marketplaces while forcing creators to adapt their business models to the shifting sands of the market.

General Market Overview

While the unprecedented explosion in use cases for NFTs in 2021 acted as a fertilizer for the entire industry, this year perfectly dovetailed with this evolution by providing the optimal breeding ground for accelerated growth. In this vein, experiments that were initially cultivated in the petri dish of Web3 escaped their echo chambers and [spilled over](#) into the public awareness.

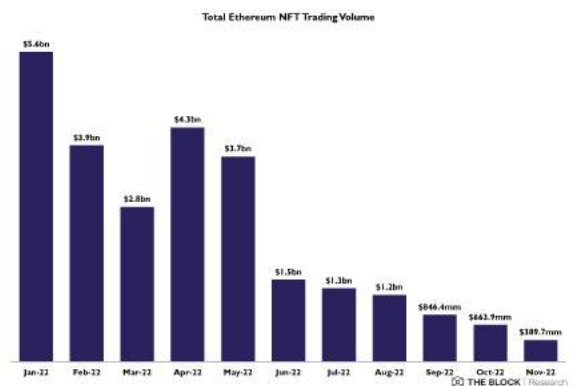


Figure 238: Monthly Ethereum NFTs trading volume in 2022

Source: The Block Research

In part, this development was reflected in the trajectory of the NFT trading activity throughout the year. Namely, in January, the monthly NFT trading volume on

Ethereum reached a record-breaking high of \$5.6 billion, 33.8% higher than its previous ATH. However, in June the market cratered, registering a 60.1% month-on-month (MoM) decline in NFT trading volume, and has since then continued to slide.

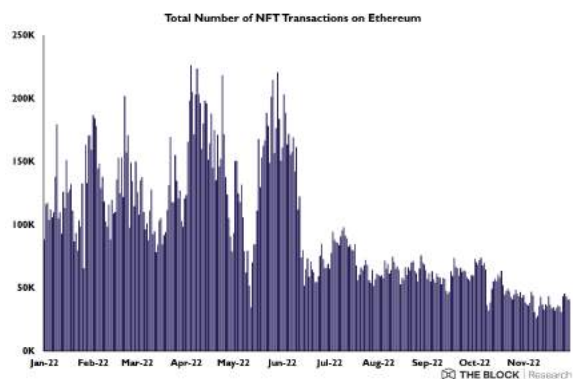


Figure 239: Number of daily NFT transactions on Ethereum in 2022
Source: Dune Analytics (@hildobby)

Likewise, the number of daily NFT transactions on Ethereum plummeted to 40,345, down 82.2% from its ATH in April.

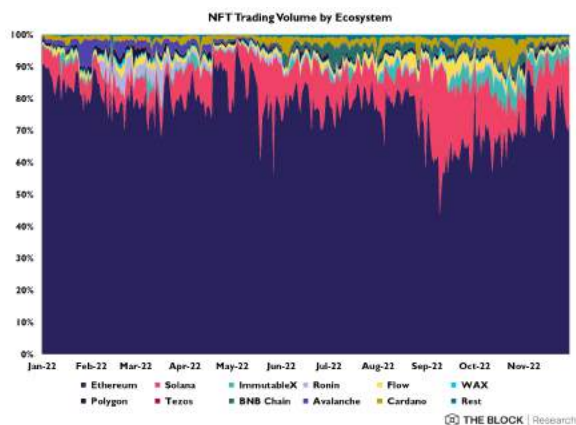


Figure 240: NFT Trading Volume by Chain
Source: CryptoSlam

In general, this trend is mirrored by other ecosystems as well, but throughout September, Solana NFTs experienced a renaissance that underscored their relative strength, resulting in a temporary market share of 46.2%. Notwithstanding the transient impact of this

comeback, Ethereum defended its title as the undisputed champion of NFT liquidity thus far, sitting at 72.5% market share as of this writing.

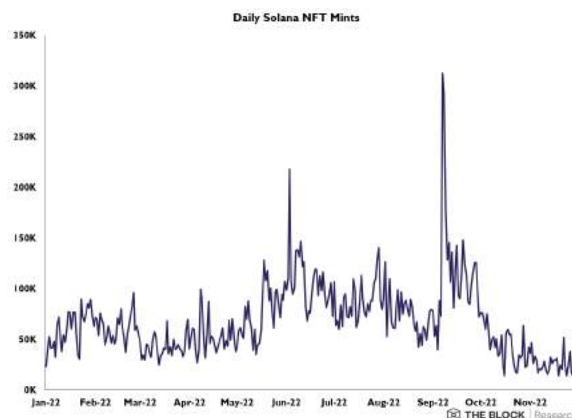


Figure 241: Daily Solana NFT mints in 2022
Source: The Block Research

The rise of Solana NFTs in September was in part driven by a sudden bout of new mints. Mainly fueled by the long-awaited launch of y00ts, the number of Solana NFT mints spiked to an ATH of 312,375, marking a 295.4% increase WoW.

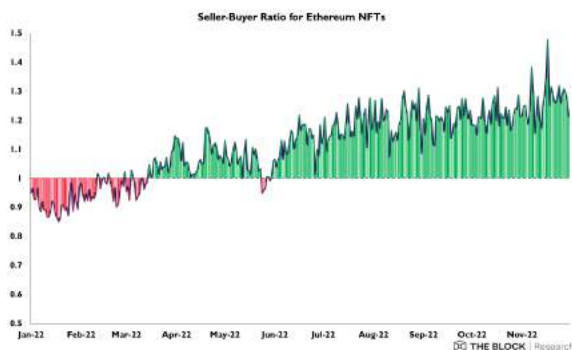


Figure 242: Seller-buyer ratio for Ethereum NFTs in 2022
Source: Dune Analytics (@hildobby)

At the same time, the market's behavior was decisively swayed by an evolving interplay between NFT buyers and sellers. In fact, the equilibrium that prevailed at the beginning of the year has since transformed into a buyer's market, with the unraveling market downturn in the second half of this year tipping the scales in

buyers' favor. On top of this, the recent FTX implosion further spurred this downward spiral, playing into the hands of buyers.

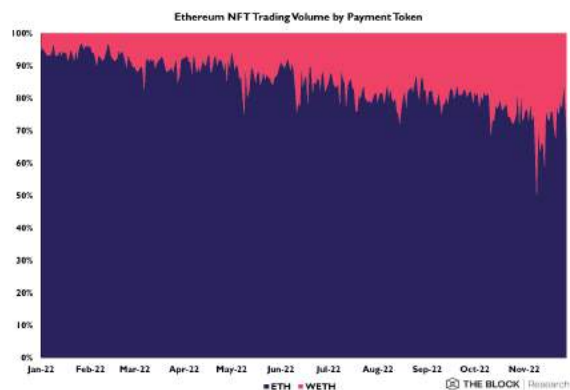


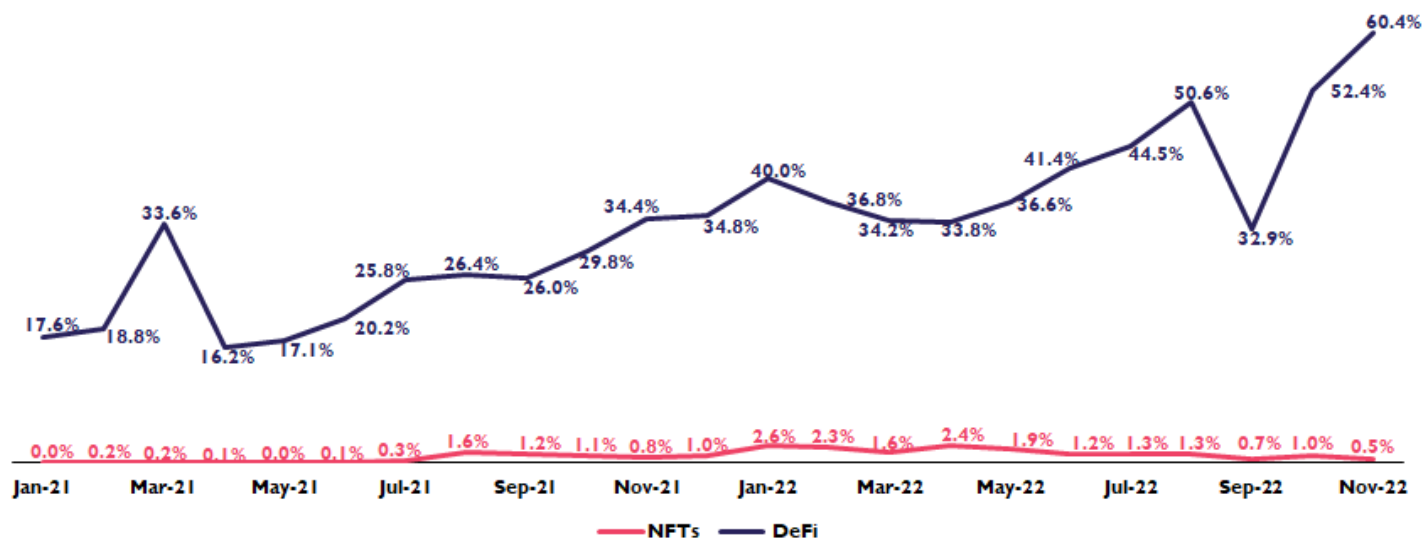
Figure 243: Ethereum NFTs trading volume by payment token in 2022
Source: The Block Research

In the wake of the mass hysteria that swept through the market following the FTX insolvency, NFT traders were also infected with the contagion of this debacle, which manifested itself in the skyrocketed percentage of

accepted WETH offers on OpenSea. Traditionally, the share of accepted WETH offers has served as a barometer of the market's urgency in seeking liquidity and, by extension, of a panic-fueled market carnage. Following on the heels of a consistent uptick, the percentage of accepted WETH offers jumped to a seminal 50.8%, as traders rushed to scrape together every penny.

Although NFTs have made a significant splash this year, the industry vertical remains a small cog in a large wheel for now, considering its relative impact on the wider crypto sphere. When measured against the total trading volume on Ethereum, the NFT trading volume accounted for merely 2.6% in January, which coincided with its ATH. By contrast, the NFT sector is still significantly overshadowed by DeFi, which contributed as much as 60.4% to the total trading volume on Ethereum this year.

Percentage of Total Ethereum Trading Volume by Sector

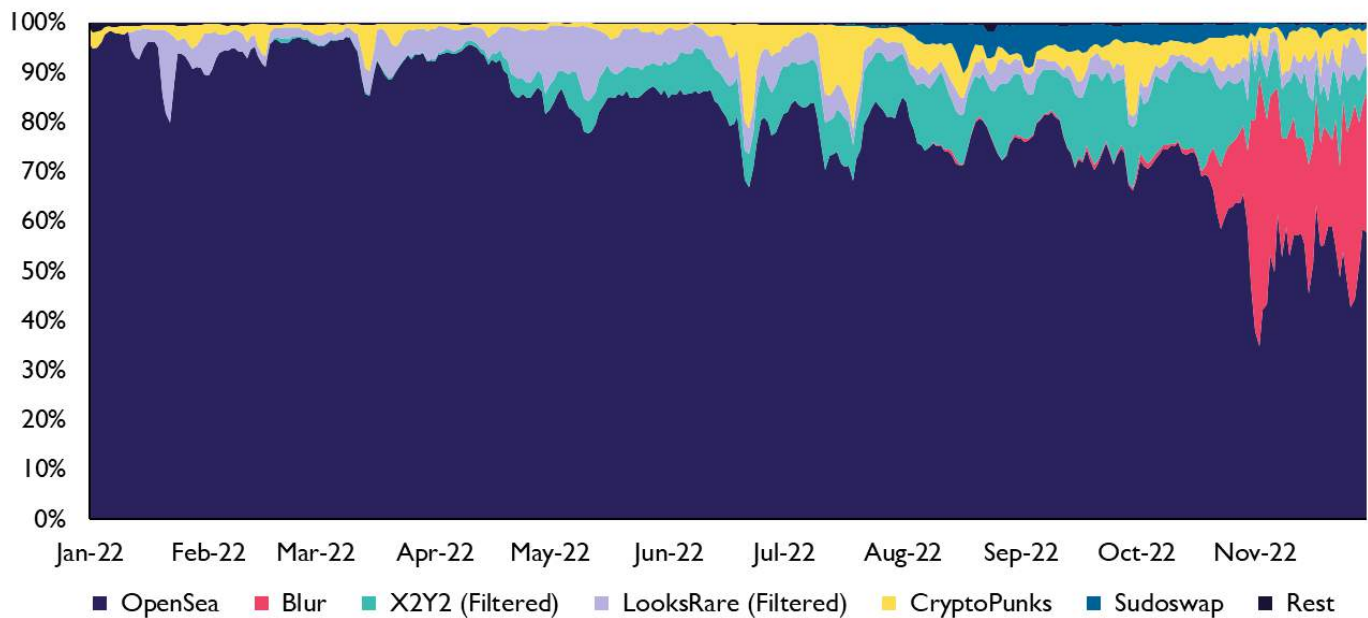


THE BLOCK | Research

Figure 244: Percentage of total Ethereum trading volume by sector in 2022
Source: The Block Research, DefiLlama

NFT Marketplace Landscape

Ethereum NFT Trading Volume by Marketplace



THE BLOCK | Research

Figure 245: Ethereum NFTs trading volume by marketplace in 2022

Source: Dune Analytics (@cryptuschrist, @hildobby, @ilemi, @sealaunch)

In a whirlwind of changes, the ensemble of existing NFT marketplaces were rocked by major structural shifts. Although a plethora of emergent properties, such as token incentives, have been harnessed by NFT marketplaces, such as LooksRare, X2Y2, or Blur, this year, they only constituted the tip of the iceberg. More importantly, a race to the bottom governed by a pervasive dog-eat-dog mentality spurred a cutthroat competition among the contending NFT marketplaces.

Therefore, undercutting tactics in combination with creator royalty circumvention, which initially was mostly deployed by upstarts, allowed these competitors to siphon off enormous amounts of liquidity from OpenSea. Taken together, OpenSea's façade of impenetrable hegemony started to crack

amidst a relentless flood of fierce competitors that went to great lengths to take over the reins.

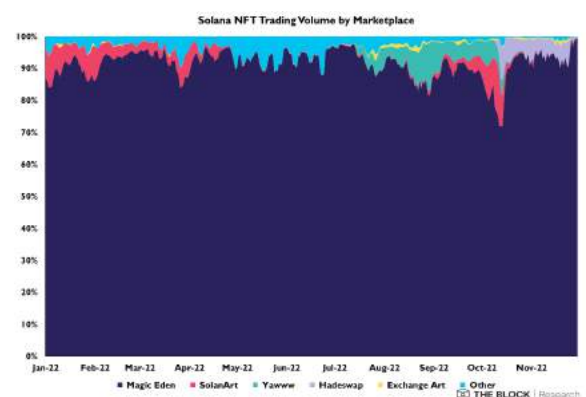


Figure 246: Solana NFTs trading volume by marketplace in 2022

Source: The Block Research

By the same token, Solana NFT marketplaces suffered the same fate, albeit to a lesser extent. As a

consequence of the rise of the zero-fee marketplaces Yawww, Hadeswap and Solanart, Magic Eden's dominance appeared to be temporarily at risk, but the blow was cushioned after the giant [retaliated](#) against the metastasizing market practices by cutting its fees as well. As a result, it managed to recoup market shares, bouncing from a low of 71.9% to 99.6% as of this writing.

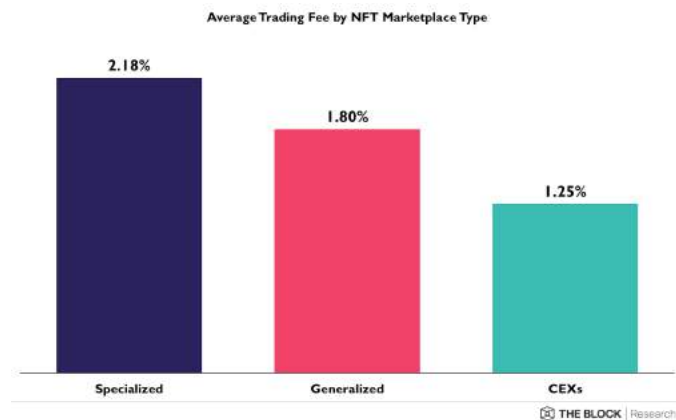


Figure 247: Average trading fee by NFT marketplace type
Source: The Block Research

Furthermore, trading fees was a prickly issue that set the tone for the future of NFT marketplaces by enshrining cost leadership as the ultimate goal in the central tenets of these infrastructure providers. Despite this lingering threat, NFT marketplaces already adapted their trading fees to their market segments.

On average, proprietary marketplaces that are tailored to the specialized needs of specific niches, such as those integrated into virtual worlds like The Sandbox, tend to levy the highest trading fees. On the other hand, CEXs seem to be able to tap into their enormous resource pools to leverage their economies of scale to reduce fees.

As the brewing price war intensified, many NFT marketplaces threw the baby out with the bath water

by not only slashing trading fees entirely but also disregarding creator royalties to gain a competitive edge.

Summary of Core Themes in 2022

In the constant tug of war for lasting relevance between various ecosystem participants, the speed of innovation continues to accelerate. As a result, the market has churned out major developments that dictated the direction of the industry. As such, new advancements entered the stage while ossifying industry structures perished.

Creator Royalties in Jeopardy

The divorce of NFT marketplaces from royalty payments sparked a heated debate about the ideological underpinnings of the industry, which soured the formerly symbiotic relationship between creators and marketplaces. Due to the lack of sustainable options to technically enforce royalties on-chain on the project level without concomitant drawbacks that stymie decentralization, many creators are ousted from their positions of power.

In turn, NFT marketplaces morphed into central gatekeepers for royalty payments. Since creator royalties cannot be hardwired into smart contracts on the project level without significant workarounds, unaware creators sleepwalked through their NFT journeys. Originally jumpstarted by SudoAMM, an avalanche of NFT marketplaces suddenly scrambled to bypass royalties or, at the very least, make them optional for the purpose of remaining competitive.

This environment has functioned as a springing board for upstart marketplaces seized market shares by

primarily catering to the needs of traders instead of creators. Although traders can voluntarily honor royalties on most marketplaces, this option did not move the needle in terms of boosting the average royalty fee paid on these platforms.

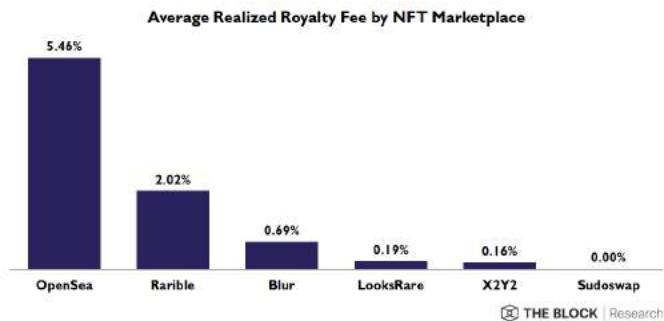


Figure 248: Average realized royalty fee by NFT marketplace
Source: Flipside Crypto (@jacktheguy)

OpenSea, which remains the last man standing in the battle for mandatory royalty payments, realized an average royalty fee of 5.46% for the present year. Unlike its competitors, OpenSea has gone out on a limb to reinstate its monopoly by means of punitive measures in the form of blacklisting marketplaces that intentionally bypass royalty payments.

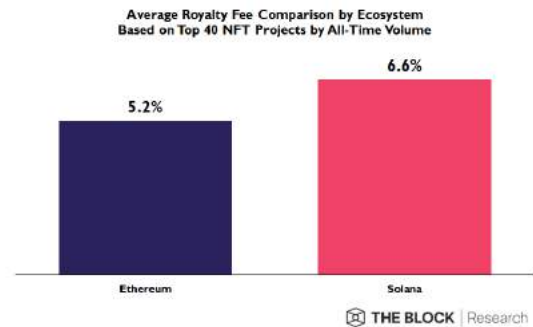


Figure 249: Average royalty fee comparison by ecosystem
Source: The Block Research

Barring OpenSea, the actual average royalty fee on various NFT marketplaces has been significantly below the average royalty fee that the top 40 projects on Ethereum would have commanded.

Interestingly, contributions from the tail ends of the royalty fee spectrum closed in on the middle ground, as paid royalty fees of both 0.0% and 10.0% or higher increasingly gained a foothold in the market. Especially since early August, the percentage of the zero-royalty trading volume jumped from 2.8% at the start of the year to 29.9% as of this writing.

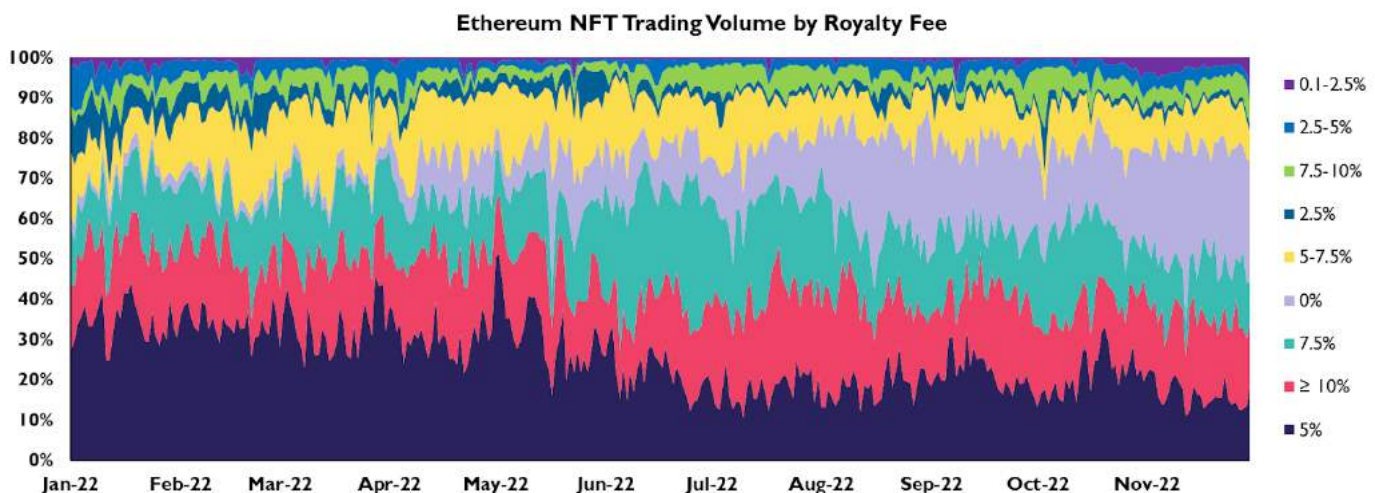


Figure 250: Ethereum NFTs trading volume by royalty fee in 2022
Source: Flipside Crypto (@rmas)

In pursuit of liaising between creators and traders, Blur devised a token incentive scheme that aims to disproportionately reward traders that voluntarily honor royalties. On the other hand, X2Y2 already backpedaled on its optional-royalty policy by reintroducing royalties as the imperative backbone of creators' monetization apparatus.

On that score, OpenSea doubled down on its endeavor to enforce royalties on-chain by means of its tool that excludes royalty-circumventing marketplaces from trading the NFTs implementing the tool. In response to this seismic shift, a couple of NFT projects already begun to reduce their dependence on the passive revenue stream of royalties.

For instance, Azuki dabbled with physical luxury goods already afforded the company an additional revenue pillar. Championing protocol-owned liquidity for NFTs, Nouns created an alternative solution that is immune to revolts against royalties and thus could perhaps enjoy greater adoption over time.

Consolidation of Market Power

Yuga Labs has proliferated into an omnipresent force to be reckoned with that turned it into an operation of epic proportions. Underscored by its acquisition spree, the juggernaut parlayed a few strategic investments into a colossal conglomerate that today encompasses a great deal of blockbuster IPs. Most prominently, its acquisition of the seminal CryptoPunks and Meebits IPs back in March shook the entire industry at the time and effectively allowed Yuga Labs to assimilate its main competitor into its growing empire.

Rounding out its expansion, the NFT giant recently acquired Wenew, the startup behind the 10KTF universe, which was co-founded by Beeple. Overall, this

reinforced the idea that Yuga Labs has the Midas touch, considering its unparalleled ability to continuously emerge as the ultimate kingmaker of NFT brands.

As a result, Yuga Labs managed to consolidate market power by boosting its total market share from 33.3% at the beginning of the year to a peak of 69.6% in early May. As it stands, the downstream effect of these brand unification efforts that aim to merge the incubated and acquired IPs under the umbrella of Yuga Labs could enable the market leader to harness operational synergies to deliver enhanced content over time.



Figure 251: Yuga Labs market share by trading volume in 2022

Source: Dune Analytics (@cryptuschrist, @sealaunch)

Golden Goose

Airdrops have been an essential instrument for informing the growth strategies of many NFT ventures this year. In essence, airdrops acted as a major catalyst for bolstering community engagement while nudging community members into becoming fervent brand evangelists. In the wake of an airdrop bonanza, many community members doubled down aggressively on the airdrop-issuing brand, given their heightened financial interests.

Moreover, it allowed NFT buyers to redeem a large chunk of their original investments that flowed into the genesis collections. For instance, the Banz airdrop

equaled 36.4% of the Azuki floor price at the time of the windfall. Considering that many holders minted their Azukis for fractions of the floor price at the time, the Beanz airdrop compensated for multiples of their incipient investments.

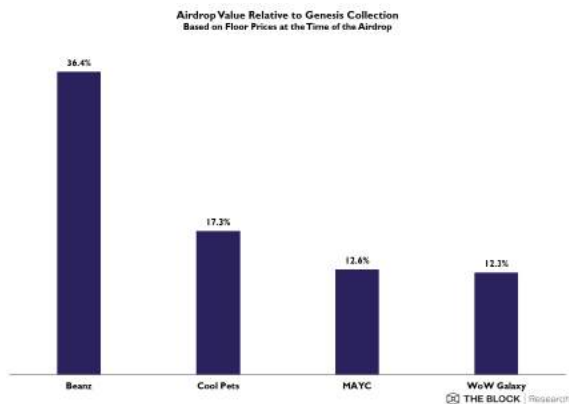


Figure 252: Airdrop value relative to genesis NFT collection
Source: Dune Analytics (@cryptuschrist)

On the flipside, the conundrum of this growth initiative is that it inevitably attracts masses of free riders who exploit this loophole by purchasing the genesis NFTs exclusively for the purpose of skimming off airdrop profits before immediately disposing of the NFTs again. As mercenary market participants progressively gravitate toward these communities, this can quickly become a slippery slope because projects forgo crucial revenues by gifting the airdropped NFTs to their communities, which invalidates the main purpose of this initiative, that is, fostering sustainable brand growth.

In the noisy reality of the bull market, enriching community members through airdrops was a celebrated way to vie for scarce attention. However, eventually the music stopped and the frenzied airdrop mania came to a screeching halt, coinciding with doubts about the sustainability of this tactic. Slowly but surely, the market came to realize that airdrops form a fine line between diluting the underlying brand and

authentically rewarding loyal supporters. In a sense, the pioneering collections paving the way for airdrops to become the norm have been reminiscent of a golden goose until insatiable greed eventually took over.

Uncoupling of Generative Art

Although the NFT market has been gripped by a widespread liquidity crisis since early May, generative art NFTs managed to defy this grim market environment by spinning off a thriving parallel universe. In particular, the Art Blocks curated series was able to weather the storm in spectacular fashion.

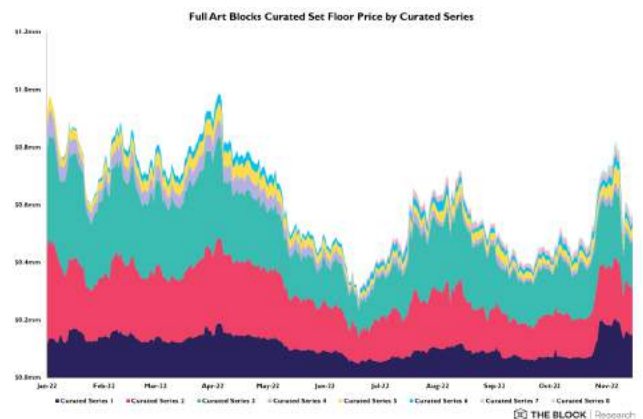


Figure 253: Full Art Blocks curated set floor price by curated series in 2022
Source: Dune Analytics (@rantum)

In this regard, full Art Blocks curated sets solidified their position as indispensable status symbols for generative art connoisseurs. After the original curated series' discontinuation announcement, a race of prominent art collectors to secure full curated sets suddenly steered the overall market behavior, resulting in an explosive price rally. As of this writing, the floor price for a full curated set decreased to \$567,900.

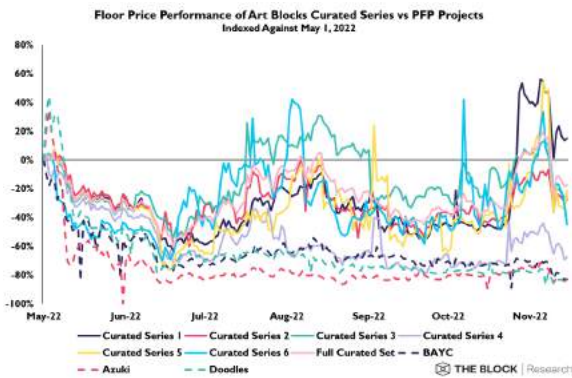


Figure 254: Floor price performance of Art Blocks curated series vs PFP projects since May 1, 2022

Source: Dune Analytics (@rantum)

From a valuation perspective, Art Blocks curated series averted the vicious floor price crunch that plagued the profile picture (PFP) vertical since the beginning of May. While the BAYC floor price plummeted by 82.2% during this period, the first curated series climbed by 14.9%, notwithstanding the FTX insolvency and the subsequent mayhem.

Interestingly, the remarkable resilience that Art Blocks demonstrated in recent months was dwarfed by the stellar rise of the Fxhash ecosystem. Hence, the uncoupling effect that has already been presaged by Art Blocks has dictated the direction of Fxhash collection even more strongly.

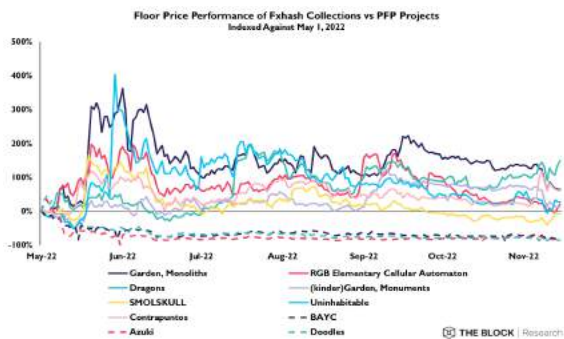


Figure 255: Floor price performance of Fxhash collections vs PFP projects since May 1, 2022

Source: The Block Research, Fxhash, Dune Analytics (@rantum)

In fact, the floor price for William Mapan's Dragons skyrocketed by a staggering 149.5% since May 1 while those of other popular collections jumped by at least 12.1% as well. By and large, it appears that generative art NFTs managed to shrug off major economic headwinds that hampered price recovery in other corners of the NFT market.

Storytelling NFTs

Integral to their tribal nature, storytelling has long been the lifeblood of organic growth in NFT communities. Although the cultivation of community lore to construct a comprehensive brand architecture has been part and parcel of growth strategies in the NFT market, it has traditionally taken a back seat in light of the preponderance of utility-focused roadmaps. By the same token, fabricated narratives often have been deployed as a smokescreen to mask a lack of concrete fundamentals.

However, a new breed of NFT ventures has repurposed storytelling by weaving interactive elements into a slowly unfolding narrative arc. Contrary to their predecessors, which mainly adopted storytelling as a means to foster brand acceptance, storytelling NFTs envelop their entire value proposition in dynamically evolving narratives.

In fact, crafting stories is their core value proposition. Hence, instead of applying this aspect only sparingly, an interactive storyline is used to steward community members to the mint event before any NFTs are even in existence. Completely shrouded in mystery in the beginning, details about a project are incrementally unveiled by embellishing a story on social media. Therefore, the main value accrual originates from a combination of cultural relevance and storytelling that stretches over a project's entire lifecycle.

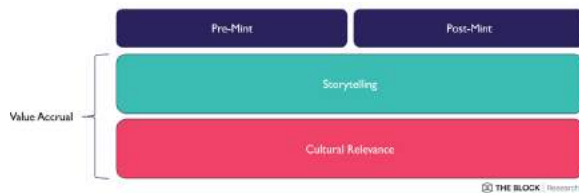


Figure 256: Value accrual model for storytelling NFTs

Source: The Block Research

At the forefront of this paradigm, Azurbala and Renga pushed the envelope of storytelling NFTs. Incubated by Web3 media startup Tally Labs, Azurbala is an outgrowth of the Jenkins the Valet universe. Originally commemorating the ecosystem's first book release, Bored and Dangerous NFTs serve as the entry ticket into the world of Azurbala. In exchange for Azur Roots, which will later be convertible to Azurian avatars, holders will be able to burn their digital books.

Alternatively, holders will be able to stake them to receive governance tokens in Hawthorn, a DAO embedded in the Azurbala ecosystem. On the downside, Azurbala highlighted that this interactive approach can be a double-edged sword that is prone to volatile market reactions. After a sneak peek of the Azurian art surfaced, the project faced an enormous backlash due to the community's discontentment with the perceived quality of the art.

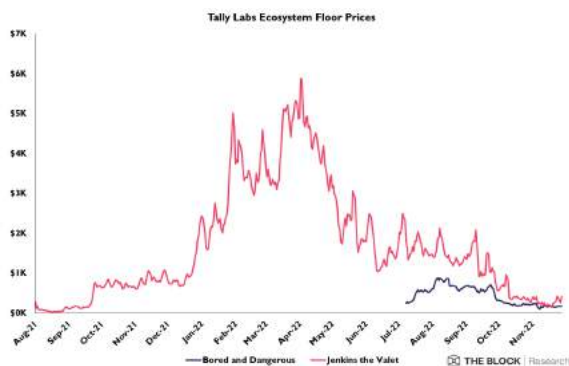


Figure 257: Tally Labs ecosystem floor prices since August 2021

Source: Dune Analytics (@cryptuschrist)

This controversy was immediately reflected in the floor price, which tanked by 72.9% since the event. To make amends for its backfiring creation of the Azurian art, the team took the criticism to heart and initiated an art council and a community council, which will collectively overhaul the existing Azurian art.

Renga has been another pivotal pacesetter in this domain that has taken the market by storm. Constituting the brainchild of artist Daniel Isles – who is otherwise known as Dirty Robot – Renga has been built on the back of Dirty Robot's The Art of Seasons (TAOS) NFT collection.



Figure 258: Unrealized profit and loss of TAOS minters in 2022

Source: Dune Analytics (@cryptuschrist)

In June, TAOS holders were airdropped Black Box NFTs, which, by means of a manga that detailed the backstory of the Renga universe, breathed life into the enigmatic black objects. In September, Black Box holders finally had the opportunity to burn their NFTs for Renga avatars. Consequently, this slow-and-steady reveal process set the stage for the development of a storytelling powerhouse, which has been extremely lucrative for minters of the TAOS NFTs thus far.

War on IP Rights

Colliding opinions on commercial rights granted to NFT holders have fractured the industry this year. At first

glance, this clash of commercialization strategies appears to rest on differing copyright approaches but actually runs deeper than that. In reality, this debate has been symptomatic of the deeper discussion about the ethos of crypto in the context of NFTs. Generally speaking, NFT projects can be plotted on a spectrum between Creative Commons Zero (CC0) and no commercial rights granted to NFT holders.

Notably, Nouns released its IP into the public domain by championing CC0, which means that everyone can commercialize the brand's IP as well as the IPs of individual Noun NFTs without any restrictions. On the opposite end of the continuum, a very restrictive approach prevents outside actors, including NFT holders, from using the IP for commercial purposes. Consequently, this has pitted NFT communities pertaining to one of the two opposing camps against each other, which resulted in a polarizing discussion.

Despite the fact that this intellectual dissonance finally culminated in a heated public debate, the writing for this trend has been on the wall for quite some time. More precisely, once-ardent CryptoPunks aficionado 4156 declared that he jumped ship due to irreconcilable differences regarding Larva Labs' tight grip on IP rights at the time.

By contrast, Yuga Labs has, for the most part, taken a goldilocks approach to this topic by guarding the BAYC brand from external use while granting holders commercial rights for their individual NFTs. On the basis of this regime, a vibrant economy of businesses built around Bored Apes blossomed. To encourage a similar growth for CryptoPunks and Meebits post-acquisition, Yuga Labs enacted copyright policy reforms that closely resemble its approach for BAYC.

Free Mint Mania

In the fallout from the NFT market meltdown, free mints emerged as the unambiguous North Star, guiding market participants toward a reimagined business model that was tailored to the changing market conditions. At a high level, the reason for the advent of this trend has been twofold. First, its opportune timing made market participants more receptive to this market dynamic. At a time when the entire range of blue-chip projects was in free fall, the idea of minting an NFT at the mere cost of transaction fees was extensively embraced.

Secondly, this development followed in the footsteps of the market growing tired of the entrenched way of drumming up support for NFT launches, namely by means of roadmaps. This systemic roadmap fatigue was mainly driven by a torrent of projects that over-promised and under-delivered, leading to the gradual corrosion of the established playbook. Born out of this frustration, free mints started to take root as the preferred way of distributing new NFTs.

In the same vein, advocates of this *modus operandi*, by necessity, shifted their top line growth from a combination of primary and secondary revenue streams to an exclusive focus on secondary revenue. To be exact, many free-mint projects zeroed in on maximizing their royalty revenues by setting royalty fees that pushed the boundaries of the upper end of the fee range.

Trailblazing the free mint evolution as the movement's poster child, GoblinTown managed to outpace many popular NFT projects in terms of royalty earnings due to its royalty fee of 7.5%, amassing an enormous war chest despite the absence of any primary revenue.

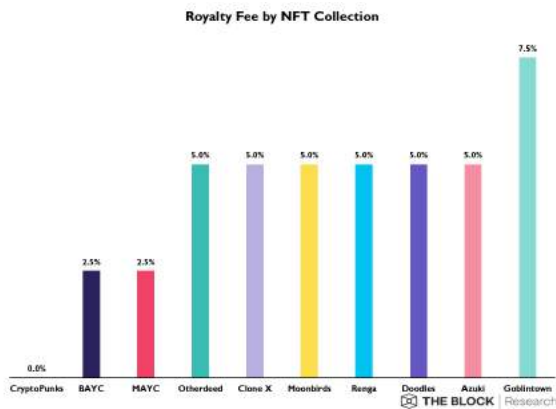


Figure 259: Royalty fee by NFT collection

Source: The Block Research

Mechanism Design

Powered by the versatility of NFTs, innovation has percolated into many facets of the market. Nonetheless, this progress primarily pertained to the cultural domain while the evolution of mechanisms stalled, as existing concepts were regurgitated. In general, there has been a dearth of originality on the mechanism design front.

The notable exception of this trend has been Art Gobblers, which tinkered with cutting-edge techniques to institute an NFT ecosystem. Created by investment firm, Paradigm, and Rick and Morty's co-creator, Justin Roiland, Art Gobblers is an experiment that blends an on-chain game with an art factory. At its core, Art Gobblers is predicated on the notion of tapping into the potent flywheel effect that arises at the intersection between art, cultural relevance, and commerce.

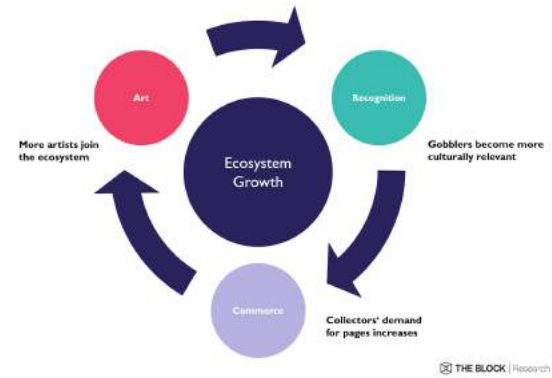


Figure 260: The flywheel effect of the Art Gobblers ecosystem

Source: Art Gobblers whitepaper

In addition, Art Gobblers is a treasure trove of new mechanisms that aim to kickstart a self-feeding ecosystem. In a nutshell, this system is bound together by Gobblers, Blank Pages, and GOO. The key objectives of Gobblers are to eat artworks and produce GOO.

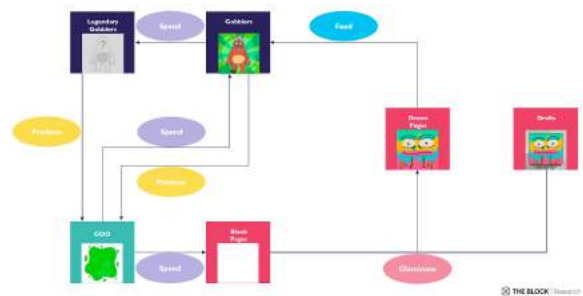


Figure 261: Overview of the Art Gobblers elements

Source: Art Gobblers whitepaper

For the purpose of immortalizing their artworks, users need to “glamine” their creative outputs, which refers to the process of spending the utility token GOO to immutably store artworks on blank pages. Conversely, finalized artworks can be fed to Gobblers, which will display them in their bellies as part of a modern-day art gallery. On top of this, Legendary Gobblers can be summoned by sacrificing ordinary Gobblers.

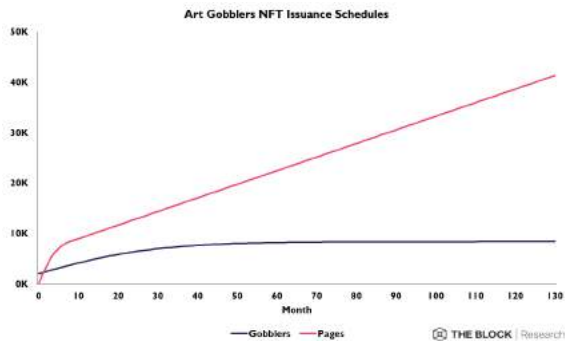


Figure 262: Art Gobblers NFT issuance schedules

Source: Art Gobblers whitepaper

Beyond the basic parameterization of the core components, users are forced to take the issuance rates of the ecosystem resources into account. To tailor the issuance rates to the changing demands of different growth stages, the issuance rates of Gobblers and Blank Pages are governed by logistic issuance schedules, which enable an explosive supply increase in the beginning while flattening off over time to prevent an excessive supply inflation.

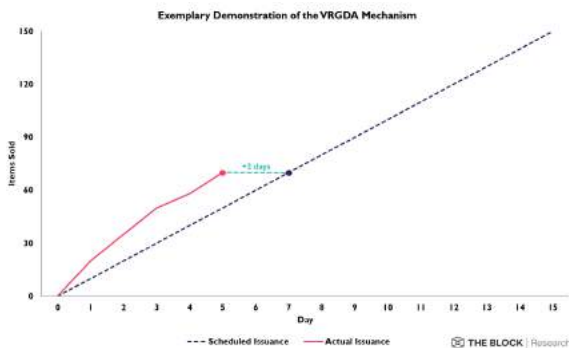


Figure 263: Exemplary demonstration of the VRGDA mechanism

Source: Art Gobblers whitepaper

Another piece of the puzzle is the concept of variable rate gradual Dutch auctions (VRGDAs), which allow for the customization of issuance schedules based on forecasted community growth trajectories. In short, VRGDAs fine-tune NFT prices based on deviations from a predetermined mint schedule by letting the issuance rate approximate the designated mint schedule over time. Based on an exponential curve that re-adjusts the

price multiplier by collating the realized mint schedule with the planned one, the daily mint rate constantly auto-corrects for the delta to stay on track.

Outlook on NFTs in 2023

Convergence of Gaming and NFTs

The pantheon of popular PFP projects has dedicated a substantial amount of its energy to laying the groundwork for an interoperable metaverse. Evidence for this trend has piled up over this year, as a diaspora of NFT tribes into siloed metaverses has taken place.

Otherdeed, Space Doodles, and Cooltopia, to name a few, are likely only the tip of the spear of an upcoming wave of gamification that will enable those capable of mastering this complex storytelling skill to cross the chasm between bleeding-edge innovation and mass adoption. As the pace of this development accelerates, the eventual triumph of one metaverse over all the others might raise the cardinal question of whether the imminent metaverse is truly decentralized.

The Great Filter

If 2021 has been the year of birth of many PFP dynasties, then 2022 has been the year of empire-building and, by extension, 2023 will likely become the year of falling empires, which will be a litmus test of which venture can stand the test of time. Assuming a prolonged crypto winter, the market might progressively prune startups that exhaust their remaining funds and are unable to kick into high gear to offset eroded revenues.

Although the market has already washed out a large chunk of ventures in the aftermath of this year's crash,

the looming era of austerity will separate the wheat from the chaff, as a non-negligible percentage of the remaining survivors disappears from the scene. While a few players will ascend from the ashes and cement their battle-hardened existence, others will not make the final cut.

Only the Paranoid Survive

Considering the barrage of landmark changes, NFTs moved in seemingly fast motion through the entire industry life cycle within the span of one year. As part of this explosive takeoff, the business acumen of many companies were undermined while critical decisions fell through the cracks.

On closer inspection, the market showed signs of complacency, which was further exacerbated by having to confront a strategic inflection point in the form of vanishing creator royalties paired with a cutthroat race to the bottom. This has not only posed an existential threat to creators but has also challenged the status quo of the incumbent marketplaces. OpenSea, specifically, saw its dominance dwindle rapidly, as masses of traders swarmed to royalty-circumventing marketplaces.

As a consequence, this raised the question whether the industry giant might become a victim of its own success, apparently unable to turn the tide. However, it began to retaliate against this attack by signaling a potential business model pivot. Likewise, NFT projects were stalemated as well, forcing them to think outside the box to break the deadlock of this battle through novel monetization avenues. What got them to point A will likely not get them to point B and beyond. Therefore, like Jazz musicians practicing improv, NFT projects will need to attune themselves to spontaneous

shifts in the competitive dynamics of the market and experiment with new initiatives on the fly in order to extricate themselves from this precarious situation.

Rebranding Attracts Big Brands

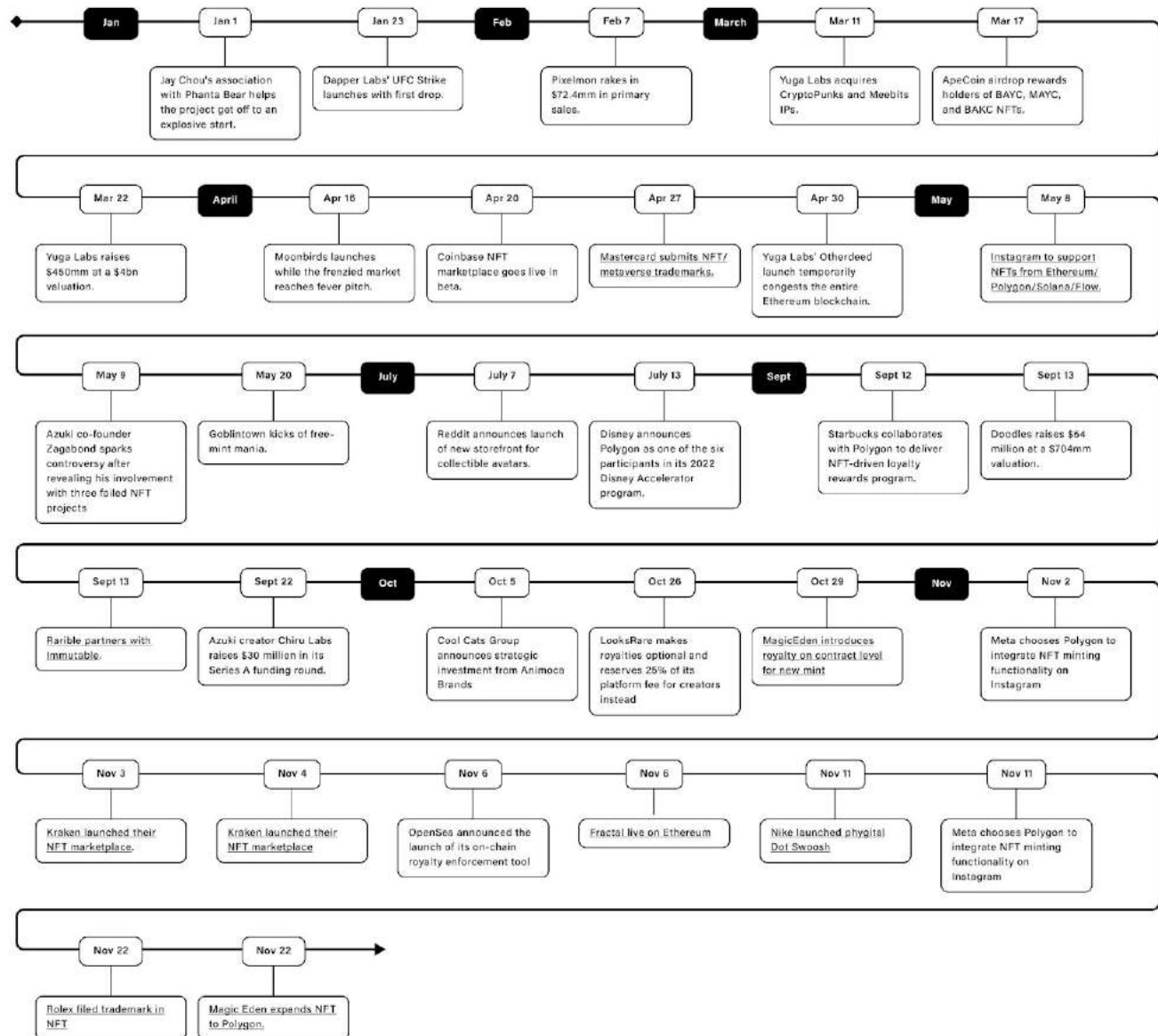
As a corollary of the phenomenal attention that NFTs garnered this year, big corporations plucked up the courage to dip their toes in the water. Household names such as Nike and Adidas strengthened their efforts to expand the scope of their Web3 operations and marshaled massive resources to become a staple of the industry. For instance, just recently, Nike rolled out its Web3-focused platform .SWOOSH which strives to become the focal point for the future of digital creations in the sport domain. In combination with its RTFKT acquisition, Nike bolstered its position in the nascent market by nurturing a native Web3 community through its diverse product range. Interestingly, Polygon solidified its role as the backbone of corporate NFT endeavors by demonstrating its ability to mediate between big brands and the Web3 landscape.

This opened the floodgates for a wealth of corporations venturing into the NFT market through collaborations with Polygon. Against the backdrop of Reddit coining its NFTs “collectible avatars,” the sterilization of NFTs through euphemistic language has been a crucial driver of the progressing corporate adoption.

In this way, an abundance of users were onboarded to NFTs without even being aware of this circumstance. In the near term, this evolution will likely continue as more brands pour into the space. Eventually, NFTs will simply be the natural extension of a brand’s holistic digital experience that encompasses various dimensions.

Appendix: Timeline Event Related to NFTs in 2022

TIMELINE OF EVENTS RELATED TO NFTs IN 2022



9

Gaming & Metaverse: 2022 Overview, 2023 Outlook

Erina Azmi

Gaming & Metaverse: 2022 Overview, 2023 Outlook

Erina Azmi

A data-driven overview of the crypto gaming landscape, growth metrics, prominent themes, and more.

Quick Take

- The GameFi market experienced a tumultuous year along with the broader market as its market cap fell 79% YTD to \$5.2 billion from \$24.5 billion early this year.
- In response to the drawdown of the GameFi market, several big guilds decided to shift their business model from scholarship providers to something more sustainable, forcing them to seek alternative sources of revenue.
- The metaverse market had a strong first quarter of 2022, with NFT worlds gaining over 500% and Somnium Space gaining 34%. However, its YTD performance exhibited a dismal 90% decline.

State of Crypto Gaming in 2022

Crypto gaming, one of the most popular crypto sectors, did not fare as well in 2022 as it did in 2021. In 2022, crypto gaming-related tokens and NFTs experienced a sharp price decline of over 90%. Nonetheless, the Web3 gaming sector still experienced myriad developments – including the launch of ImmutableX as the global liquidity orderbook for gaming assets, Yuga Labs' launch of its metaverse Otherdeeds, and games like Blankos Block Party and Grit making their first appearances on Epic Games' stores.

In 2017, CryptoKitties generated a lot of buzz by allowing players to buy and sell digital cats using blockchain technology. This was followed by the release of Axie Infinity in 2021, which created a new P2E trend in gaming. We predict that the next big thing in crypto gaming will be less about earning and more about revolutionizing the gaming experience. Although this is an obvious trend, it is still challenging because Web3 games are competing in a crowded market along with existing Web2 games (i.e., traditional video games).

The next gaming evolution that offers novel experiences is likely to be initiated by on-chain gaming. One of the expectations is that on-chain gaming will spawn a strong decentralized identity beyond the typical DeFi activities or asset holdings – for example, one's voting will be weighted according to one's performance within the game and may lead to token-less governance within the game.

Types of Crypto Games

Before diving into the crypto gaming market, it is important to distinguish between different definitions. The most common definition is “crypto gaming,” referring to any game that utilizes blockchain technology in any way, with or without earning mechanisms (i.e., receiving tokenized in-game rewards upon playing). Additionally, the term “crypto gaming” is also used interchangeably with “GameFi,” “blockchain-based games” and “Web3 games.” There are currently two main types of crypto gaming:

- **Fully on-chain games**
On-chain games are those whose game logic is stored on smart contracts, with every in-game action triggering a transaction and incurring

gas fees. Consequently, the more active a game is, the more costly it is for the players. For instance, the increasing popularity of Crabada's idle game caused network congestion on Avalanche C-Chain. They migrated to their own network, Swimmer Network, to alleviate the scalability issue.

Thus, on-chain games are experimental, and many live on-chain games (e.g., DarkForest, Conquest, and Mithraeum) use Gnosis Chain as an alternative for cheaper transactions. Nevertheless, there has been a recent emergence of on-chain gaming built on StarkNet – an L2 that is expected to handle much more complex computation and have higher transaction throughput.

- **Off-chain games with on-chain real monetary trading**

In contrast to on-chain games, 99% of the current blockchain-based game are hosted off-chain such as on trusted software programs like AWS, Unity, or Unreal Engine. These games mainly use blockchain technology to develop their own “real monetary trading” (RMT) venue, so that they can monitor its direct impact on their games.

RMT refers to in-game assets sold for real money. In Web2 games, RMTs are often done in a gray market (i.e., unofficial P2P trading marketplace between players) and are forbidden by most game developers as they disrupt an otherwise controlled game

experience and economy.

With on-chain RMT, Web3 game developers can internalize the take rate of selling or minting their game assets. For instance, Axie Infinity charges 4.25% on its marketplace, whereas StepN and Illuvium charge 1% and 5%, respectively.

Similarly, on-chain RMT supports the development of NFT scholarships, which let guilds rent their game assets to other players in a trustless manner. On the flipside, emerging concerns might include smart contract risks, as shown by the [\\$600 million](#) hack of Axie Infinity's Ronin bridge.

Crypto games with on-chain RMT are often referred to as GameFi. GameFi refers to blockchain-based gaming that combines gaming elements with financial concepts. It offers digital asset ownership in addition to monetary incentives, thereby revolutionizing the relationship between players, game developers, and game publishers. From this point forward, Crypto games will be referred to as GameFi, as these games constitute the vast majority of crypto games in 2022.

As of this writing, there are 1,873 Web3 games, a 34% increase from January 2022. 40% of these games exist on BNB Chain, 32% on Ethereum, and 16% on Polygon. Interestingly, the market share of BNB Chain and Polygon grew since January, while Ethereum's shrank. Note that games from game-specific chains are excluded due to a lack of time-series data.

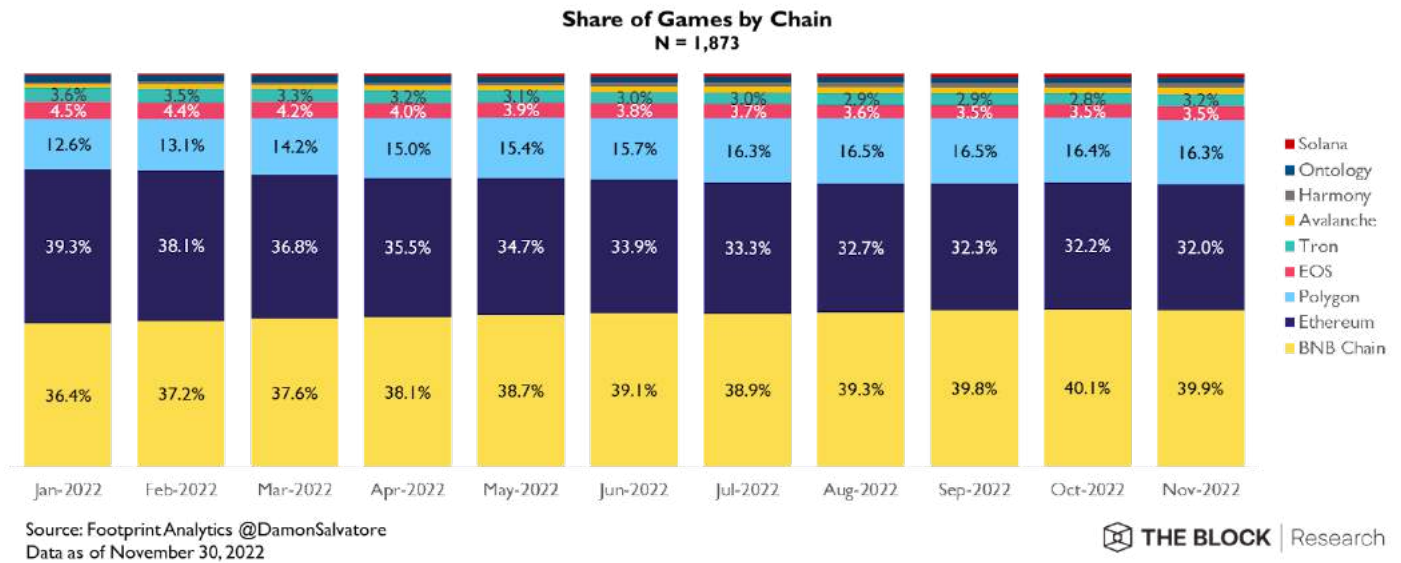


Figure 264: Share of games by chains in 2022
Source: Footprint Analytics

If those games are included, the total number of Web3 games would be 2,089. The marginal differences mean that those game-specific chains (e.g., WAX, ImmutableX, Enjin, Gala Games, Catheon, and MarbleX) command less than 11% of the total market share.

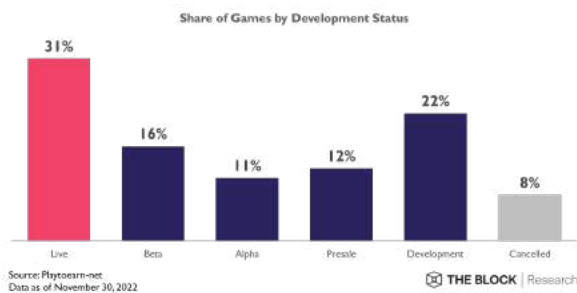


Figure 265: Share of games by development status in 2022
Source: Playtoearn.net

Only 31% of all GameFi projects are now playable, while 64% are still under development. This is in line with the expectation of a long game development cycle of 3 to 5 years since most GameFi projects only received funding between 2021 and 2022. See the [Digital Asset Investment section](#) for more information on NFT/Gaming funding.

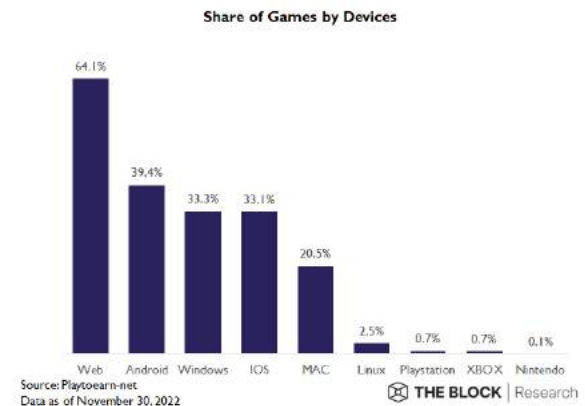


Figure 266: Share of games by devices in 2022
Source: Playtoearn.net

The bulk of GameFi projects (64%) choose web browsers to host their games, followed by Android (37%) and Windows (33%). Web browser as the preferred platform is likely because it is easier for players to connect their crypto wallets and self-custody their game assets while engaging with the game's RMT services (e.g., trading, minting, and staking).

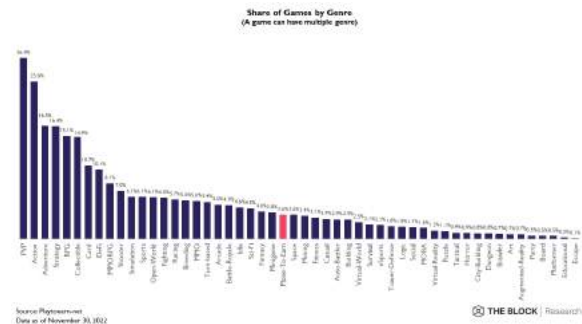


Figure 267: Share of games by genre in 2022
Source: Playtoearn.net

In terms of game genres, many games are centered on player-versus-player (PvP), action, adventure, strategy, and RPGs, which correspond to the [most popular genres](#) on the Web2 market. Note the recent hype around Web3 games such as move-to-earn (e.g., StepN, Genopets, and Sweatcoin) and auto-battlers (e.g., Axie Infinity, Crabada, and Illuvium) are niche compared to other genres, accounting for fewer than 4% of all GameFi projects.

GameFi Market Overview

The GameFi market experienced a tumultuous year along with the broader market as its market cap fell 79% YTD to \$5.2 billion from \$24.5 billion early this year. The decline is consistent with the broader cryptocurrency market, as the top 50 cryptocurrencies and DeFi have declined 65% and 79% YTD, respectively.

As of writing, the GameFi market accounts for 25% of DeFi or 0.8% of the total cryptocurrency market capitalization. It is 35 times smaller than the global gaming industry, estimated to be around [\\$184 billion](#) in 2022.

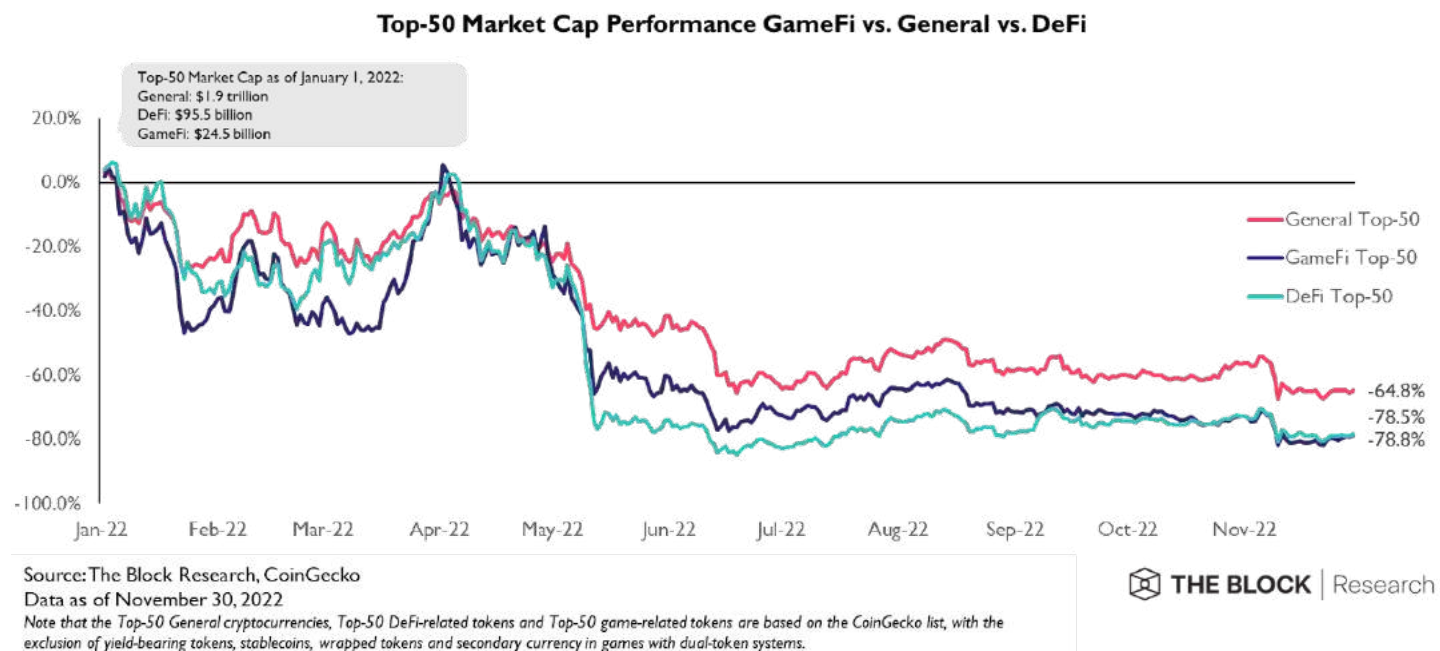


Figure 268: Top 50 market cap performance by crypto sector in 2022
Source: The Block Research, CoinGecko

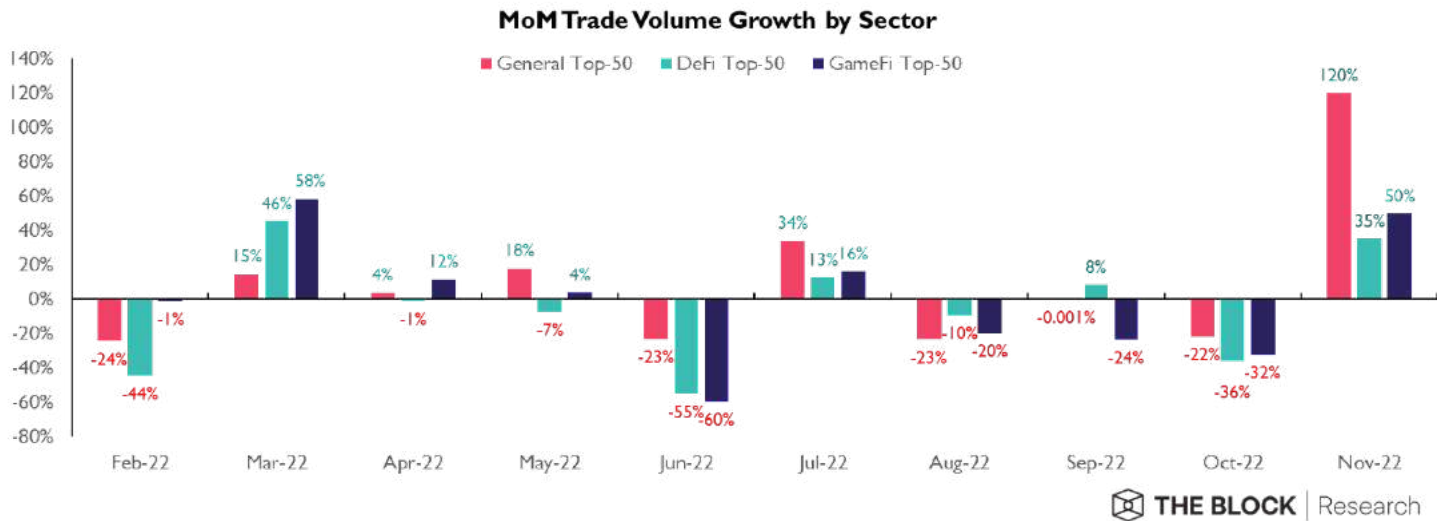


Figure 269: Top-50 tokens volume performance by category in 2022
Source: Playtoearn.net

Figure 269 illustrates the MoM volume growth of the three markets over time. The GameFi market saw decent volume growth in Q1 2022 before declining in the subsequent months. Note that all three markets increased in volume in November after months of sell-offs.

Token Sustainability

Even though the success of a GameFi project does not solely hinge on the short-term market performance of its game tokens, it affects its monetary-motivated players. Figure 271 compares the MoM price performance of five game-related sectors: (1) game index tokens, (2) selected popular games' governance tokens, (3) metaverse-related tokens, (4) move-to-earn governance tokens, and (5) gaming infrastructure tokens.

At first glance, Q1 2022 has a good performance prior to sell-offs from April onwards. Although almost every token saw a relief bounce in July, the price growth did not sustain and continued to slide. Overall, most tokens across subcategories saw a price drop between 80% and 99%, except for BinaryX, a free-to-play, web-based RPG game on BNB Chain, which saw its native token outperform the market by 120%.

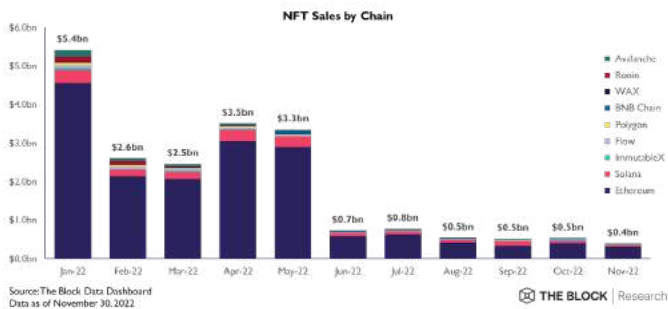


Figure 270: NFT sales by chain in 2022
Source: The Block Data Dashboard

Total NFT sales volume in November recorded this year's low at \$390 million, a 93% drop from January's \$5.4 billion. 79% of November's volume occurred on Ethereum, followed by Solana (13%) and ImmutableX (4%). Meanwhile, BNB Chain recorded only 0.7% despite having the highest number of games.

	Protocol	Token	Jan-2022	Feb-2022	Mar-2022	Apr-2022	May-2022	Jun-2022	Jul-2022	Aug-2022	Sep-2022	Oct-2022	Nov-2022	YTD
Gaming Index	Merit Circle	MC	-48%	-4%	11%	-37%	-36%	-37%	34%	-22%	-5%	7%	-43%	-92%
	JPG Index	JPG	NA	NA	NA	NA	-53%	-40%	90%	-11%	-20%	18%	-23%	-65%
	Yield Guild Game	YGG	-43%	13%	-13%	-50%	-52%	-1%	19%	-43%	-27%	-17%	-25%	-96%
	Metaverse Index	MVI	-29%	-10%	9%	-39%	-38%	-36%	22%	-26%	-14%	-6%	-29%	-91%
Selected Popular Games	Axie Infinity	AXS	-44%	3%	16%	-54%	-18%	-39%	26%	-22%	-11%	-27%	-26%	-93%
	My Neighbour Alice	ALICE	-45%	9%	-1%	-34%	-36%	-28%	26%	-30%	-15%	0%	-28%	-90%
	BinaryX	BNX	-68%	19%	160%	97%	1%	-10%	19%	-3%	18%	-6%	-4%	120%
	Crabada	CRA	69%	-17%	-20%	-70%	-78%	-78%	31%	-10%	-5%	-19%	-34%	-99%
	Alien World	TLM	-40%	1%	10%	-40%	-49%	-34%	24%	-20%	-4%	-8%	-29%	-93%
	Splinterland	SPS	-49%	21%	-17%	-1%	-18%	-47%	21%	-13%	36%	-20%	-35%	-83%
	Aurory	AURY	-31%	-6%	14%	-20%	-75%	9%	10%	-18%	-28%	-16%	-56%	-96%
	TownStar	TOWN	-73%	-29%	-39%	-29%	-36%	-48%	25%	-3%	-23%	41%	-21%	-97%
	Thetan Arena	THG	-65%	-23%	-7%	-62%	-66%	-53%	18%	0%	-5%	1%	-33%	-99%
Metaverse	Illuvium	ILV	-40%	-4%	5%	-26%	-34%	-54%	-15%	-34%	-27%	17%	-40%	-96%
	ApeCoin (Otherdeed/BAYC)	APE	NA	NA	NA	58%	-66%	-33%	47%	-29%	14%	-13%	-14%	-68%
	The Sandbox	SAND	-30%	-22%	6%	-42%	-26%	-23%	16%	-20%	-11%	3%	-35%	-90%
	Decentraland	MANA	-14%	0%	-8%	-45%	-24%	-20%	12%	-21%	-10%	-4%	-41%	-88%
Move-to-earn (M2E)	Somnium Space	CUBE	-27%	-11%	-14%	-36%	-45%	-22%	6%	7%	-17%	10%	-51%	-92%
	NFT Worlds	WRLD	-26%	203%	-30%	-42%	-51%	-55%	-42%	-55%	16%	-9%	-22%	-96%
	StepN	GMT	NA	NA	NA	42%	-66%	-30%	15%	-30%	-5%	-15%	-31%	-85%
	Dotmoov	MOOV	-43%	-9%	404%	-17%	-68%	-21%	-9%	-25%	-8%	3%	-33%	-77%
	Genopets	GENE	-48%	11%	152%	-23%	1%	-33%	-10%	-32%	-44%	-28%	-59%	-92%
	Step App	FITFI	NA	NA	NA	NA	-73%	-41%	15%	-17%	-29%	-1%	-19%	-91%
Infrastructure/Alternative LI chains	Dose	DOSE	-42%	3%	87%	-35%	-72%	-51%	-6%	-26%	-20%	-7%	-12%	-96%
	Gala Games	GALA	-56%	31%	-2%	-48%	-37%	-35%	5%	-12%	-19%	4%	-40%	-94%
	Wax	WAXP	-27%	-7%	13%	-38%	-42%	-25%	17%	-10%	-13%	-4%	-30%	-87%
	Immutable X	IMX	-45%	-42%	50%	-42%	-18%	-10%	9%	-24%	-9%	-21%	-26%	-91%
	Flow	FLOW	-23%	-7%	8%	-34%	-40%	-45%	28%	8%	-19%	-1%	-34%	-88%
	Ronin	RON	NA	-11%	-20%	-45%	-48%	-37%	33%	-22%	-23%	8%	-19%	-91%

Source: The Block Research, CoinGecko
Data as of November 30, 2022

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Figure 271: MoM price performance by game-related token subcategory in 2022

Source: CoinGecko, The Block Research

Our initial research did not find any clear reason why BinaryX's token BNX outperformed other gaming tokens. With its static UI/UX, the game seems primitive and resembles an early 2000s web game. Simply put, the game offers an unremarkable gaming experience and has [less than 6,000 daily active users](#).

Tokens that saw their value drop over 90% are unlikely to witness their previous-high valuations again. One of the reasons is the inherent economic flaw of tokenized assets that can be explained via the Mundel-Fleming trilemma. According to the trilemma, an open market can only control two of the three aspects of free capital flow, fixed exchange rate, and sovereign monetary policy.

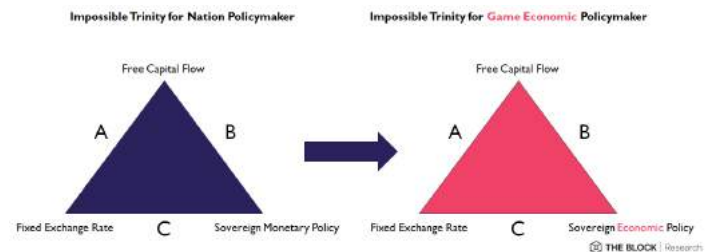


Figure 272: Impossible Trinity for gaming economy

Source: The Block Research

Side A: There are currently no Web3 games on this side because having a fixed exchange rate requires the in-game currency to be pegged to a certain external value, such as stablecoins. The problem is that the game developer will lose control of the game's monetary policy (i.e., the token supply) and will no longer be able to mint tokens at will, resulting in a

budget constraint in development funds to bootstrap the initial growth.

Side B: All crypto games with tokenized assets are on this side because they can have both free capital flow (e.g., NFT sales and staking) and autonomous monetary policy (e.g., minting of in-game rewards). However, they will be required to forgo fixed exchange rates of in-game currencies, which are the bane of token economic sustainability.

In 2022, the value of tokens in numerous P2E games released in 2021 fell by more than 90%, indicating their demise. Most of them were designed to have a net inflationary effect on their in-game rewards to attract initial players. For instance, players are guaranteed to receive \$200 in-game rewards if they purchase a \$100 NFT game asset, resulting in a \$100 profit. The situation worsens when the net \$100 reward is cashed out instead of being retained within the game's ecosystem, causing economic leakage. This occurred in each and many P2E games, such as Axie Infinity and StepN.

Some may argue that economic leakage occurs when a game is not “fun” to play, though we contest that “fun” is difficult to quantify and measured. Even if a game is rated as the most enjoyable by a large number of players, a mental shift is inevitable among those who believe they can earn “money” by participating in an open-economy game. Therefore, regardless of “fun,” a game with a poor economic design will suffer in the long run.

Side C: This aspect is inapplicable to Web3 games because the introduction of tokenized assets automatically subjects a Web3 game to the dynamics of the open market. Thus, Side C is the pinnacle of Web2 game monetary governance, as seen with Roblox sets a price for their ROBUX in US dollars.

Other Web3 Gaming Trends in 2022

Pivot of GameFi Guilds

Numerous gaming guilds were formed in response to the Axie Infinity craze that defined 2021, and many received significant funding from big investors. Some of these guilds released their native tokens that can be traded as part of their equities, or as a means of obtaining access to their revenue stream, or used within the guild ecosystem.

The prices of guild tokens dropped significantly in 2022, dropping up to 98% YTD. In most cases, a guild's business is to earn higher revenue from in-game rewards than its expenses. Hence, when the in-game rewards they earned dropped in price throughout 2022, guilds experienced high operating expenses and inventory losses.



Figure 273: Price performance of guild tokens in 2022

Source: CoinGecko, The Block Research



Figure 274: Quarterly YGG's number of scholars

Source: YGG Q3 2022 community update

The situation for the guilds deteriorated further as some scholars may no longer find the in-game rewards appealing enough to continue putting hours into Web3 games. Yield Guild Games (YGG) saw a 32% drop in its number of scholars from 29,548 in Q1 2022 to 20,213 in Q3 2022.

Thus, it became clear that guilds that hinge on in-game rewards as their business model will not survive in the long run and thus forcing them to seek alternative sources of revenue. To that end, several big guilds

pivoted to a different business model, mostly focusing on investing. More specifically, GuildFi and YGG begun investing in other gaming projects and infrastructures. Meanwhile, Merit Circle ceased its scholarship services and transitioned into becoming a venture capital fund, game publisher, and incubator. These changes will allow guilds to help their scholars while also improving the game environment for all players.

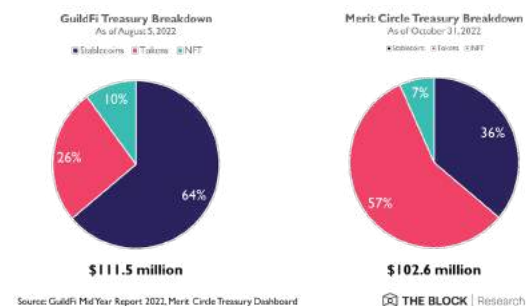


Figure 275: Treasury breakdown of GuildFi and Merit Circle

Source: GuildFi mid-year report 2022, Merit Circle treasury dashboard

Both GuildFi and Merit Circle have a treasury of over \$100 million, but GuildFi has a more prudent allocation to stablecoins (64%) than Merit Circle. Meanwhile, Merit Circle allocated a large portion of its treasury to volatile

tokens (57%), such as BTC, ETH, and game-related tokens.

Despite never updating its financial statement since December 2021, YGG claimed in its Q3 2022 community update that it had a two-year runway. Its public wallets showed a total asset worth less than \$25 million, including its NFT holdings, much lower than what it reported back in December 2021 of over \$845 million.

X-to-earn

As Web3 gaming evolved from Axie Infinity's P2E game, developers began to create novel gameplay mechanics to attract diverse audiences. For instance, StepN, Sweatcoin, and Genopets introduced the gamification of exercises, known as move-to-earn, with a bigger target audience than just gamers. Since then, numerous Web3 developers created various variants of "X-to-earn" projects, including learn-to-earn projects such as Hooked and RabbitHole and sleep-to-earn projects such as Pacer.

StepN's success hinges on the gamification of its fitness app and the incorporation of in-game rewards via the move-to-earn mechanism. As the market leader in move-to-earn, it attracted more than 3 million monthly active users at its peak in April, resulting in a high trading volume of its Sneaker NFTs, which generated \$149.3 million of revenue in H1 2022. Despite the impressive revenue, StepN's tokenomics has proven unsustainable as their token supply has continued to become net inflationary in the absence of sufficient user demand.

Free-to-play Web3 Games

Following the failure of Axie Infinity's SLP token model in 2021 and spur of purchasing NFTs first before one could play a Web3 game, "P2E" gained a negative public perception and induced poor brand imagery among players.

As a result, many games pivot towards the free-to-play model to lower the high entry barrier of the current iteration of GameFi. Free-to-play examples include Axie Infinity with its Axie Origin, Thetan Arena, Illuvium: Zero, Skyweaver, and EV.io. Though it remains to be seen whether this shift would solve the economic woe of Web3 games.

Thetan Arena, a free-to-play multiplayer online battle arena on the BNB chain, boasts over 25 million active users. Yet, only 134,358 holders of its in-game NFTs, Thetan Heroes. In other words, fewer than 0.5% percent of its gamers contributed to Thetan Arena's in-game economy.

On-chain Games

The current wave of Web3 games appears to be stifled, with the vast majority offering the same gameplay as Web2 games, albeit with on-chain RMT. Consequently, we anticipate that the gaming experience will remain unchanged even with tokenized assets.

The Block Research believes that games that may create a novel and unique experience are on-chain games because they are built on top of new technology and infrastructures, such as zk-SNARKs, a form of zero-knowledge proof that can prove the correctness of complex transactions cheaply.

On-chain Games by Chains

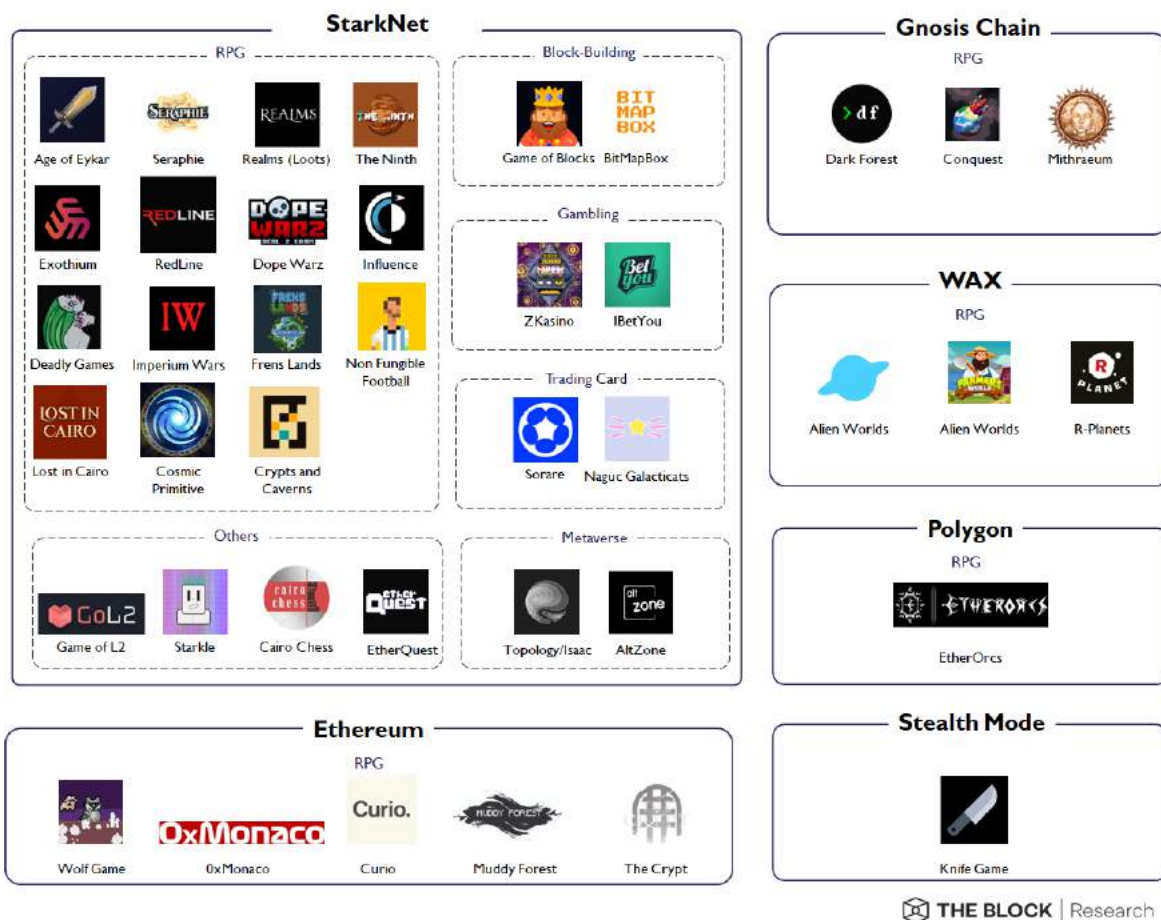


Figure 276: List of known on-chain games in 2022

Source: The Block Research

That said, such technology and infrastructure are still in their early stages, and thus there are only a few on-chain games. Figure 276 showcases 40 existing on-chain games.

While it remains to be seen, developments and activities on on-chain gaming can spill over innovations, such as tokenless governance, more transparent and unique gaming metric, a more immersive gaming identity, and a strong presence of a decentralized metaverse that is never seen in Web2 gaming.

Metaverse

The term “metaverse” became one of the most overused words in 2022 due to its wide variety of interpretations. The Block Research defines “metaverse” as a unified experience between digital and physical realities. Numerous Web3 developers are currently utilizing blockchain technology and digital assets to create a more immersive and meaningful metaverse, ushering in the next generation of the digital economy. Nonetheless, we may be a generation

too early for blockchain-powered technology, as the demand for such an experience stems only from a small user base.

In reality, the Web3 metaverse industry lacks matured infrastructure, compelling content, and user-friendly applications. All of these increase friction in accessing the metaverses, making it less appealing even for those early adopters, further preventing widespread adoption of these virtual worlds.

We identified two types of Web3 metaverse:

- **Social metaverse** is a virtual world that simulates the real world and is primarily used for social interaction. Social metaverses mainly provide landowners and visitors with soft benefits, instead of hard benefits.

Soft benefits are based on improvements in aesthetics and status that have little to no impact on player experience. For example, a landowner can decorate their lands with castles and pets to create a virtual space where friends, co-workers, and other communities socialize. In contrast, hard benefits grant players rewards with in-metaverse utilities. For example, a player can purchase stables to store their in-game horses.

Therefore, visitor retention in social metaverses is highly dependent on landowner-created content. Some metaverse, like Decentraland and Voxels, may suffer when their holders become land squatters instead of producing meaningful content. To avoid this, The Sandbox is curating its content experience by partnering with large brands with strategic land locations (e.g., Binance, Snoop Dogg, Gucci, and Adidas),

encouraging future visitors to explore and participate in its virtual world.

The Sandbox, Decentraland, Voxel, and Somnium Space are well-known social metaverses, also called the Big4.

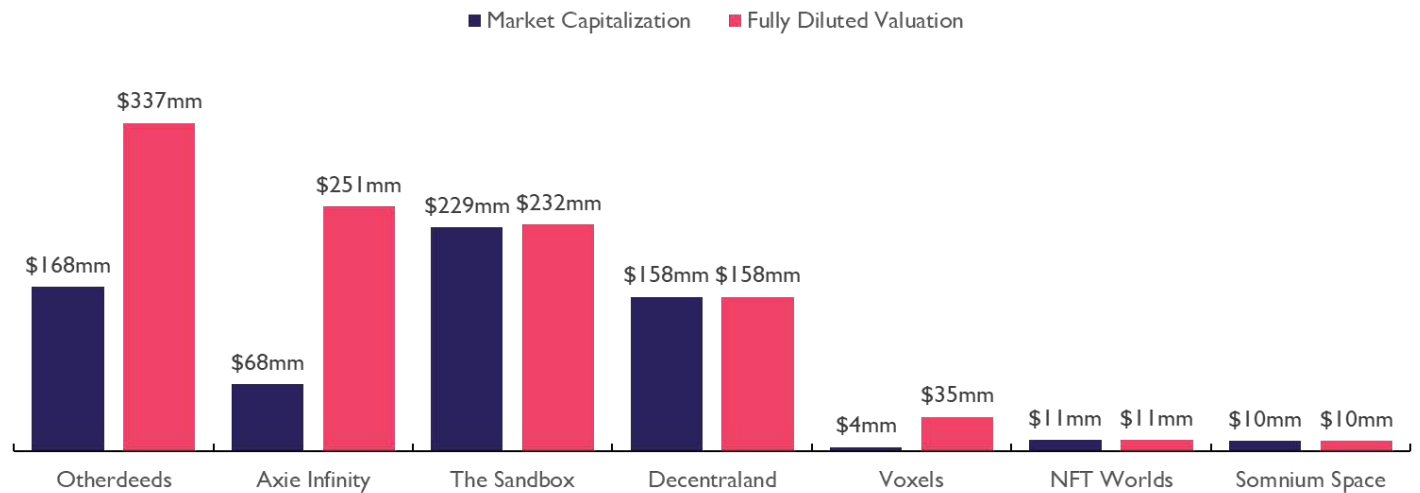
- **Gaming metaverse** is a virtual world where players are given a map and a set of objectives to achieve. The experiences in gaming metaverses center around the lands and surrounding resources. For example, it is more strategic to purchase lands near resource areas such as water and gold mines so that players can loot the items. These instances are hard benefits as they change the players' experience.

If successful, the virtual economy on gaming metaverses is anticipated to be more robust than social metaverses as it has clearer functionality, objectives, and relationship with all players. Social metaverses are much less sticky than gaming metaverses and more prone toward land speculators. For example, many of Decentraland's lands were left unbuilt for 4 years.

Market Overview

In 2021 and early 2022, many social and gaming-oriented metaverse platforms emerged. On a fully diluted basis, the top three metaverses (i.e., Otherdeeds, The Sandbox, and Axie Infinity) are valued at roughly between \$230 million and \$340 million. However, these valuations appear to be on a speculation basis as these three metaverses are still in the development phase, with The Sandbox and Axie Infinity being in development since 2019.

Valuation of 7 Popular Metaverses



Source: The Block Data Dashboard

Data as of November 30, 2022

Market Cap is taken as circulating supply times the floor price.

Fully diluted valuation is taken as total supply times the floor price.

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Figure 277: Valuation of 7 popular metaverses by market cap and fully diluted valuation as of end November, 2022

Source: The Block Data Dashboard, The Block Research, OpenSea, CoinGecko

The metaverse market had a strong first quarter of 2022, with NFT worlds gaining over 500% and Somnium Space gaining 34% in land price. However, its YTD performance exhibited a 90% decline.

Worlds has since [shifted its focus](#) towards developing its own engine, MetaFab.

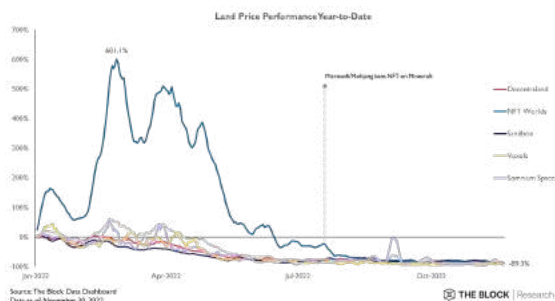


Figure 278: Land price performance across popular metaverse in 2022

Source: The Block Data Dashboard

Although all metaverse platforms experienced land devaluation, NFT Worlds suffered the most as it lost 98% from its ATH. This was due to Mojang's new policy [banning NFT](#) usage within Minecraft, the game platform NFT Worlds used to build its metaverse. NFT

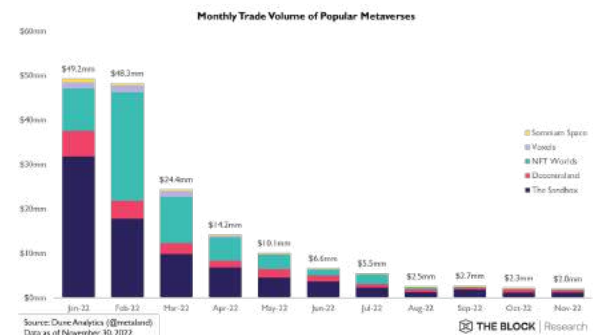


Figure 279: Monthly trading volume on popular metaverses in 2022

Source: Dune Analytics (@metaland)

The decline in the hype surrounding metaverses is reflected in the monthly volume traded on these popular metaverse platforms, which decreased by 96% from its ATH of \$49.2 million in January to this year's low of \$2.0 million in November.

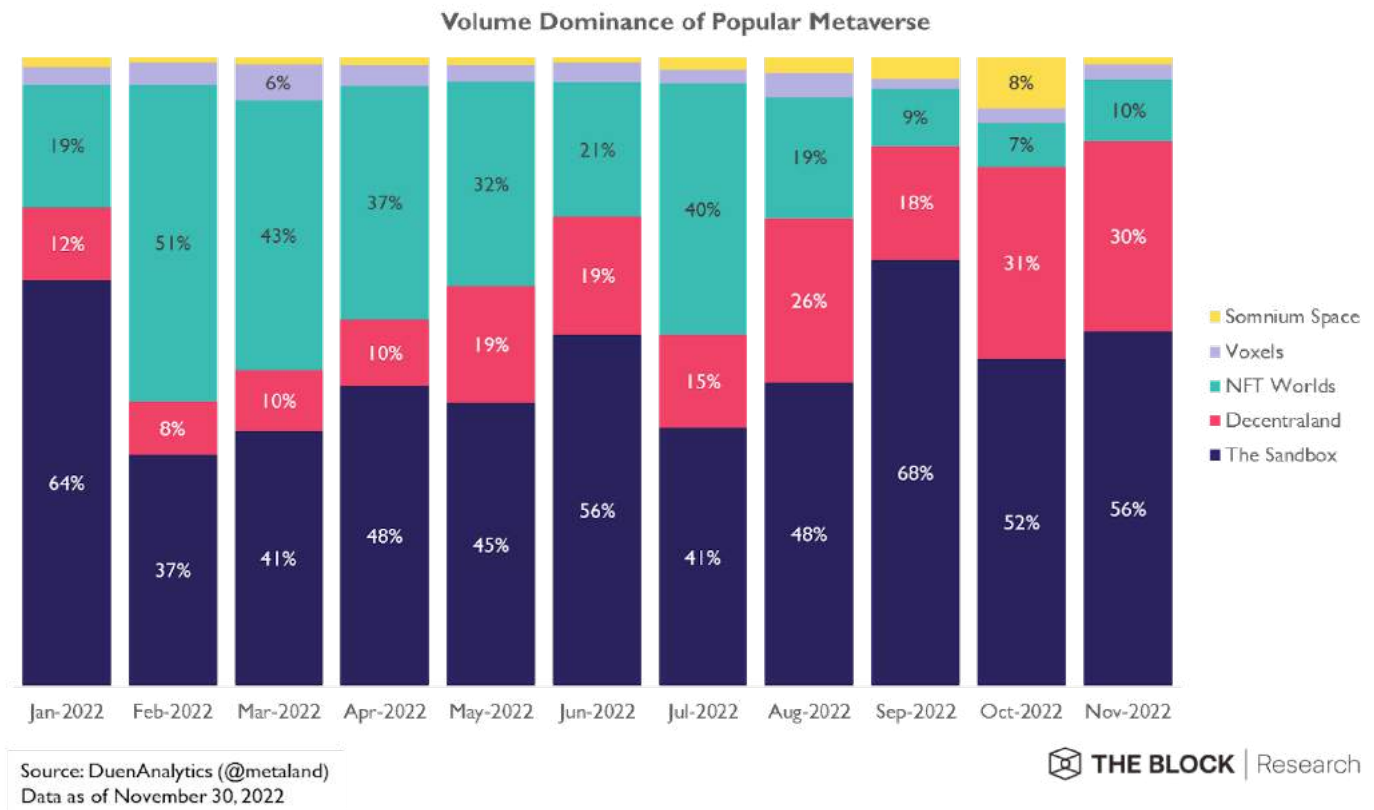


Figure 280: Volume dominance of popular metaverses in 2022
Dune Analytics (@metaland)

At the start of 2022, The Sandbox enjoyed a high market dominance at 65% as it conducted aggressive land sales and auctions towards the end of 2021. Of its 21 land sales in 2021, 60% were done in Q3 and Q4 2021. In contrast, there had only been 5 land sales in 2022, leading to low trading volume. The Sandbox's market share shrunk from 65% to 54% YTD.

Meanwhile, NFT Worlds' market share fell sharply to less than 10% following the Mojang bans on Minecraft. The only metaverse project which grew its volume dominance this year is Decentraland, which more than doubled its share from 12% in January to 33% in November.

Are We Too Early?

The primary distinction between the physical and the virtual worlds is that lands in the former are naturally scarce. Meanwhile, the latter is by arbitrary rules set by the metaverse developers. Users will have to trust the developers' claims that the land supply is fixed or follows a known inflation schedule.

The land supply in the metaverse has been widely discussed by developers and users, but the question remains: is fixing land supply the right thing to do? If it is fixed, then how do users ensure that the project developer will not release new collections of lands that devalue existing ones? At the same time, if it is not fixed, then this raises the question of how a developer

can implement a plan that does not lead to the excessive dilution of existing landowners' holdings.

For example, Yuga Labs recently released Otherdeeds, a metaverse airdropped to its BAYC and MAYC holders with a fixed supply of 200,000 lands. However, it does not mean it will not release another series of metaverse for its other NFT collections like CryptoPunks and Meebits.

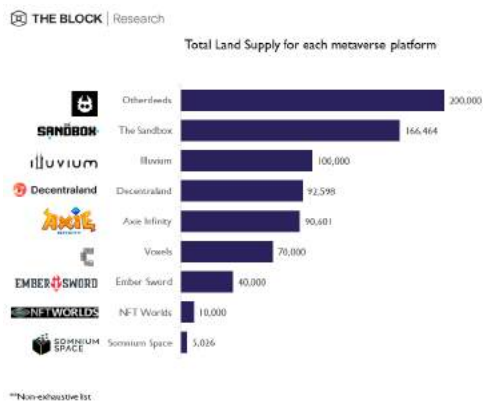


Figure 281: Total land supply across popular metaverses
Source: Etherscan, Nansen, public documentations

The overall number of unique landowners in the metaverse increased marginally throughout the year, except The Sandbox and NFT Worlds, both of which saw a reduction by 4%. Meanwhile, Decentraland and Voxels experienced an increase in unique holders by 34% and 26%, respectively. Although The Sandbox has the highest number of holders, one must also consider the supply size of each platform. A metaverse with a large land supply will naturally have more holders.

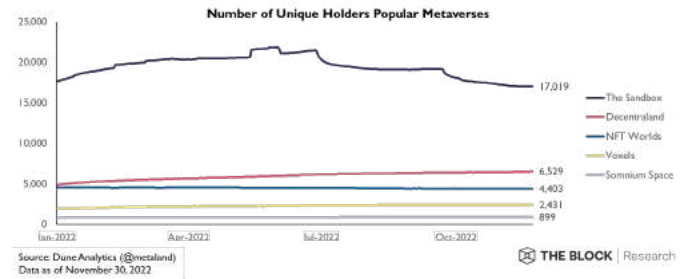


Figure 282: Number of unique holders for each popular metaverse in 2022
Source: Dune Analytics (@metaland)

To better understand the ownership concentration in each metaverse, we examine their Gini coefficient, which ranges from 0 (perfectly distributed) to 1 (high ownership concentration). Additionally, lands in each metaverse are stratified according to supply and estimated market capitalization based on floor price.

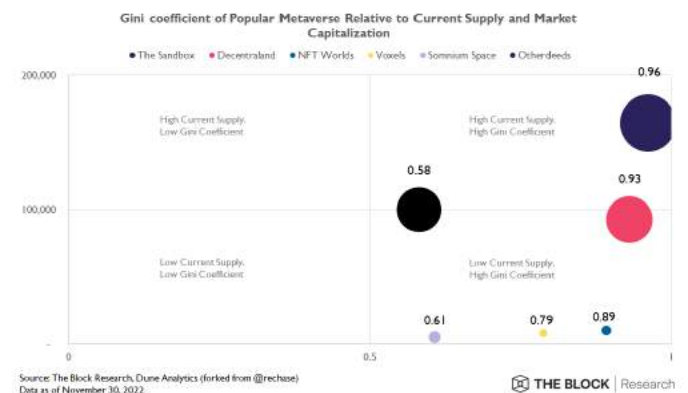


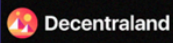

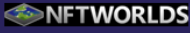



Figure 283: Gini coefficient of popular metaverses relative to its current supply and market cap
Source: The Block Research

The Gini coefficient shows that most popular metaverses are skewed toward high ownership concentration. Otherdeeds has the lowest at 0.58, while The Sandbox has the highest at 0.96. This makes Otherdeeds has the most distributed and Somnium Space comes second at a score of 0.61.

	 Otherdeeds (OTHR)	 The Sandbox (LAND)	 Decentraland (PARCEL)	 Voxels (CVPA)	 NFT Worlds (NFT Worlds)	 Somnium Space (PARCEL)
Total Supply	200,000	166,464	92,598	70,000	10,000	5,025
Circulating supply	100,000 (49% of total supply)	164,363 99% of total supply	92,598 (100% of total supply)	7,865 (11% of total supply)	10,000 (100% of total supply)	5,025 (100% of total supply)
Total holders	33,983	17,019	6,529	2,431	4403	900
Number of land holders who hold 2 or more lands	40% of holders	30% of holders	20% of holders	38% of holders	20% of holders	30% of holders
Number of lands corresponded to wallets >= 2 lands	79,610 (80% of circulating supply)	152,450 (93% of circulating supply)	87,375 (94% of circulating supply)	6,358 (81% of circulating supply)	6,478 (95% of circulating supply)	4,395 (87% of circulating supply)

Source: Nansen.ai, Etherscan, The Block Research
Date as of November 30, 2022

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Figure 284: Ownership concentration across popular metaverses

Source: Dune Analytics (@metaland), Nansen, Etherscan, The Block Research

Figure 284 tabulates the ownership concentration in different metaverses. In most cases, 30% of landholders of each metaverse control 90% of the total land supply. Meanwhile, 40% of Otherdeeds holders control 80% of the land supply.

Outlook on Gaming & Metaverse in 2023

Web3 Gaming SuperApp for Mass Adoption

The adoption of blockchain technology in the gaming industry is hampered by a lack of strong infrastructures, which prevents developers from innovating and scaling their games. The major problem for developers working with blockchain technology is not so much about developing games themselves but integrating blockchain infrastructure into their games.

A gaming project that wishes to leverage Web3

infrastructure often needs to build a browser-based game. Web browsers are not designed for high-quality games, which can limit the gaming content and thereby create inferior player experiences. Even if the game has its own desktop client, on-chain activities will still need to be conducted through web browsers. Otherwise, the game will need to allocate more resources to build its own blockchain infrastructures such as in-game wallets and marketplace. Thus, various Web3 infrastructure projects are developing an all-in-one platform to solve the issue.

1. **HyperPlay** is a game launcher that aims to solve interoperability issues between gamers and developers. Developers can focus on building their games without having to build the infrastructure needed to support them. Meanwhile, players are able to install and connect their wallets to the same platform,

keeping track of all their assets and tokens in one place. For example, players can exchange items between games, which might be useful for someone who wants to swap their sword for a shield in a different game.

2. **Sequence** is a smart contract-based wallet that can be used with dapps and games. It allows multiple private keys to control the wallet rather than just one private key as most Ethereum wallets do. The multiple keys add extra security because more than one of these keys would need to be compromised for the wallet to be compromised. Additionally, one can modify the wallet's smart contract logic to meet their needs and thus have multiple accounts under one wallet.

Smart-contract wallets are proposed solutions to the problems of Ethereum wallets, which are externally-owned accounts (EOAs). An EOA is an address on the blockchain controlled by a private key and derives a public blockchain address from it. The issue with EOAs is that they cannot be programmed to execute custom logic. Additionally, you cannot prevent your fund from being drained if your private key is compromised. Thus, many blockchain developers – including Vitalik Buterin – proposed switching Ethereum wallets to smart contract-based. Account abstraction is the process by which EOAs are replaced by smart contracts.

3. **Cartridge** is a gaming console that enables users to interact with and sign various on-chain StarkNet games. It also functions as a session key, allowing users to pre-approve a set of rules during gameplay. The pre-approvals transactions are an issue that is most prevalent in on-chain games, where players are bombarded with transaction approvals for every in-game action.

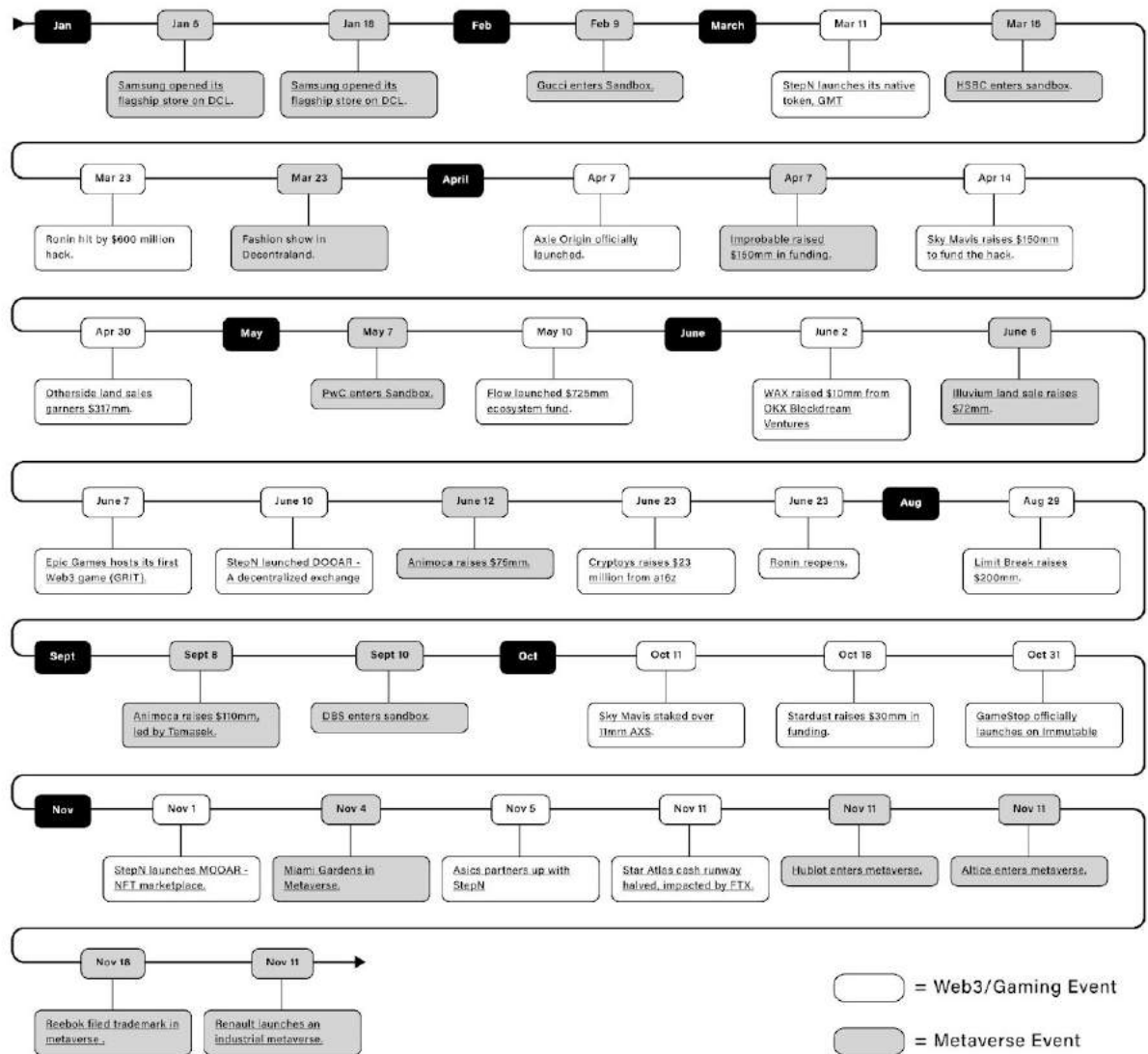
Metaverse Development Remains Slow

Recent interest in VR and metaverse surged as Facebook rebranded itself as Meta in late 2021. Hopes were high that VR would provide a more immersive avenue for digital economies and be powered by tokenized assets, including NFTs and cryptocurrencies.

Web3 metaverses have yet to prove themselves having superior experiences than their Web2 counterparts (e.g., Roblox and Minecraft). It is clear that land scarcity caused irreparable damage, now some of these Web3 lands being gatekept by land squatters, thereby creating pockets of empty land. This is evident upon logging into Decentraland, Somnium Space, or Voxels.

On the other hand, The Sandbox tried to mitigate the “ghost town” effect by partnering with various Web2 and Web3 brands, although it has yet to fully launch its virtual world to the public. If The Sandbox proves to offer a more enjoyable experience than Roblox or Minecraft, Web3 Metaverse may experience widespread adoption.

Appendix: Timeline Event Related to Gaming & Metaverse in 2022

TIMELINE OF EVENTS RELATED TO WEB3
GAMING AND METAVERSE IN 2022

10

Macro Perspectives: 2022 Overview

George Calle, Ian Devendorf, Greg Lim, Edvin Memet

Macro Perspectives: 2022 Overview

George Calle, Ian Devendorf, Greg Lim, Edwin Memet

An analysis of the macroeconomic factors depressing cryptocurrency prices, and the resultant blowups of centralized finance businesses that were overleveraged on these assets and/or each other.

Quick Take

- While fiscal and monetary policy responses to COVID-19 created tailwinds for asset prices in 2020 and 2021, central bankers' responses to the resultant inflation created massive headwinds in 2022.
- The Terra collapse brought down multiple funds, most notably 3AC, which had downstream impacts on creditors, notably BlockFi, Celsius, Voyager, and Genesis.
- The FTX and Alameda bankruptcy added additional strain to creditors (disrupting the Voyager bankruptcy, causing the BlockFi bankruptcy, and forcing Genesis and Gemini to halt withdrawals), while wiping out equity investors in the business and generating massive value reduction to related tokens.

Weathering Macro Uncertainty

While the growth of crypto as a sector and blockchain as a technology follow their own trendlines, the price of cryptocurrencies and digital assets over the past year have been almost entirely a function of

macroeconomic conditions (external) and various market crises resulting in liquidations (internal).

Like broader financial markets, the crypto market has responded acutely to US Federal Reserve actions, particularly the Fed's six rate hikes, along with monthly Consumer Price Index (CPI) releases, which generate expectations for how the central bank may leverage interest rates as a tool to curb inflation. While fiscal and monetary policy responses to COVID-19 created tailwinds for asset prices in 2020 and 2021, central bankers' responses to the resultant inflation created massive headwinds in 2022. [Section 1](#) of this chapter explores various macroeconomic indicators that could be used as barometers for broader economic conditions.

Simultaneously, this year kept both market participants and the broader public captivated as many of the large, centralized institutions that service the digital asset industry or speculate on it have blown up spectacularly. [Section 2](#) of this chapter outlines the most notable examples, focusing on lending firms, trading firms, and exchanges. It also examines the interlinkages between the affected counterparties. Additionally, given the importance of credit within any financial market, we analyze various sources of demand for loans within the crypto industry.

We conclude that these two market drivers are not independent. Rather, external market pressures reversed last year's "everything rally," brutally punishing those overexposed to the riskiest strategies and their counterparties.

2022 Economic Data Summary

This section looks to provide an assessment of the major economic trends that occurred in 2022. Below are 5 key predictive indicators for the economy:

Inflation / Fed Rate

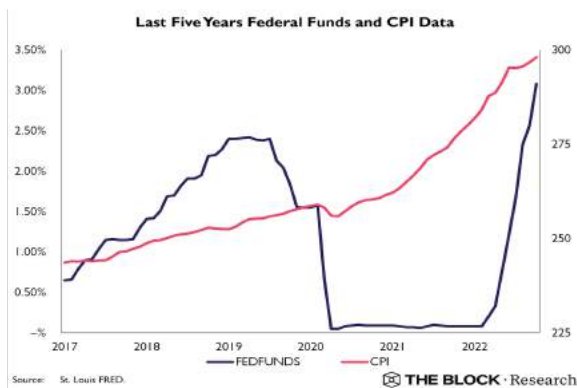


Figure 285: Federal funds and CPI data 2017 - 2022

Source: St. Louis FRED

The US Federal Open Market Committee (FOMC) meets eight times annually to set a target rate. The FOMC's target rate determines what commercial banks can borrow and lend to each other overnight. Central banks adjust short-term interest rates to influence economic inflation. Inflation is calculated from CPI which tracks changes in prices. High inflation led to institutional investors pulling back from crypto. Lower Fed rates enable easier borrowing with increased borrowing enabling more spending, causing growth and inflation to increase. Following the ongoing COVID-19 outbreak in 2020, the FOMC set a near-zero rate. On the other hand, higher rates discourage spending leading to lower inflation. Generally, healthy economies operate at a 2.0% – 3.0% inflation rate. According to the Quantity Theory of Money, as money supply grows, prices rise as each individual unit of currency is worth

less. The Fed spent \$4.13 trillion of its \$7.09 trillion allocation in response to the pandemic.

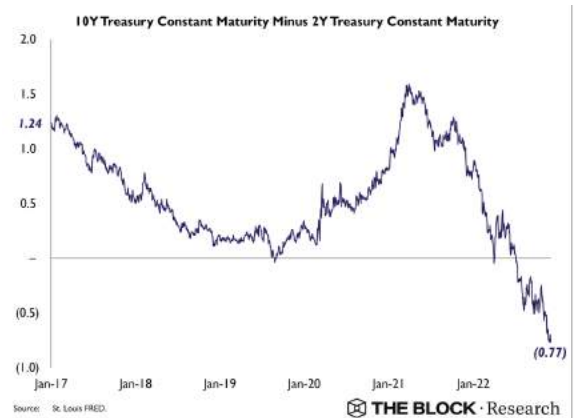


Figure 286: 10-year treasury constant maturity minus 2-year treasury constant maturity 2017 - 2022

Source: St. Louis FRED

An inverted yield curve is when long-term rates are lower than short-term rates. This means yield decreases at further dated maturities. Economists and market participants often cite an inverted curve as a reliable leading indicator for a recession. Per the above chart, investors believe the Fed will need to decrease borrowing costs in the long run. In conjunction with the prior commentary, a declining rate encourages more spending and helps alleviate economic burdens during a recession.

Housing

30-year fixed mortgage rate continues hovering at pre-2008 housing crisis levels of 6.80%. In mid-October 2022 to early November 2022, 30-year fixed rate traded above the 6.80% benchmark from 6.92% to 7.08%. The current 6.49% rate as of December 1, reflects a 108.7% increase from December 2, 2021.

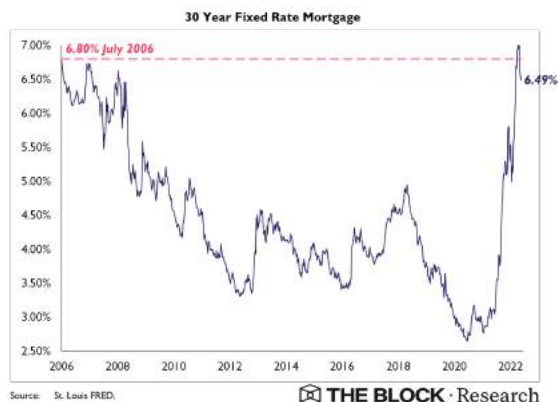


Figure 287: 30-year fixed rate mortgage 2006 - 2022
Source: St. Louis FRED

On the other hand, while rates dramatically increased, housing prices remain inflated with the latest September 2022 data reflecting a 10.6% gain and 54.2% gain on 1-year and 5-year, respectively.

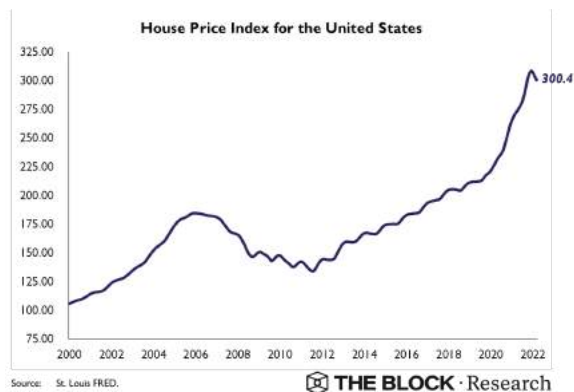


Figure 288: House price index for the United States 2000 - 2022
Source: St. Louis FRED

The inherent dislocation between inflated rates and prices indicates further corrections ahead. Per John Burns Real Estate Consulting, owning a home reflects an over \$800 premium to renting. As demand falls for housing, there should be a subsequent contraction in housing prices.



Figure 289: MoM change in US Housing price index 2021 - 2022
Source: St. Louis FRED

On the institutional front, real estate investors like Blackstone's Real Estate Income Trust (BREIT) also suffered. Per the [Wall Street Journal](#), BREIT's requested withdrawals in October exceed the monthly 2% and quarterly 5% thresholds. The majority of withdrawals come from Asian investors as they seek to offset losses from other areas. To note, Blackstone President John Gray clarified that BREIT is "designed for an inflationary environment." The fund is optimized for performance, rather than fund flows.

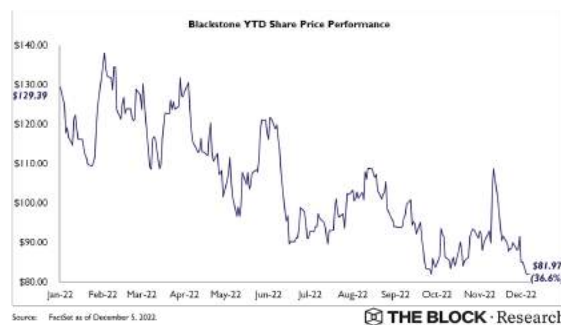


Figure 290: Blackstone share price performance in 2022
Source: St. Louis FRED

Unemployment

While the 2008 – 2009 recession saw unemployment peak at ~10.0% across all job-seeking adults, the current unemployment rate remains low at ~3.7%. However, the difference between this cycle and 2008 – 2009 is the increasing unemployment reflects high

earnings professionals. Particularly prominent within this category is the number of layoffs within software engineering and technology fields. These high earnings with more disposable income for spending and retail trading and investing activities reflect a lagging variable as positions will eventually need to be liquidated for rainy day funds.



Figure 291: US unemployment rate 2006 - 2022

Source: St. Louis FRED

Retail Credit

Per the latest quarterly household debt filing, US credit card debt reflects \$0.93 trillion, higher than the 2008 – 2009 peak levels.

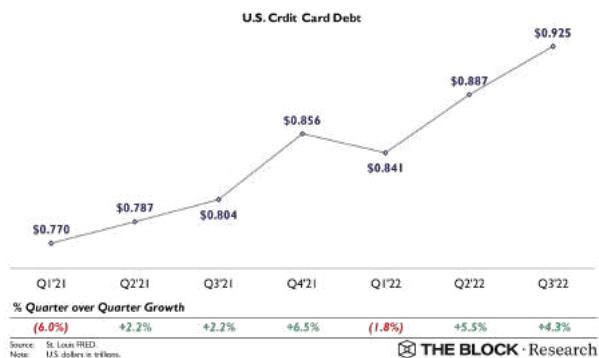


Figure 292: US credit card debt 2021 - 2022

Source: St. Louis FRED

Q3'22 marked the second consecutive increase in serious delinquency across US credit card debt.

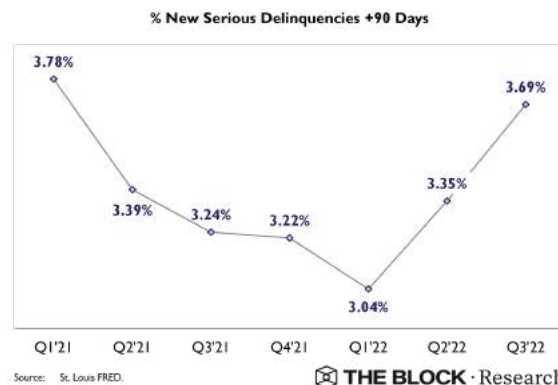


Figure 293: Growth of new serious delinquent over 90 days 2021 - 2022

Source: St. Louis FRED

Q3'22 marked the third consecutive increase in new delinquency across US credit card debt.

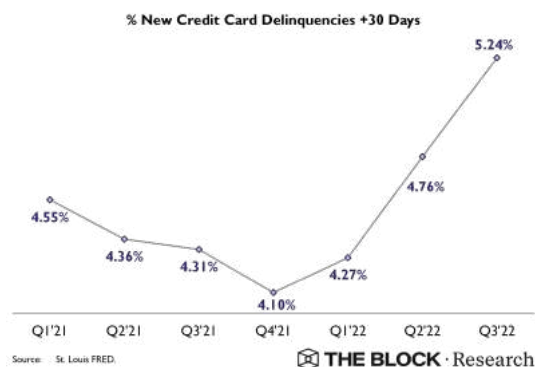


Figure 294: Growth of new serious delinquent over 30 days since 2021

Source: St. Louis FRED

August saw a new high of 16.27% interest rate on credit card plans, a massive jump from May 2022 of 15.13% and February 2022 of 14.56%.

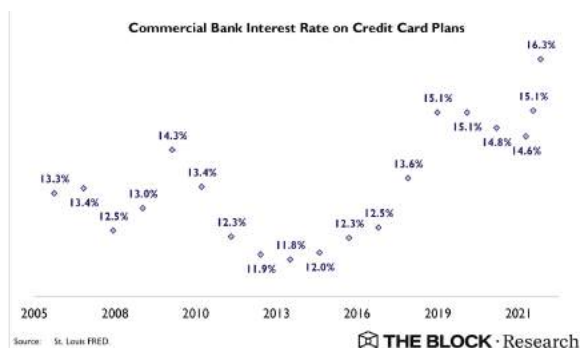


Figure 295: Commercial bank interest rate on credit card plans 2005 - 2022

Source: St. Louis FRED

Institutional Credit

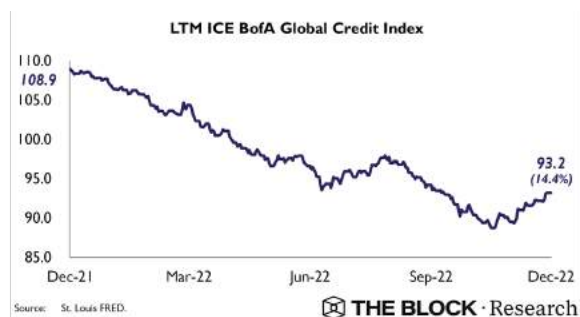


Figure 296: ICE BofA Global Credit Index since December 2021

Source: St. Louis FRED

Institutional credit markets reflect a (11.5%) return YTD and (12.1%) return last twelve months. ICE BofA Fixed Income indices provide a comprehensive view of the fixed income markets including investment-grade and high-yield bond issues that cover both developed and emerging market countries. Coverage includes both domestic and international bond markets, and performance can be denominated in a wide variety of currencies. Represents the ICE BofA AAA US Corporate Index value, a subset of the ICE BofA US Corporate Master Index tracking the performance of US dollar denominated investment grade rated corporate debt publicly issued in the US domestic market. This subset includes all securities with a given investment grade rating AAA.

High uncertainty surrounding global interest rates and their impact on spending and various asset classes creates a frothy short-term outlook. The inverted yield curve represents a leading recession indicator. The Block Research believes that as more asset classes, like real estate, capitulate, investors will need to liquidate holdings and pull back from trading activities to cover losses. It is unclear where digital asset holdings and trading volume fall in the hierarchy, but it is likely that blue chip assets like Bitcoin and Ethereum contract even further as investors cover losses in other asset classes and seek liquidity. Furthermore, with rising rates, investors can lend capital to the US government to capture this yield as opposed to risk their capital in high-volatility positions like digital assets.

Centralized Finance Blowups

Warren Buffet has famously quipped, “It’s only when the tide goes out that you realize who has been swimming naked.” As both asset prices and investment appetite in crypto declined in 2022, a spate of negative market events revealed multiple types of shoddy investment practices across some of the industry’s most reputable players. Specifically, this section outlines the following common strategies or events:

- The rise and collapse of Terra and the acute shock it dealt the market
- Circular webs of lending to counterparties that shared directional risk
- Rehypothecation and generally poor sources of collateral

To color these strategies, this section is organized around the key trading and lending firms that faced the greatest stress over the past year. Specifically, 3AC and

Alameda Research are the trading firms most impacted and culpable for the two large market events book-ending the past six months: the Terra crash and the FTX fiasco. This section also highlights lending businesses offering yield to retail investors: Voyager, Celsius, BlockFi, and Gemini (Earn), due to the strain felt by that market segment as credit dried up. Additionally, recent events regarding Genesis, the largest lender in crypto, along with its parent company Digital Currency Group (DCG), warrant inclusion.

Rise & Collapse of Terra

While the cascading failures of crypto businesses in 2022 have multiple interrelated causes, it is worth starting with the Terra collapse in May, as it was the first true “black swan” event of this market cycle.

The core product of the Terra protocol is its algorithmic stablecoin, UST. Unlike other decentralized stablecoins, UST is not directly backed by any crypto assets such as BTC or other stablecoins. Instead, the stability of UST is supported by Terra’s seigniorage mechanism, which allows anyone to swap 1 UST with \$1 worth of LUNA at any time. Theoretically, this mechanism creates an arbitrage opportunity whenever UST loses its \$1 peg, incentivizing the market to continually reestablish the UST peg. For example, if the price of UST rises above \$1, users can mint 1 UST by burning \$1 worth of LUNA, subsequently selling UST for a profit. This sell pressure on UST should then drive the price down closer to \$1. Conversely, if UST drops below \$1, arbitrageurs can buy UST at a discount (driving price up), swap for \$1 of LUNA, and sell for a profit.

By May 2022, Terra had become the second largest smart contract platform, with north of \$20 billion TVL. Its native token, LUNA, had reached a peak market

capitalization of over \$40 billion in April (hovering around ~\$30 billion in the days leading up to the crash), and the stablecoin, UST, had reached a market capitalization of over \$18 billion.

One of the core drivers for adoption was the ability to earn 19.5% yield on UST in a DeFi application called Anchor. While yield was sourced in part from staking rewards from other PoS assets including ETH and LUNA, it was heavily subsidized by Terraform labs and LFG. In the months leading up to Terra’s collapse, over 50% of UST’s supply had been deposited into Anchor. Due to its deposit growth, the yield reserve was losing ~\$5 million daily. This put Terra in a tough situation, where declining APY may encourage users to flee the Terra ecosystem, but retaining users carried an unsustainable cost.

On February 17, 2022, the Anchor yield reserve received \$450 million from LFG to bring the total up to \$507 million. On March 25, 2022, the Anchor community passed a governance proposal to implement a dynamic earn rate to ensure stability for the yield reserve. The earn rate would be adjusted if the yield reserve increases or decreases on a given time period.

Between May 7 and May 9, UST lost its peg, and in the following few days, the price of LUNA fell by over 99% as supply flooded the market while holders simultaneously looked to exit en masse. The exact dynamics of the crash are covered extensively in the [Algorithmic Stablecoins subsection](#).

The actions and exposure of relevant parties provide useful background for the impact on major market participants.

Luna Foundation Guard

One may argue that the whole point of an algorithmic stablecoin is that stability is guaranteed by designing the protocol in a way where any deviations from a \$1 peg should be arbitrated away. However, by the start of the year, in conjunction with UST's expansion into other ecosystems (such as Avalanche), Do Kwon, Terra's founder, embarked on a mission to build up exogenous collateral that could be used in periods of potential market volatility to defend the stablecoin. LFG was formed in January 2022 to support this goal. Per LFG's inaugural Medium [post](#) on January 20: "LFG's core mandate is to buttress the stability of the UST peg and foster the growth of the Terra ecosystem. Building reserves that backstop the peg of algorithmic stablecoins amid volatility and funneling resources into research that further advances what's possible with stablecoins are only just the beginning."

LFG was initially financed via gifts of LUNA tokens from Terraform Labs (i.e., core operating company behind the Terra ecosystem), which it could use to purchase collateral directly or burn to create UST, which could then be lent or used directly to purchase collateral. LFG received multiple LUNA grants from Terraform Labs over the period during which it accumulated external collateral.

LFG first sourced external assets via a \$1 billion OTC sale of LUNA on February 22. The [raise](#), one of the largest in the history of the crypto sector, was led by Jump Crypto and 3AC, with Republic Capital, GSR, Tribe Capital, DeFiance Capital, and other unnamed investors participating.

On May 5, LFG announced the purchase of \$1.5 billion worth of BTC for its stablecoin reserves. According to its

announcement, "LFG bought 37,863 BTC (\$1.5 billion) via [over-the-counter swaps with Genesis Trading and Three Arrows Capital](#). Of the \$1.5 billion, \$1 billion was an OTC swap with Genesis while the other \$500 million was acquired from Three Arrows Capital."

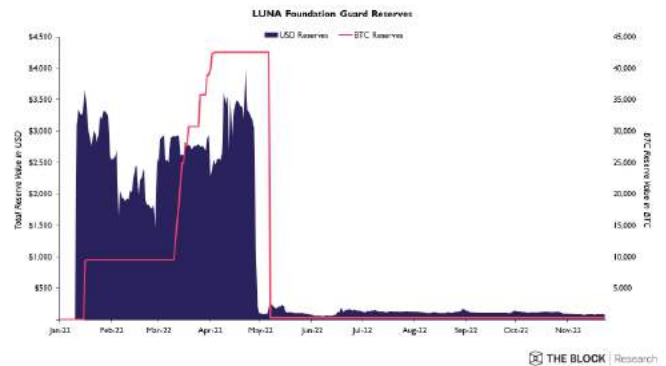


Figure 297: Luna Foundation Guard reserves in 2022

Source: Luna Foundation Guard, The Block Research

By May 12, all of the BTC in LFG's wallet had been emptied as LFG exhausted the vast majority of its reserves (313 BTC and some other assets remained, which LFG claimed would be used to compensate smaller UST holders) in its attempt to bring UST back to \$1. Clearly, these attempts were unsuccessful. The LFG also lent out ~\$1.5 billion in a combination of BTC and UST to various market makers and trading firms to help maintain the UST peg. Additionally, as a last-ditch effort, the LFG began reaching out to investment firms around May 9 to raise over \$1 billion to protect the UST peg. The terms would include selling LUNA to investors at a 50% discount, along with two years of vesting. However, the deal fell through, marking the final nail in the coffin for the foundation and the broader Terra ecosystem.

The next section will focus on the impact of this market event on the centralized hedge funds involved in the Terra ecosystem and the lenders exposed to them. However, it is worth noting that while this event

essentially removed tens of billions of dollars from the cryptocurrency markets and revealed inherent flaws in algorithmic stablecoin models in their current form, immediate impacts to other decentralized protocols could have been worse had Terra grown larger before crashing.

Specifically, just a month earlier, Terra founder Do Kwon boldly pronounced “the Curve wars are over”, launching 4pool, a stablecoin pool on Curve that pooled liquidity between UST, FRAX, USDC and USDT. At that point, the deepest stablecoin liquidity could be found in the 3pool, which consisted of USDC, USDT and DAI. These stablecoin pools are useful because smaller market cap coins can pair with them to benefit from their depth. Ironically, UST leveraged 3pool heavily as it grew on Ethereum and required a liquid market. However, with the [launch of 4pool](#), Kwon intended to

incentivize users (via Curve emission bribes) to withdraw their liquidity from 3pool and deposit into 4pool. On May 5, the vote to supply CRV rewards to 4pool was [approved](#). Had it not been for the collapse of UST days later, things looked very grim for 3pool, and potentially DAI.

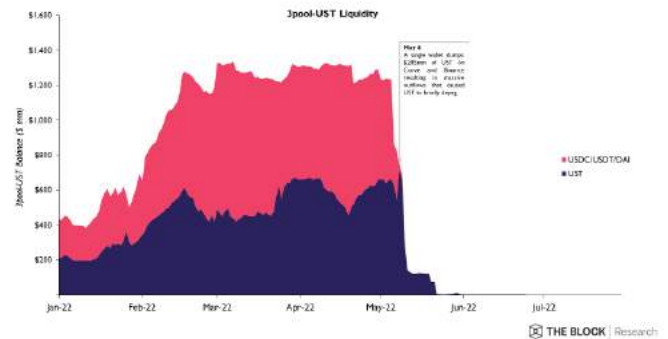


Figure 298: 3-Pool UST liquidity on Curve in 2022

Source: Dune Analytics (@mhonkasalo)

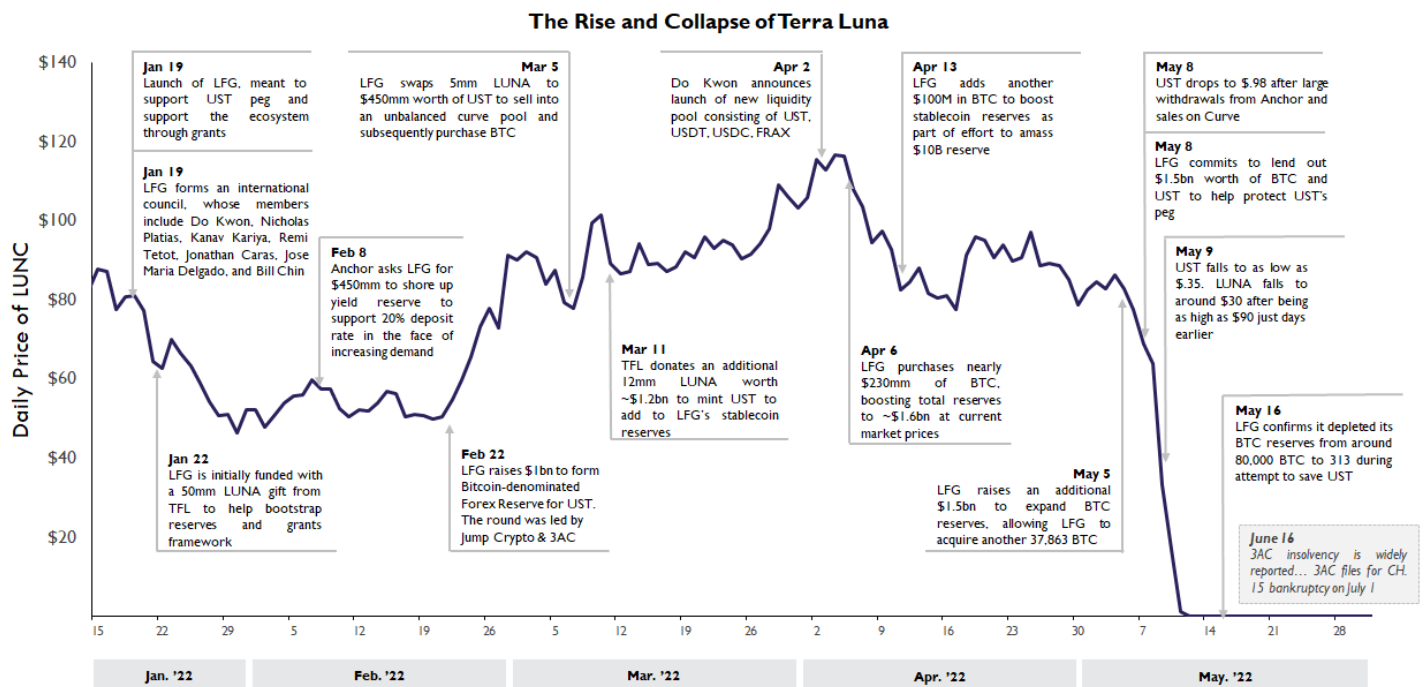


Figure 299: Chronology of events surrounding the demise of Terra in 2022

Source: The Block Research

We introduce this as a crisis averted because had 4pool actually grown to the size of 3pool and become as systemic within DeFi, the fallout of the UST collapse could have been far greater. And ironically, while centralized lending platforms began blowing up in the face of a market wide credit crunch in the following months, Maker, the decentralized lending protocol that issues DAI, operated exactly as intended.

Initial Unraveling of Lenders

The following sections will walk through various companies that went bankrupt, faced significant stress, or resembled the business models of impacted companies over the remainder of 2022. In sum, there are five bankruptcy cases that will be of particular focus:

- Three Arrows Capital (July 1, 2022)
- Voyager (July 6, 2022)
- Celsius (July 13, 2022)
- FTX & Alameda Research (November 11, 2022)
- BlockFi (November 28, 2022)

First Arrow to Fall

As soon as Terra collapsed, the crypto community looked to the major investors most publicly associated with the project. Given their involvement in the financing of LFG, along with publicly known positions in LUNA, creditors were quick to question 3AC.

The hedge fund was founded and run by Su Zhu and Kyle Davies, who met at Philips Academy. Both attended Columbia and later worked at Credit Suisse. The firm was founded in 2012 when the two were arbitraging emerging market foreign exchange derivatives, but by 2018 was [exclusively involved in the cryptocurrency market](#). Its total AUM was never

publicly confirmed. Internal documents show that assets grew to be worth over \$3 billion as of April 2022, though Nansen, a crypto analytics firm had estimated the firm held \$10 billion worth of crypto assets in March.

Trading Woes

Of 3AC's portfolio, a significant portion was LUNA and UST. Specifically, as part of 3AC's participation in LFG's February 2022 token sale, 3AC assumed a \$200 million position in LUNA, according to Kyle Davies' statement to the Wall Street Journal. In total, 3AC's affidavit claimed that the company held [~\\$600 million](#) in UST and LUNA as of May 9.

Still, there is speculation that 3AC's exposure to Terra could have been even larger. In June 2022, it was alleged by a whistleblower from the Terra community forum that 3AC had [purchased 10.9 million locked LUNA](#), originally valued at close to \$560 million, but whose value at the time of disclosure (June 14, 2022) had fallen to \$670.45. So, there are at least three potential scenarios that arise for 3AC. First, 3AC only lost its initial \$200 million investment; second, 3AC lost \$560 million which represented an accumulated LUNA investment (\$200 million plus \$360 million); or third, 3AC lost \$760 million which represented a cumulative LUNA investment (\$200 million plus \$560 million).

3AC was also heavily involved in the GBTC arbitrage trade, which was a profitable trade strategy when GBTC shares were trading at a premium to NAV in 2020. Investors would borrow BTC and exchange those with the trust for GBTC shares. After the six-month lockup, investors could sell their shares in the secondary market to retail investors at a premium, pay back the borrowed BTC and keep the rest as profit.

When The GBTC premium turned into a discount, this trade trapped traders who were locked in for six months. Over the past two years, [the discount has only grown](#), sitting at ~30% in May and June 2022, and now ~40% at the end of November 2022. 3AC borrowed heavily to finance this trade and was known to be one of the largest holders of GBTC. Given that 3AC used GBTC as collateral in its 2019 and 2020 loans with Genesis totaling \$2.6 billion (interestingly, Genesis and Grayscale, the manager of the GBTC trust, are both owned by DCG), it is possible that 3AC was able to build up significant amounts of leverage by using the borrowed money (against GBTC collateral) to further participate in the GBTC strategy.

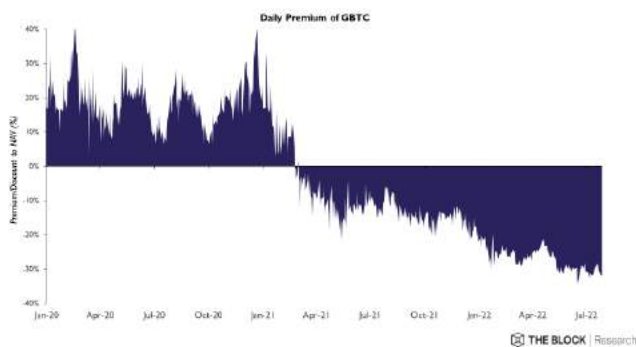


Figure 300: Daily premium/discount of GBTC 2020 - 2022
Source: The Block Research

The third largest opportunity 3AC had pursued was liquid staking on Lido. Lido is an Ethereum DeFi platform that allows users to deposit ETH, allowing them to earn passive income from ETH staking along with a stETH token that represents their staked balance. The benefit of this approach is that the stETH is liquid and can be used for other purposes, such as collateral. Some traders had built up massive amounts of [stETH leverage](#) by using stETH as collateral in Aave loans for ETH, depositing ETH into Lido for stETH, and repeating the cycle. Sometimes stETH trades at a slight discount to ETH. For example, during the Terra

collapse, Nansen reported that 615,980 bETH (staked ETH on Terra) was bridged back to Ethereum and unwrapped back to stETH. stETH was then sold back to ETH, creating pressure on the stETH price. Since 3AC was a large holder of stETH and used it as collateral for loans, deviations from the price of ETH placed immense stress on its on-chain activities. More information on liquid staking can be found in its [Liquid Staking subsection](#) of this report.

Time to Pay the Piper

3AC also maintained trading books across different venues. While the exact timing for each counterparty is not known, by mid-June, multiple creditors and trading venues had initiated margin calls. According to the affidavit of Jos van Grinsven, who serves as Head of Compliance at Deribit, the leading crypto options venue, 3AC's account breached its margin limit. Deribit began working with 3AC to liquidate their positions via a Telegram conversation, where 3AC discussed sending the additional collateral (BTC and ETH) required to top up their account. However, 3AC stopped responding, prompting Deribit to fully liquidate the account on June 15. By June 20, the account had a negative asset value of 997.3101 BTC and 15,911.1270 ETH (\$37,162,616.80). In addition, Deribit had provided 3AC with 1,300 BTC and 15,000 ETH in aggregate interest-bearing loans over a two-year period (\$42,252,859). With interest, this puts the current amount outstanding to Deribit at over [\\$80 million](#).

As trading balances dwindled and margin calls loomed, 3AC frantically attempted to raise cash, first by sourcing new lines of credit. On June 7, 3AC circulated an investment deck [pitching a GBTC arbitrage trade](#) ahead of a SEC ruling on whether GBTC could convert into an ETF, which would collapse the discount. This is

interesting given 3AC’s existing exposure to GBTC. Not only would the excess capital provide breathing room for the fund, but it could be used to potentially increase the value of an asset it held a lot of and used as collateral in two of its loans, including that of Genesis, its largest creditor. It was also claimed that when 3AC realized they probably could not raise any new capital, they began liquidating existing assets, much of which was on-chain.

Meanwhile, large lenders started making capital calls. Between June 15 and June 24, 24 different firms demanded capital back, totaling over \$3 billion. The largest of which being Genesis, whom they owed \$2.3 billion. Notably, Voyager, a crypto lending platform that will be covered later in this report, had an exposure of 15,250 BTC and 350 million USDC (total of ~\$660 million) to 3AC, and had requested repayment on June 22, to be paid in full by June 27. When the required

payments were not made, Voyager issued a notice of default to 3AC.

Date	Event
May 12	Luna collapse prompts creditors to message 3AC asking about their Luna exposure. Su Zhu responds that there is nothing to fear and Luna positions are publicly known.
May 13	Davies signs letter to creditors that 3AC has a net asset value of \$2.387 billion
May 18	Co-founder Kyle Davies tries to prevent loans from getting called.
June 3	Interest rates raised on loans due to market conditions.
June 7	3AC team pitches investors on new GBTC opportunity
June 11	3AC's trading account on Deribit breaches margin requirement triggering liquidation
June 13	Davies tries to arrange a new loan from Genesis to pay the margin call.
June 14	3AC sold about \$20 million worth of its stETH holdings in an apparent attempt to pay back its debt.
June 14	3AC transfers over \$30 million worth of stablecoins to a Cayman Islands company owned by Zhu and Davies's partner, Kelly Kaili
June 16	3AC insolvency widely reported
June 27	Voyager Digital LLC notified 3AC of default after the fund failed to repay loan payments on time.
June 27	Singaporean court orders 3AC to liquidate
July 1	3AC files for chapter 15 bankruptcy

Figure 301: Event timeline of the 3AC collapse in 2022
Source: The Block Research

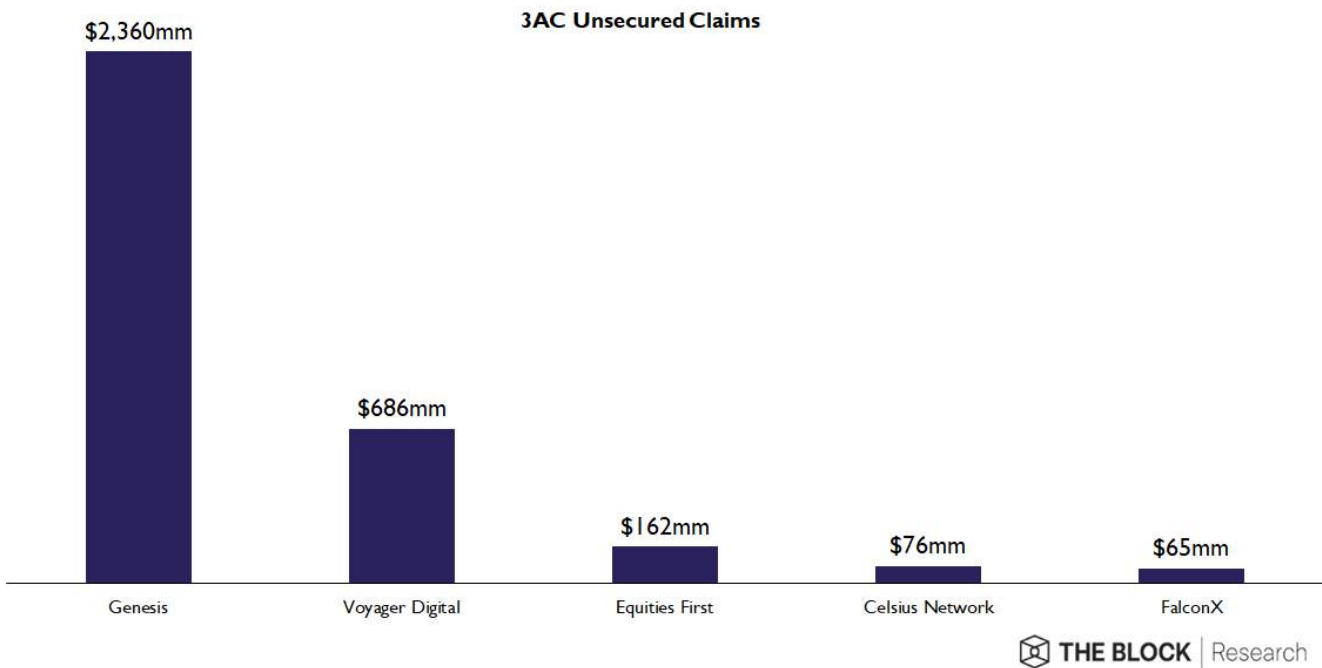
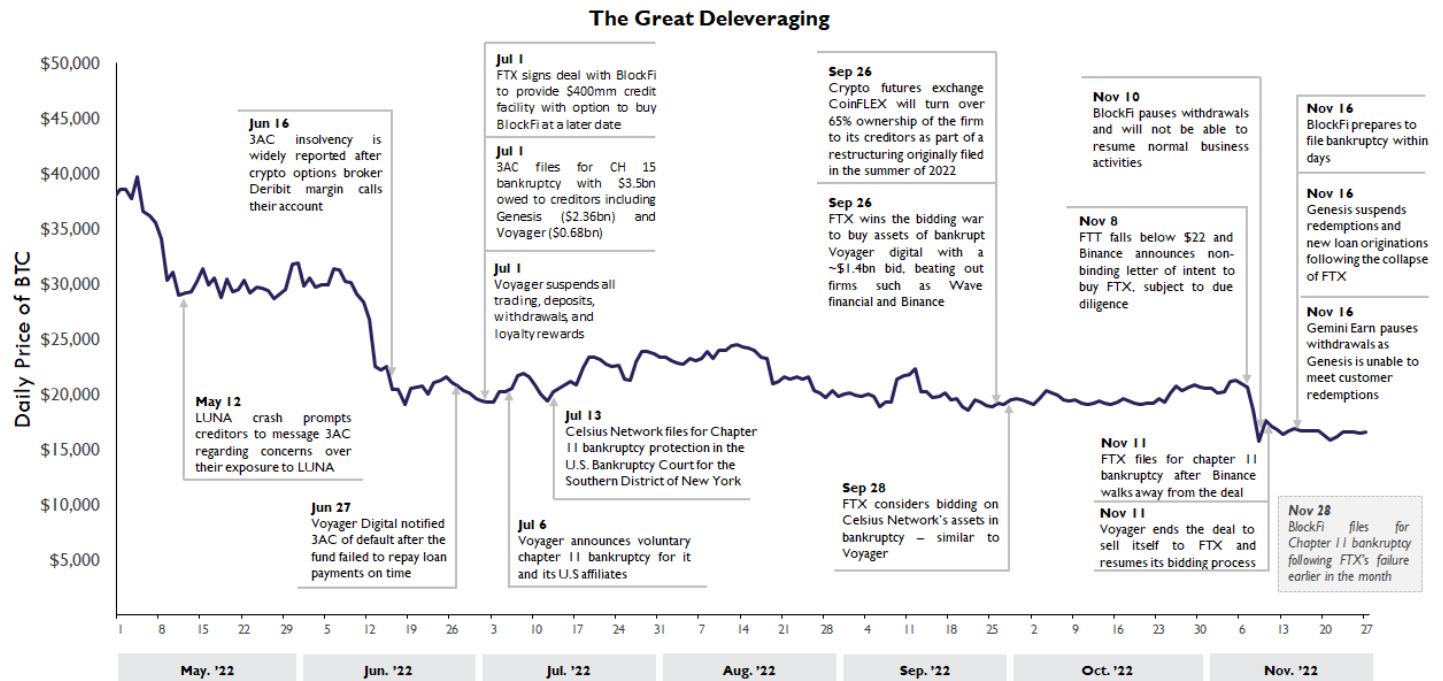


Figure 302: 3AC unsecured claims
Source: Public filing



THE BLOCK | Research

Figure 303: Chronology of events surrounding insolvent crypto firms in 2022

Source: The Block Research

The Next to Fall

The falling price of cryptocurrencies and psychology associated with collapsing firms created an inherent issue for businesses that relied on retail deposits for the remainder of the year. Particularly during market crises that tended to be characterized by lower asset prices and limited credit, depositors increasingly withdrew from these platforms exacerbating the stress.

During the days and months following the collapse of 3AC, multiple lending and trading platforms either collapsed, halted withdrawals or began some sort of restructuring process. While these events are unfolding, the remainder of this section will focus on two notable examples of lenders filing for bankruptcy over the summer, following their developments through the fall.

Voyager

Voyager, whose core business was lending digital assets deposited by users to third parties, was the following firm to file for bankruptcy. As discussed above, Voyager was a direct creditor to 3AC, which officially defaulted on June 27. While 3AC, Alameda and Celsius both had nuances to their investment strategies worth investigating, for Voyager, it was really just a case of bad counterparty risk management.

Voyager's strategy was to lend to leading crypto funds in order to generate yields to pay retail depositors. This worked well when times were good, but collapsed once the music stopped in June. Specifically, the failure of 3AC, which was widely regarded as a top fund, to pay up on their loan by June 27 forced Voyager to mark the fund as having defaulted.

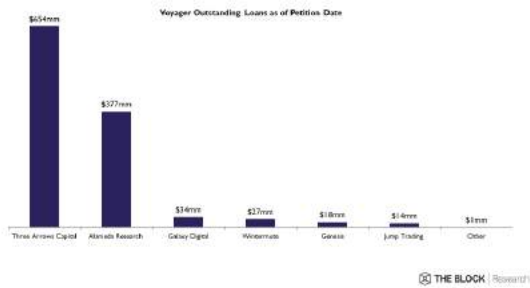


Figure 304: Voyager outstanding loans as of petition date
Source: Public filings

In conjunction with the issues created by the Terra and 3AC collapse, on June 13, Celsius Network paused all account withdrawals, leading to further asset price corrections and a bank run for Voyager with mass withdrawals and liquidations. Due to the reliance on broader market participants and the circular nature of their brokerage, custody and lending services, Voyager lowered withdrawal limits on June 23, from \$25,000 to \$10,000 per day. Because Voyager lends out deposits, a bank run would cripple their entire ecosystem and business operations. Finally, on July 1, Voyager froze all withdrawals and trading activity.

FTX's Rescue: "White Knight" or Brazen Opportunist?

At time of bankruptcy, 3AC remained the largest debtor, followed by Alameda Research, which had a \$377 million loan outstanding. Interestingly, at the time of 3AC's default, Voyager turned to Alameda to provide Voyager with a loan facility totaling \$200 million in cash and 15,000 BTC. At the time of Voyager's bankruptcy, Voyager had drawn \$75 million from the loan facility. This left a scenario in which Alameda represented 43% of Voyager's top 50 unsecured claims, with the remaining 57% attributable to customer deposits.

Fast forward to July 22, FTX Trading, West Realm Shires and Alameda Ventures made an attempt to purchase

Voyager Digital customers' unsecured claims including digital assets and loans outstanding. Under the terms of the agreement, Alameda would purchase Voyager's digital assets and loans (except for loans made to 3AC), giving Voyager customers a faster path to liquidity on Voyager's remaining assets at a haircut. Given these assets and/or cash equivalent would be redeemable on FTX, the offer was viewed publicly as a land grab from a well-capitalized company looking to grow its deposit base. Voyager [rejected the deal](#), claiming the offer as a "low ball" and "publicity stunt," sending the question of ownership of Voyager's digital assets to auction. This did not deter FTX, which on September 26 submitted the winning \$1.422 billion bid for control of Voyager's assets. The price accounted for FTX's estimation of a \$1.311 billion market value for the assets plus an additional \$111 million in value, and [the deal](#) was inclusive of all claims against 3AC. With the deal, depositors would expect to recover 72% of assets.

Between FTX's unsuccessful July 22 offer and its successful September 26 bid, Voyager began the process of collecting repayments of loans from its debtors. Specifically, on September 19, Voyager filed an announcement detailing Alameda's repayment of their \$200 million loan, which was primarily comprised of BTC and ETH worth ~\$193.2 million at time of filing. In return, Voyager Digital would return Alameda's collateral which reflected 4.7 million FTT and 63.8 million SRM tokens. At the time of the Master Loan Agreement, September 2, 2021, the collateral was worth ~\$886.3 million. At the time of the filing, the collateral reflected just \$158.8 million.

In the following section dedicated to FTX, we will unpack the significance of this deal in greater detail and track latest developments pertaining to Voyager. However, now let's look at the other large yield

platform, Celsius, which filed for bankruptcy protection just a week after Voyager did in June.

Date	Event
June 27	Voyager issues notice of default to 3AC for 15,250 BTC and \$350M USDC unsecured loan worth \$625M in total
July 1	Voyager suspends all trading, deposits, withdrawals, and loyalty rewards in response to 3AC exposure (Shares plunge more than 26% in U.S trading)
July 5	Voyager digital and two affiliates file for chapter 11 bankruptcy protection
July 6	Voyager announces voluntary chapter 11 bankruptcy for it and its U.S affiliates
July 22	Voyager receives an unsolicited bid from FTX to buy out all of Voyager's assets and outstanding loans — except the defaulted loan to 3AC — The offer is rejected and seen as predatory (FTX owes Voyager \$377M and FTX extended \$70M to Voyager in a line of credit which is secondary to customer deposits)
Sep 26	FTX wins the bidding war to buy assets of bankrupt Voyager digital with a ~\$1.4B bid, beating out firms such as Wave financial and Binance
Nov 11	Voyager ends the deal to sell itself to FTX after FTX itself files for bankruptcy — Voyager additionally announces that it has \$3M locked on the platform
Nov 11	Voyager Digital and the official committee of unsecured creditors announced that they are resuming the sale process and are in active talks with alternative bidders
Nov 11	Voyager announces they have a \$5M good faith deposit from FTX US currently being held in escrow. Additionally, Voyager was able to get back 6,500 BTC and 50,000 ETH from Alameda and no longer has any outstanding loans with any borrower

Figure 305: Event timeline of Voyager insolvency in 2022

Source: The Block Research

Celsius

Celsius is essentially a crypto retail bank offering a yield on user deposited assets. The company aims to profit on the spread between the interest it pays on deposits and the return it receives from lending those deposits out. However, this description doesn't tell the whole story: since early 2021, when DeFi was booming, Celsius rapidly became more brazen in its attempts to generate high yields. Unlike Voyager, Celsius actively managed a portfolio of on-chain strategies, acting more like a hedge fund than a bank and creating a complex web of profit and losses.

Celsius' yield generating activities can be broken down into five categories: institutional lending (e.g., lending to institutions, exchanges, and other counterparties on terms set off-chain), retail lending (e.g., Celsius allows users to borrow stablecoins against their crypto assets at an advertised interest rate), Bitcoin mining, DeFi deployments, and other trading strategies.

Celsius was one of the biggest players in DeFi, actively allocated billions of capital and accounting for a huge portion of the funds deployed to the three largest DeFi protocols – Compound, Aave, and Maker. Notably, a lot of the strategies deployed by Celsius relied on leverage; on-chain analysis of Celsius wallets indicates that Celsius had billions of dollars in leveraged positions on DeFi protocols that were threatened with liquidation in the June crypto market crash. The fragility of Celsius' leveraged positions forced the company to deploy \$750 million of liquid assets – funds that could no longer be used to honor customer withdrawals – across Maker, Aave, and Compound to [protect their positions from being liquidated](#).

On the trading side of the business, in order to generate the high ETH yields it advertised, Celsius converted customers' ETH into stETH – liquid staked ETH that can be further lent out to generate additional yield (besides ETH staking yield). This almost got them into trouble when they managed to narrowly escape insolvency in May by withdrawing ~\$535 million worth of stETH from Anchor just prior to Terra and UST's collapse. After the May incident, [Celsius sent nearly all of its stETH to the Aave lending protocol](#) as collateral, against which it promptly took on ~\$145 million worth of stablecoin debt. Amid the market crash, fears of a broad crypto asset selloff triggered by forced liquidations of Celsius' on-chain positions grew to a head around June 8-9, when Celsius withdrew a total of 50,000 stETH from Aave and deposited the funds to FTX, presumably signaling an OTC deal that would help pay down its debts. Ultimately, Celsius – similar to 3AC – painted themselves into a corner with the stETH carry trade; with 409,000 stETH deposited into Aave and 127,000 ETH remaining in Compound, Celsius would have no way of offloading their stETH without incurring

substantial losses from slippage, not to mention from the struggling stETH price.

In addition, Celsius remarkably [sent over \\$500 million worth of customer assets to a pseudonymous group of traders](#) known as “0xB1,” with “no formal written agreement between the parties.” The strategies used by 0xB1 proved to be ultimately unexceptional, [incurring a loss of \\$350 million](#) compared to simply holding those assets. Celsius incurred further losses (35,000 ETH) when liquid staking platform Stakehound announced they had lost the keys to over 38,000 ETH tokens.

A [lawsuit between the entity behind 0xB1 and Celsius](#) sheds further light on Celsius’ basic failure to hedge against trading risks. 0xB1 alleges that, since Celsius failed to maintain ETH holdings equal to ETH-denominated user liabilities (deposits), it incurred heavy losses when it was forced to buy more ETH in the open market at higher prices to service ETH withdrawal requests. 0xB1 also alleges that, in response, Celsius became a de facto Ponzi scheme, as it began offering double-digit interest rates in order to lure in new depositors whose funds could be used to repay earlier depositors and creditors.

At a high level, the collapse of Celsius can be attributed to poor management of their (customers’) assets, in the futile chase of unsustainably high yields during a prolonged market downturn. It is very unlikely Celsius possessed the level of skill, sophistication, and specialized personnel required to operate as a de facto hedge fund, especially since it seemingly started out as a more traditional lender. In particular, their \$50 million loss in the \$120 million BadgerDAO hack also illustrates their lack of sophistication. The hack was apparently carried out through a front-end exploit, which indicates

that Celsius managed some of its assets in a Metamask wallet, with [no multi-party computation or multi-sig](#).

In addition to negligence and lack of skill, there are also signs of potentially fraudulent activity. On-chain analysis of Celsius’ wallets and their CEL transactions show that Celsius was purchasing hundreds of millions of dollars of its CEL token to pay out to users electing to be paid in CEL. One possible explanation for purchasing CEL rather than distributing it from its own treasury is that Celsius was trying to prop up the price of CEL, and consequently the wealth of CEL whales such as CEO Alex Mashinsky. At the same time that he was promoting CEL to users and denying that he was selling the token, Mashinsky appears to have been quietly [selling tens of millions of dollars worth of CEL](#), as indicated by activity on [eight Ethereum addresses identified as likely belonging to Celsius' CEO](#). In particular, Mashinsky tweeted on December 9, 2021, “All @CelsiusNetwork founders have made purchases of #CEL and are not sellers of the token.” While just 5 days earlier, a suspected Mashinsky address sold 11,000 CEL.

Building a banking business on the model of high yield at low risk is a perfect model in theory, but in practice it requires finding someone who will take the other side of the trade. If other lenders agreed that a loan was low risk then it would not be high yield, so you have to rely on systematically beating the market. This is hard to do with billions of dollars of capital at rates many times those of conventional low-risk loans, especially if you do not nearly possess the level of sophistication required to do so.

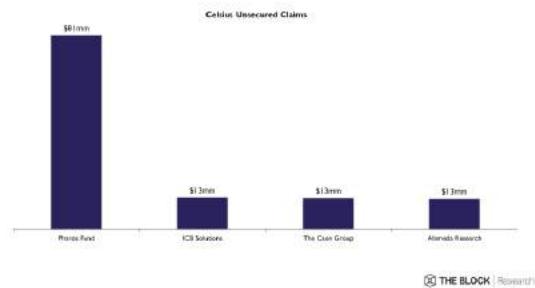


Figure 306: Celsius unsecured claims
Source: Public filings

Taking a look at Celsius’ creditors, It is worth noting that Pharos Fund, which has a \$81 million claim, was reported to have [close ties to Alameda Research](#), another Celsius creditor, and FTX.

Date	Event
2022 (June)	Stake found misplaced keys resulting in 26,000 ETH loss for Celsius
2022 (Dec. 15)	Celsius announces it had lost money in Badger DAO hack. On-chain researchers estimated that it was to be ~\$90M
April 12	Celsius Network shows no first signs of distress by announcing it is a U.S. platform and begins holding non-accrual investors' coins in custody, where investors will no longer be able to add new assets and can no longer use Celsius Earn platform
May 21	Celsius announces withdrawal from Celsius, estimated \$250 million worth of USDT from Celsius just prior to Terra and LUNA collapse. Celsius sent nearly all of its USDT to the Aave lending protocol as collateral for a loan, which it also promptly took on about \$45 million worth of stablecoin debt as well
May 25	Celsius Network fails to post its regular, weekly report of its assets
June 8	Celsius sold about \$6.06B of ETH from its Reserve deposits in order to pay down its debts
June 12	Celsius also reported about 4,706 WBTC - worth about \$1.43 billion as of this writing - to its Stakeholders in order to prevent liquidation
June 12	Celsius issues withdrawal, suspension and disclaimer to "extreme market conditions," stating that the platform has become deeply insolvent
June 30	Celsius hires restructuring expert Alvarez & Marsal to explore the firm's options to reorganize the failed crypto med. business
June 30	Reported that FTX passes on a deal to purchase Celsius
July 2	Celsius lays off about 22% of its workforce a month after passing user withdrawals and transfers, as the company faces mounting liquidity issues
July 15	Celsius Network files for Chapter 11 bankruptcy protection in the U.S. Bankruptcy Court for the Southern District of New York
July 14	A court filing from Celsius' advisory partner Alvarez & Marsal reveals Celsius has a \$1.3 billion hole in its balance sheet. The filing marks the first time Celsius has acknowledged the hole in its balance sheet
July 24	Celsius has over 100,000 creditors with largest being Pharos an entity owed \$81M, the most of any creditor with Alameda on a claim of itself being owed \$13M (via Bloomberg reported). Thursday, the only email linked to Pharos on the bankruptcy filing originated with Lantier Ventures, a British crypto money trading firm - and not a CEO and largest shareholder in Terra Money, a co-founder of Alameda Research

Figure 307: Event timeline of Celsius insolvency in 2022
Source: The Block Research

Collapse of FTX & Alameda Research

While crypto markets traded sideways or down alongside macro in H2 2022, it is worth shifting attention to the more recent market crisis pertaining to the FTX and Alameda insolvency. The event is certainly notable in its own right, but it also helps indirectly explain some of the rescue packages from the summer, along with more directly leading to further collapses that are currently unfolding.

Over the course of 2021 and 2022, FTX emerged as one of the most central players in the crypto ecosystem,

established a dominant brand presence through celebrity endorsements and aggressive advertising campaigns, and became a leading crypto voice in Washington DC. FTX also came to embody the coming mainstream adoption and acceptance of crypto from a product perspective, as the company pursued licenses in the US, submitted proposals for regulated financial products to trade on its platform, and began building out suites of products to enable more mainstream game developers and payments providers. Additionally, FTX had taken in capital from some of the most distinguished investors in the world, ranging from blue chip venture capital and private equity firms, to pension plans and sovereign wealth funds, further cementing the firm’s institutional credentials.

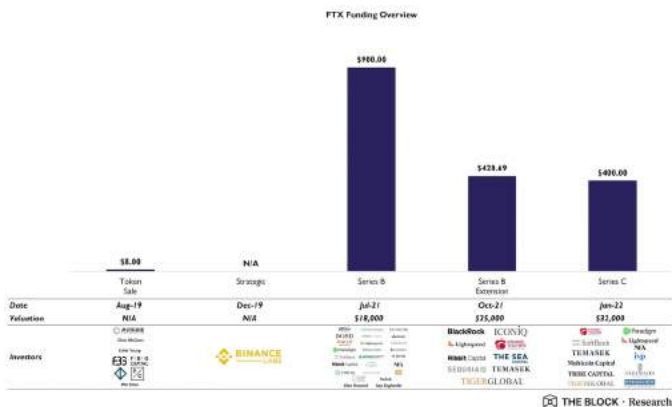


Figure 308: FTX funding overview
Source: The Block Research

Roughly estimating the revenues of a crypto exchange is not rocket science. Exchange volumes can be sourced directly from APIs or on the websites of multiple data aggregators that list volumes by exchange, and each exchange lists its fee structure online. FTX did \$612 trillion in spot and \$2.9 quadrillion in futures volume in 2022, with FTX US adding an additional \$65 billion in volume within the lucrative US market. So one might wonder, how could a business that is seemingly

printing money go bankrupt and why would management enable risks to jeopardize it?

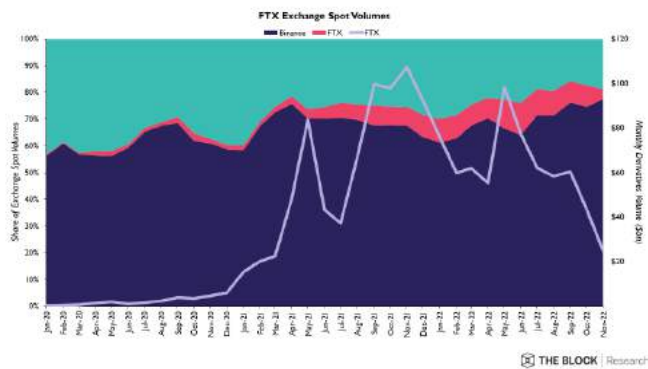


Figure 309: FTX spot volume and market share 2020 - 2022

Source: The Block Research

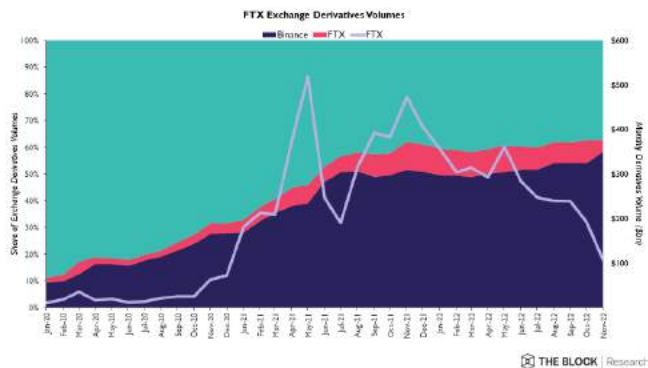


Figure 310: FTX derivatives volume and market share 2020 - 2022

Source: The Block Research

Alameda Research: Poor Trading Sowing the Seeds of Collapse

Alameda Research was a secretive quantitative trading firm founded around October 2017 by Sam Bankman-Fried and Tara Mac Aulay, which later filed for bankruptcy in November 2022 along with its sister company FTX in a plot twist that shook the crypto market to its core. Notably, in what can now symbolically be interpreted as a crossroad of sorts for Alameda, co-founder Tara Mac Aulay along with a group of other employees decided to quit Alameda only 6 months after its founding, citing concerns over

Bankman-Fried's business ethics and risk management.

After the latter's spectacular fall from grace enabled the general public to finally get a glimpse into the inner workings of secretive Alameda Research, it might be said that Alameda's undoing was baked in from the very beginning, via the culture instilled by Bankman-Fried. This appears to have been a culture epitomized by extreme recklessness and hedonism, one that glorified untenable and short-sighted practices, such as [use of stimulants](#) or working to exhaustion.

In January 2018, soon after founding Alameda, Bankman-Fried organized an arbitrage trade to take advantage of the higher price of BTC in Japan compared to the price in America, which netted around \$20 million. Obviously, this was no trivial task as – in Bankman-Fried's words – it required putting together an “incredibly sophisticated global corporate framework.” However, according to an alleged former Alameda employee, most of the profits earned from this trade had been subsequently lost over the next 2 to 3 months to [a series of bad trades and egregious mismanagement of assets](#):

“Examples included some number of millions lost to a large directional bet on ETH (that Sam made directly counter to the predictions of our best event trader), a few million more on a large OTC trade in some illiquid shitcoin that crashed long before we could get out of it, another couple million in a series of XRP transfers that nobody noticed had never arrived, and that had fallen in value by something like 90% when they finally showed up much later, and various other random small things like a junior trader accidentally transferring half a million dollars of USDT to a BTC address [...] due to a complete lack of safeguards on transfers, etc. Not to mention absurd levels of expenditures, e.g. an AWS bill that at one point reached about a quarter million dollars per month.”

Such a scale of organizational failure and reckless risk-taking is consistent with the timeline and reasoning cited for the April 2018 exodus of co-founder Mac Aulay along with a number of other employees.

If true, this anecdote from early on in the life of Alameda perfectly encapsulates its subsequent trajectory, succinctly painting a paradoxical picture comprising both extremely clever wins and absurdly thoughtless losses. Remarkably, Bankman-Fried learned nothing from such costly failures in fundamental systems such as operational security and accounting, as it was revealed by Alex Pack who was considering investing in the company in early 2019 that Alameda was unable to provide him with an answer to a basic inquiry regarding [the origin of a \\$10 million loss](#) incurred in an earlier month. More recently, shocking revelations also surfaced about the manner in which FTX was run, including but not limited to their (lack of) basic accounting or their use of an unsecured group email account for storing unencrypted wallet private keys.

Alameda initially managed around \$55 million, capital that came from a mix of the group's own funds and high-interest cryptocurrency loans from wealthy investors, according to a [2018 firm presentation](#) viewed by The New York Times. Based on archived versions of their website, Alameda's AUM grew to over \$100 million by August 2019 and over \$1 billion by July 2021. The company blurbs recorded in these archives also shed light into the massive scale of Alameda's operations, with daily trading volumes as high as 5-10 times their AUM, spread across thousands of products; for example, in July 2021 the landing page stated:

"We manage over \$1 billion in digital assets and trade \$1-10 billion per day across thousands of products: all major coins

and altcoins, as well as their derivatives. We have a full-scale global operation with the ability to trade on all major exchanges and markets."

Not only the scale, but also the scope of Alameda's strategies can be described as ambitious, encompassing market making, arbitrage, [MEV](#), OTC quoting, and [DeFi](#). It is difficult to fathom how Alameda could successfully carry out operations of such scale and scope, given their trademark disregard for basic bookkeeping. One answer might be, simply, that they could not; according to 2021 tax returns, Bankman-Fried's businesses, which primarily consist of Alameda Research and FTX, had posted a [net loss of \\$3.7 billion](#) since their inception in 2017 and 2019, respectively.

This is counter to the [theory](#) that the seeds of Bankman-Fried's downfall were sown in 2022, when Alameda reportedly took huge losses after Terra's implosion. It is difficult to say – possibly even for those directly involved – when the brunt of Alameda's losses took place, but a popular theory for why the losses occurred in the first place is that at some point Alameda lost its competitive edge as more experienced firms like Jump Crypto ramped up their crypto trading business; in response, [Alameda moved away from its initial focus](#) on making high-speed, market-neutral bets that did not depend on predicting if cryptocurrency price would rise or fall towards less sophisticated strategies such as discretionary positions and [news/event-based trading](#). For example, by early 2022, Alameda had invested [several billion dollars](#) in directional, unhedged, illiquid, and/or long-term investments, funded through loans from digital asset lending platforms, traditional bank lines of credit, and its unlimited borrowing abilities on FTX (including its access to customer funds).

In this scenario, even though their market making activities had been hemorrhaging money, Alameda either did not realize this because of shoddy bookkeeping, or they justified keeping those systems running on the rationale that, when considering the Alameda-FTX conglomerate, the results were still net positive, as the inflated trading volumes generated by Alameda on FTX would [justify higher venture valuations for the exchange](#) (and its FTT token). The latter theory seems highly plausible, given [revelations](#) that Bankman-Fried seriously considered shutting down Alameda but ultimately decided against it citing the interconnectedness between Alameda and FTX. That doesn't completely exclude the first theory from also being a factor: if FTX/Alameda only had a vague understanding of their books, especially considering the incredible amounts of money that FTX expended on advertisements, branding deals, and other discretionary expenses, it is possible that the Alameda-FTX conglomerate [did not realize the severity of their situation](#) until their [loans started being recalled](#) after the Terra implosion.

That Alameda may have been hemorrhaging money long before Terra is surprising, running counter to Alameda's notoriety as one of the most [sophisticated](#) and ruthless players in the market. This reputation is, no doubt, part of the reason why virtually everyone was blindsided by the collapse of Bankman-Fried's house of cards. Given their apparently huge trading volumes, they definitely amassed a lot of resounding wins among their potential losses; some of these wins they publicized themselves while others seeped into the collective consciousness anecdotally, usually via disgruntled retail traders caught on the other side of the trade.

Indeed, Alameda had developed a reputation for [aggressively yield farming](#) (i.e., using a protocol to generate token-based rewards) and selling those tokens back onto the market, including [farming over \\$1 billion on Iron Finance](#), whose seigniorage token eventually collapsed spectacularly. Other Alameda strategies border less on the unsavory and more on the illegal, as – according to public data reviewed by The Wall Street Journal – Alameda amassed a total of \$60 million worth of various crypto tokens [ahead of FTX announcing it would list them](#). Coming back to DeFi, Alameda also [interacted frequently with cross-chain bridges](#), possibly in an attempt to perform cross-chain arbitrage. Given that many bridges ended up being exploited for large amounts of money, Alameda may have suffered some losses there. More information on hacks and exploits that happened in 2022 can be found in the [DeFi Exploits subsection](#).

Whether Alameda was losing substantial amount of money before Terra's implosion or not, it seems that Terra was the single most devastating blow to Alameda, who took huge losses during the debacle which all but sealed its fate. Alameda was the “backstop liquidity provider” on FTX, injecting liquidity to cover large liquidations that could otherwise result in a possible bankruptcy for FTX. If, as a result, it [absorbed an exorbitant amount of LUNA and UST](#), Alameda would have had no way to offset the losses. Terra-fueled liquidations may have further impacted Alameda's balance sheet as counterparties defaulted on loans.

In addition, the sharp market downturn fueled by Terra's collapse also crippled Alameda indirectly, who had been taking on excessive leverage collateralized by largely illiquid coins such as SRM and FTT (FTX's own token). Notably, only a tiny portion of FTT was traded in

public markets, with FTX and Alameda holding the vast majority of its reserves, whereas SRM had similar tokenomics. So while those holdings were effectively illiquid – impossible to sell at the open market price – Alameda was nevertheless taking out loans marked at these fictitious prices.

This highly reflexive bet would blow up in their face when the market downturn caused a lot of selling pressure on FTT/SRM prices, forcing Alameda to buy up these coins to prevent their prices from tanking and their collateral from being liquidated. These overleveraged, poorly collateralized bets would explain why Alameda ended up with a balance sheet dominated by FTT. Similarly, it is speculated that Bankman-Fried was all but forced to bail out Voyager and BlockFi to prevent them from liquidating the substantial amount of FTT/SRM collateral they held, which would negatively impact every other loan that Alameda has taken against these tokens. Interestingly, Bankman-Fried reportedly stated privately that he was pursuing an [aggressive acquisition strategy](#) in part to gain access to additional sources of capital that could be used to support his existing businesses and fill the hole in customer funds that had been created.

Finally, it is worth noting the massive amounts of capital Alameda spent out of its venture capital arm. Alameda allocated a total of \$5.3 billion, spread across equity or token investments in startups (\$3.2 billion) and investments in other funds (\$1.1 billion).

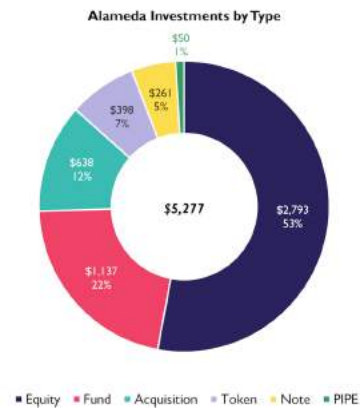


Figure 311: Alameda investments by type
Source: Financial Times

Unpacking the Fallout of the FTX Collapse

As has become customary, we will use this section as an opportunity to walk through the strategies and downfall of another centralized crypto business, BlockFi being the most recent to file for bankruptcy. However, before recapping BlockFi's tumultuous year, it is worth quickly highlighting two other businesses, Genesis and Gemini, which faced stress as a result of the FTX and Alameda bankruptcy, though events are still unfolding.

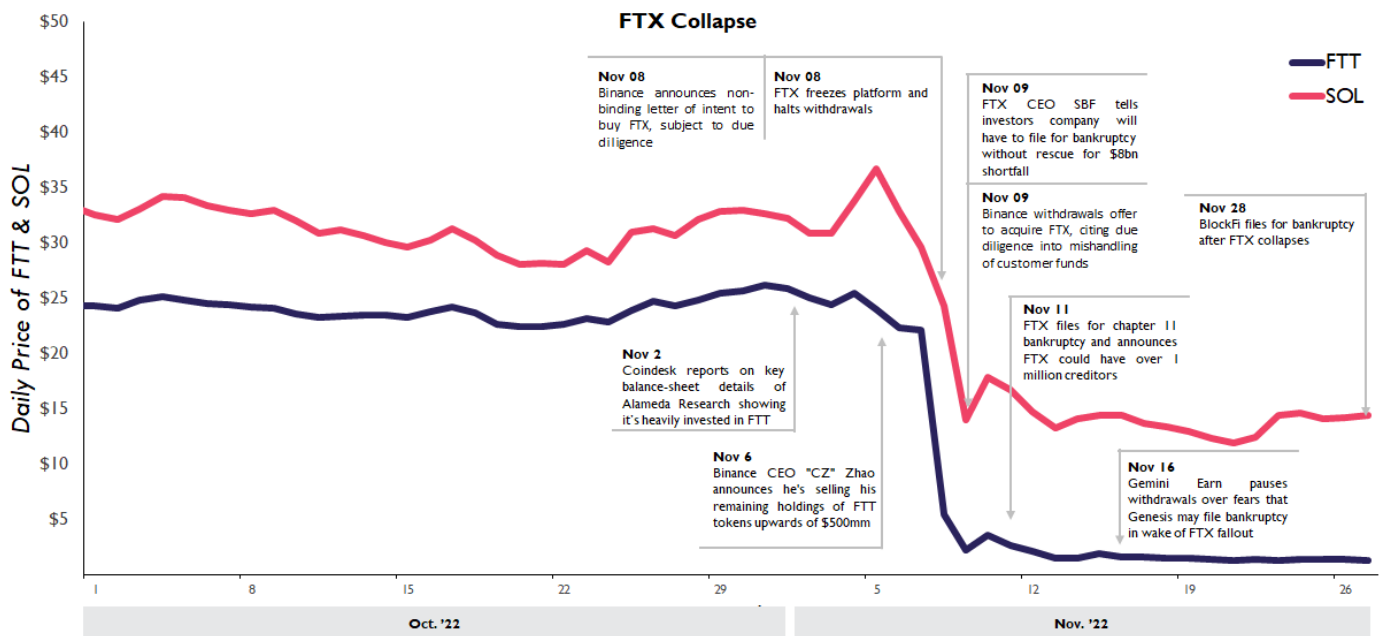
Genesis, one of the original DCG portfolio companies, has grown into one of the largest providers of trading and lending services to the digital asset market. During this most recent market cycle, Genesis also became potentially the largest lender to cryptocurrency funds. In the process, they emerged as a critical partner to companies offering retail depositors interest-bearing crypto accounts, essentially serving as a de facto yield-as-a-service provider to these businesses.

As a result, Genesis became one of the key B2B pillars within the crypto credit ecosystem, and unsurprisingly appeared at multiple junctures within this recap of centralized finance (CeFi) business crises. Specifically,

they were the largest lender to 3AC, who borrowed a total of \$2.36 billion from them alone. In the wake of the FTX and Alameda bankruptcy, Genesis suspended redemptions and new loan originations after [seeking an emergency loan of \\$1 billion \(later slashed to \\$500 million\)](#). While the total impact of the bankruptcies on Genesis is unclear, DCG publicly stated that they provided Genesis a \$140 million equity infusion since Genesis derivatives had \$175 million locked on FTX.

from its Gemini Earn platform. Genesis is one of the partners in Gemini's Earn program, where users could lend out their crypto for returns. Just days before publishing, the Financial Times reported that Gemini is in the process of [recovering ~\\$900 million from Genesis](#). Developments across both firms will be key for understanding further fallout resulting from the FTX and Alameda collapses.

What we do know is that shortly after Genesis suspended redemptions, Gemini halted withdrawals



THE BLOCK | Research

Figure 312: Event timeline of FTX insolvency in 2022

Source: The Block Research

BlockFi: The Most Recent Domino to Fall

Like Celsius and Voyager, BlockFi's flagship product is interest-bearing accounts for retail depositors. Similar to industry peers, [BlockFi grew rapidly during the bull market of 2020-2021](#), growing users to over 650,000 by early 2022 while raising over \$460 million across eight

funding rounds, carrying a \$3 billion valuation from its March 2021 raise. By 2022, the firm was reported to have an AUM of ~\$15 billion.

BlockFi, however, has had one of the more tumultuous years of any crypto business, facing challenge after challenge in every quarter of 2022. In Q1, BlockFi faced

a large regulatory settlement, greatly reducing its cash on hand. In Q2, the lender suffered losses as a 3AC creditor. Shortly after, the business felt the strain of the market-wide credit crisis as other impacted lenders began recalling loans and depositors rushed to withdraw in early Q3. Finally, BlockFi filed for bankruptcy in Q4 after FTX fell despite best efforts to cut costs and seek emergency funding throughout the year.

The February \$100 million SEC settlement occurred in the backdrop of rampant crypto spending as other retail-facing businesses used excess cash to pursue a land grab strategy. In that same month, FTX, Crypto.com and Coinbase all sought mass adoption through splashy Super Bowl advertisements and broader marketing campaigns. BlockFi viewed protecting its flagship product, the BlockFi Interest Account (BIA), as critical to its future growth. BlockFi even described the settlement positively, framing it as a “landmark resolution with federal and state regulators providing clarity on the pathway for crypto interest securities.” Indeed, getting regulatory approval for a yield product would give BlockFi a massive advantage over competitors. However, the road to such approval is long given the uniqueness of a crypto yield product. In conjunction with the settlement, [BlockFi also made BIAs unavailable to new US clients and forbade the transfer of new assets within existing BIAs for US users](#). Also, according to Morgan Creek, a BlockFi investor, the [\\$100 million fine represented nearly all of the \\$130 million BlockFi had in the bank at the time](#), just enough to prevent technical insolvency. Notably, Coinbase decided to drop its Coinbase Lend product after the SEC threatened a lawsuit.

The major event that hit every large lending desk, 3AC's collapse, did not spare BlockFi. On June 16, BlockFi

CEO tweeted that they liquidated a [“large client that failed to meet its obligations on an overcollateralized margin loan”](#), in a clear reference to the now defunct hedge fund. According to Morgan Creek, [the loan was 130% collateralized with 1/3 of the collateral made up of GBTC and 2/3 BTC](#). Even with this over-collateralization level, BlockFi experienced loan losses due to the sharp price decline of both assets and the deepening GBTC discount since the collateral had been pledged. Specifically, offloading the GBTC at a discount led to BlockFi's first loss of capital on a loan in the company's history, according to Morgan Creek. Even with a large drawdown in BTC price, Morgan Creek claimed BlockFi had no loan losses until the 3AC blowout due to the illiquidity of the GBTC collateral. According to Morgan Creek, BlockFi had even liquidated other GBTC loans in 2021 and “took the pain in Q4 [2021] when the rest of the business was doing well.” Still, Morgan Creek claimed the 3AC claimed that the loan represented 15% of BlockFi's loan book, which is corroborated by the November 28, 2022 affidavit of Mark Renzi, BlockFi's bankruptcy advisor, who claimed that “3AC was one of BlockFi's larger borrower clients” and “led to material losses for BlockFi.”

It's worth noting that [BlockFi was well known to be a large holder of GBTC](#) through early 2021, though it is unclear if GBTC remained a key holding into 2022. According to the February 2021 GBTC SEC filing, BlockFi had a \$1.7 billion position in GBTC (36,156,866 shares; 5.66% of the total outstanding) as of December 2020. An updated filing on June 24, 2021, showed that BlockFi reduced its GBTC position, with an updated count of 19,852,158 shares (2.87% of the total outstanding). It is difficult to track the current GBTC position BlockFi is holding as the company is no longer obligated to report ownership (13G filing tracks stock ownership changes that exceed 5% of a company's

total stock), but any reduction from the updated position would have incurred massive losses as GBTC discount has been on a downward trend.

While BlockFi claimed to have no direct exposure to the other desks that blew up in June and July 2022, Celsius and Voyager, the widespread panic in the market led to a dramatic increase in withdrawals. This could not have come at a worse time, as BlockFi was just starting to recover from the SEC fine and its loss on the 3AC loan. BlockFi had tried to raise a Series F at a discounted valuation to provide cushioning, but the deal was ultimately put on hold following rumors of potential insolvency and due to the overall poor funding environment at the time.

It was with this context that [FTX US swept in with a deal to provide a \\$400 million credit facility to provide liquidity for BlockFi](#). The rescue package was subordinate to customer deposits, but essentially wiped out all equity holders by granting FTX US the option to buy out the business. In the following four months, the deal seemed to accomplish its goal. Some degree of faith was restored in BlockFi, which now had the backing of the seemingly cash flush FTX. But then on November 8, the day FTX halted withdrawals, BlockFi requested \$125 million pursuant to the loan agreement, which FTX did not provide. FTX filed for bankruptcy three days later. The remaining \$275 million had presumably already been provided to BlockFi given it showed up as an [unsecured claim in the BlockFi bankruptcy filing](#).

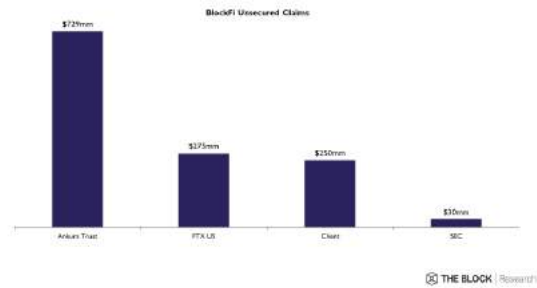


Figure 313: BlockFi's unsecured claims
Source: Public Filings

But BlockFi's entanglement with the FTX and Alameda empire was not limited to the July rescue package. BlockFi was in the business of generating yield for its depositors, and Alameda Research was widely regarded as one of the preeminent crypto funds that could absorb loans from BlockFi's. According to Mark Renzi's affidavit, "BlockFi acted as a lender to Alameda, one of the FTX companies (starting in 2019) and traded on the FTX platform (starting in 2021)." Following questions surrounding Alameda and FTX's financial health and the subsequent FTX price fall from ~\$22 to ~\$3, according to the affidavit, "BlockFi took several proactive measures to attempt to limit its exposure to FTX and Alameda through a combination of margin calls and recalls of open-term loans. In early November 2022, BlockFi made an additional borrowing request per the terms of the FTX Loan Agreement, which was not honored. Alameda thereafter defaulted on ~\$680 million of collateralized loan obligations to BlockFi, the recovery on which is unknown." Given FTX's failure to meet their obligations, BlockFi paused withdrawals, liquidated some of their remaining cryptocurrency to generate cash, then finally declared bankruptcy on November 28.

Date	Event
Feb 14	SEC \$100 million settlement and S-1 filing for BlockFi Yield
June 21	20% firm-wide headcount reduction; signed a term sheet with FTX to secure a \$250 million revolving credit facility
July 1	FTX signs a deal with BlockFi to create a \$400M credit facility with the option to buy BlockFi at a later date for between \$15-\$240M based on performance targets and milestones.
Nov 7	BlockFi's founder and chief operating officer, Flori Marquez said on Twitter that all of the company's products were fully operational and that the lender was processing client withdrawals.
Nov 8	BlockFi requested an additional \$125M loan from FTX, which FTX did not provide.
Nov 10	BlockFi pauses customer withdrawals due to status of FTX/Alameda
Nov 16	BlockFi prepares to file bankruptcy within days
Nov 28	BlockFi files for bankruptcy
Nov 28	In filing, BlockFi claims to have already received the remaining \$275M in USDC (though this conflicts with John Ray's filing that FTX lend BlockFi \$25M in FTT)
Nov 28	In filing, BlockFi claims that Alameda research has defaulted on \$680M in collateralized loan obligations to BlockFi

Figure 314: Event timeline of BlockFi insolvency in 2022

Source: The Block Research

Conclusion

In summary, due to the change in macro conditions, the prices of cryptocurrencies would probably be depressed in 2022 regardless of any specific blow ups. Rather than looking at asset prices as the symptom of market crises, the nature of a risk-off market can shine light on the strategies that brought ruin to the slate of bankrupt and struggling firms and broken protocols. A few common, and somewhat related, themes emerged:

First, the positive feedback loops that facilitated the explosion of certain DeFi protocols in times of growing asset prices turn into negative loops once prices turn south. For example, the burn-and-mint mechanism created a virtuous cycle in 2021 when there was a demand for UST via Anchor, and the stablecoin started to grow on other blockchains. Since the minting of new UST required the burning of LUNA, the value within the entire ecosystem grew as the price of LUNA appreciated. However, as soon as a shock created forced selling of UST (in excess of LFG's backstop reserves), the redemption of UST for LUNA created a

supply glut at the same time investors were looking to sell.

Similarly, the market did not appreciate how much leverage firms, traders, and protocols had amassed secured by endogenous or highly correlated collateral. The most glaring example of this was Alameda and FTX's use of FTT, SRM, and MAPS as collateral in loans. Given FTT was created by FTX and seen as a pseudo-equity in the business, the value of the token eroded exactly when FTX was most vulnerable.

Although the above paragraph already alluded to the more fundamental flaw and potential inevitability of the Terra crisis, the mechanism designed to protect it chose bad collateral. Since the goal of LFG was to backstop UST, a stablecoin dependent on new flows of crypto users, choosing a cryptocurrency as a backstop is a poor hedge. Third, while nothing disastrous came of this example, the Lido-Aave feedback loop (i.e., deposit ETH into Lido, receive stETH, borrow ETH on Aave with stETH collateral, and repeat) theoretically introduces risks of massive liquidation cascades in times of strain on stETH.

The third theme is the lack of appreciation for trading strategies that tie up liquidity for long periods. The largest example, though somewhat outdated, is the GBTC trade, which put arbitrageurs underwater when they were forced in the position for six months, and likely used borrowed capital. Similarly, potential risks with Ethereum liquid staking derivatives could emerge in times of market turmoil if large holders are forced to sell before staked ETH withdrawal is enabled. Especially in a market as volatile as crypto, liquidity is king.