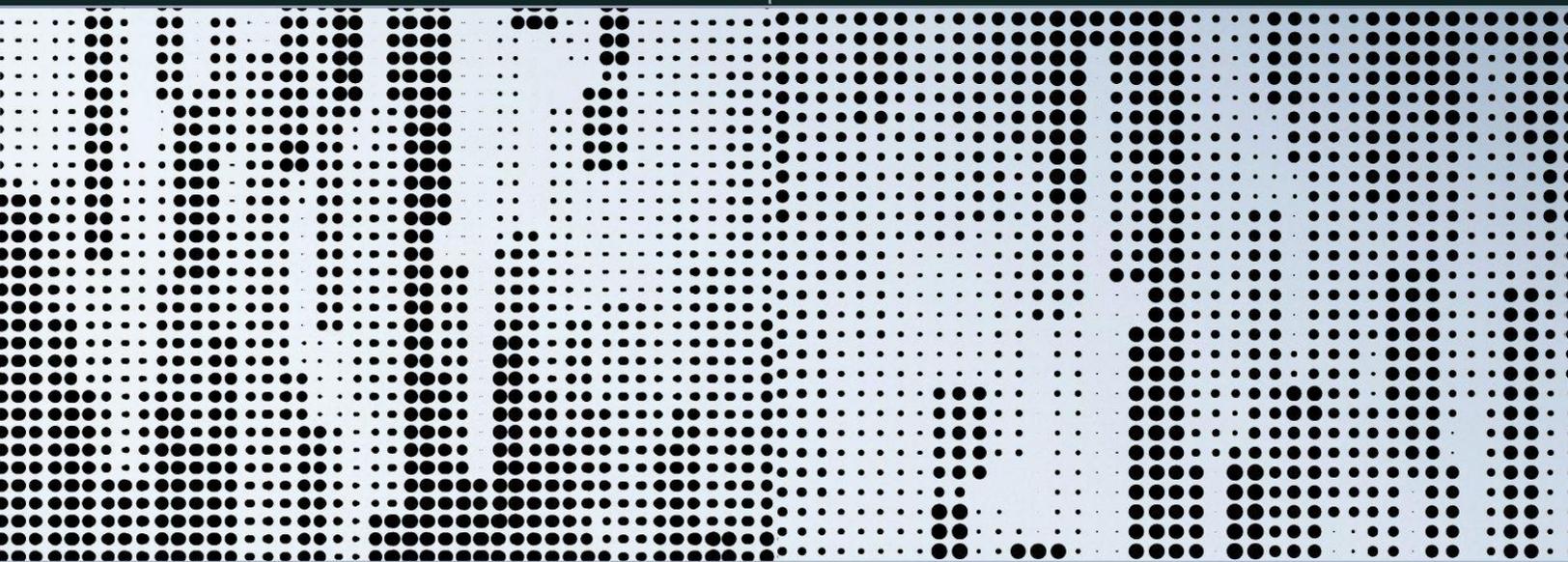




THE BLOCK · Research

2022

# Digital Asset Outlook



COMMISSIONED BY

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## About:



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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.

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# Forward:

In 2021, The Block Research produced more than 300 unique pieces of research for our research members.

The 2022 Digital Asset Outlook Report looks at the most important cryptocurrency developments in 2021 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 2022.

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# Executive Summary:

## State of the Market

**2021 has been a record year for cryptocurrencies.** Most metrics The Block tracks via our real-time [Data Dashboard](#) have hit annual or all-time highs in November. [\(pg 13\)](#)

**Bitcoin broke its previous all-time high to reach nearly \$67k and has gone up ~100% in 2021.** The clear market leader in terms added roughly \$545 billion to its market capitalization — versus Gold: -2.5%, S&P500: 26%, and Nasdaq: 31% in the same time period. [\(pg 13\)](#)

**Layer-1 platforms and doge-themed “memecoins” were the breakout winners in 2021.** In 2021, two major layer-1 platforms, Solana and Avalanche, witnessed astronomical returns on their native tokens, SOL and AVAX, of over 12,000% and 4,000% respectively. Meanwhile, the prices of Dogecoin and Shiba Inu cryptocurrencies, DOGE and SHIB, have grown by more than 4,000% and 63,200,000% respectively. [\(pg 13\)](#)

**Stablecoins continue to prove to be one of the growing handful of assets that have found broader institutional acceptance.** The aggregate stablecoin supply has grown by 388% — from \$29 billion to over \$140 billion, a record high. Annual stablecoin adjusted transaction volume crossed \$5 trillion in 2021, an over 370% year-over-year growth relative to 2020 volumes. [\(pg 15\)](#)

**Cryptocurrency spot volumes breaking through previous highs recorded in December 2020.** According to The Block’s legitimate volume index, volume hit all-time highs of \$2.2 trillion in May and ended at \$1.4 trillion in November. Binance remains the dominant option with 66% of spot trading volume occurring on their exchange in 2021. [\(pg 19\)](#)

**Crypto derivatives market grew exponentially in 2021.** November 2020 average bitcoin futures volumes were \$869 billion when aggregated across all major exchanges. Since then, average monthly dollar volumes have surpassed \$1 trillion and peaked at \$2.4 trillion in May, before closing at \$1.6 trillion in November. [\(pg 21\)](#)

**The U.S. regulators cautiously embracing bitcoin.** Three futures ETFs were approved this year: the ProShares,

Valkyrie, and VanEck Bitcoin Strategy ETFs. All gain exposure through CME Bitcoin Futures. Year-to-date, CME BTC Futures open interest rose 146%, from \$1.6 billion to \$3.9 billion. [\(pg 24\)](#)

## Digital Asset Investment: 2021 Overview

**Historic levels of venture capital were allocated to crypto companies.** This year, there was more private investment allocated to crypto companies than the previous six years combined, which in aggregate equated to roughly \$14.4 billion. Year to date, the industry received more than \$24.7 billion in private investment across ~1,700 total deals. [\(pg 29\)](#)

**2021 saw an uptick in unicorn status crypto companies.** At least 65 companies in the crypto sector now have the unicorn status (defined as a private firm with a valuation of \$1 billion or more). Over two years, there has been nearly a 491% increase in the number of companies reaching unicorn status. [\(pg 33\)](#)

**NFT/Gaming funding experienced parabolic growth.** NFT/Gaming deals became one of the fifteen largest deals for the first time. Prior to this year, not a single NFTs/Gaming deal had qualified as one of the fifteen largest. In both October and November, roughly 42% of all deals that occurred were in firms that cater to non-fungible tokens or gaming. [\(pg 36\)](#)

**Investment firms increased their bets on specific L1 ecosystems.** There have been 73 Solana-based funding deals, whereas the next highest is Polkadot, which had 53 funding deals. [\(pg 38\)](#)

**M&A transactions were at a record high for the sector.** The 197 acquisitions that occurred topped the previous high last year, when 85 transactions took place. That growth represents roughly a 130% increase in M&A activity year-on-year. Subsequently, crypto mergers and acquisition volumes have so far surpassed \$6 billion this year, which is roughly a 730% increase year-on-year. [\(pg 43\)](#)

## Institutional Custody: 2021 Overview, 2022 Outlook

**A large demand for sophisticated custody products and services.** 2021 marked a high point for investment into institutional-focused digital asset firms. Fundraising in 2021

was nearly three times larger than the 2018 amount, the previous record year. Fireblocks and Ledger led the fundraising with \$443 million and \$380 million respectively in 2021 alone. [\(pg 47\)](#)

## Layer by Layer: 2021 Overview of Layer-1 and Layer-2 Platforms

**Layer-1 (L1) platforms this year saw a dramatic increase in quantifiable user activity.** It is largely driven by the emergence of DeFi ecosystems across the various L1 platforms including Ethereum. In comparison, DeFi TVL in L1 ecosystems overall grew even quicker (+974% or \$166 billion) than DeFi TVL on Ethereum (+588% or +\$99 billion). [\(pg 53\)](#)

**Non-Ethereum L1s with comparatively lower fees began to take center stage.** Average transaction fees on Ethereum rose to record-high levels in the first half of the year. Users were paralyzed with exorbitant gas fees and long confirmation times during times of extreme network demand for Ethereum. As a result, users sought alternatives with other L1 networks that offer lower transaction fees. [\(pg 58\)](#)

**Large increase in incentives offered through L1 teams and their treasuries.** One of the most noteworthy is perhaps the Avalanche Foundation's "Avalanche Rush" program, launched in August with a directive to scale its DeFi ecosystem by distributing 10 million AVAX tokens (worth nearly a billion USD at current prices). [\(pg 55\)](#)

**The emergence of cross-chain bridges.** TVL in cross-chain bridges surged considerably this year, from \$670 million at the start of the year to over \$32 billion. Of the various bridges from Ethereum to other L1s, the Binance Bridge has grown to become the largest with a TVL of about \$10.4 billion, reflecting the rise of Binance Smart Chain to become the second-largest smart contract platform in 2021. [\(pg 71\)](#)

**Major layer-2 scaling solutions (mainly optimistic rollups and zk-rollups) witnessed significant growth in 2021.** The total TVL of optimistic rollups stands at \$3.3 billion and the total TVL of zk-rollups is currently at \$1.9 billion. [\(pg 74\)](#)

## Decentralized Finance: 2021 Overview, 2022 Outlook

**Decentralized Finance (DeFi) had a stellar rise and the ecosystem continued to mature.** The net value locked in

DeFi protocols skyrocketed from \$16 billion to more than \$100 billion this year, with the majority of crypto assets allocated to lending protocols and DEXs. [\(pg 82\)](#)

**Many of the DeFi projects are accruing value through revenue generation and increase in active users.** Total revenue generated in DeFi in 2021 is amounted to over \$3 billion. However, most recorded DeFi revenue was supply-side, i.e. fees belonging to protocol users such as liquidity providers and lenders and not to token holders. [\(pg 82\)](#)

**The landscape of DeFi has become more diverse.** In 2021, there are many new categories of DeFi beginning to spur, for example, crypto derivative markets, structured products, liquid staking, and algorithmic stablecoins. [\(pg 87\)](#)

**Decentralized exchange (DEX) volume grew at a breakneck pace with 522% increase year-on-year.** Overall, monthly DEX volume peaked in May at \$163 billion before ending November at \$107 billion. The DEX-to-centralized exchange spot volume ratio remained just under 10% throughout the year. [\(pg 84\)](#)

**Nearly 2% of total BTC is now wrapped on Ethereum as DeFi opportunities surge.** The amount of wrapped BTC on Ethereum rose steadily from 140k to 317k BTC this year, corresponding to 1.7% of the entire BTC supply. [\(pg 94\)](#)

**Number of stolen funds increased as billions of funds were stored from DeFi protocols.** The amount of stolen funds increased by eight times and, as a result of fifty exploits, reached more than \$600 million. About a third of all stolen funds (\$200 million) belonged to projects on BSC, which suffered the most in May this year. [\(pg 98\)](#)

## Web 3: 2021 Themes, 2022 Outlook

**Web3 became one of the 2021 buzz words.** Worldwide interest in the term "Web3" reached an all-time high on Google in November, increasing about 150% since the beginning of October. [\(pg 111\)](#)

**There are more than 170 million Ethereum unique addresses.** 2.2% of those addresses have interacted with DeFi protocols, up 300% from the previous year. [\(pg 125\)](#)

**Increasing number of active wallets in the NFT marketplace.** Overall, the number of active wallets in the NFT marketplace has increased over 600% this year alone. ([pg 125](#))

## Non-Fungible Tokens (NFTs) & Blockchain-based Gaming: 2021 Overview, 2022 Outlook

**The year of NFT.** Total NFT volume traded in 2021 stood at \$8.8 billion with 60% coming from trading Art and Collectibles and the remaining 40% from gaming NFTs. NFT activity hit a peak in the third week of August with just over \$1 billion in weekly traded volume. ([pg 129](#))

**Google searches for “NFT” and “OpenSea” reached all-time highs in September and November.** However, the aggregate NFT marketplace volume fell by 37% since August to ~\$2 billion. ([pg 134](#))

**Axie Infinity dominated the gaming sector in terms of weekly NFT volumes and all-time sales by collection.** Axie Infinity’s activity started picking up in May, after the launch of its sidechain Ronin. Additionally, Axie Infinity has almost twice the total secondary sales as the following best NFT collection, CryptoPunks. ([pg 131](#))

**NFT and play-to-earn (P2E) is carving a new path for the gaming business model.** The ability to earn from games has opened new business models with the so-called gaming guilds being one. Guilds support players ranging from onboarding to lending necessary in-game assets and take a share of players’ game earnings in return. The majority of the guilds are structured as DAOs (Decentralized Autonomous Organizations). ([pg 131](#))

## Macro Perspectives

**El Salvador became the first mover in making bitcoin its legal tender.** El Salvador President Nayib Bukele signed the bill into law in June. While Mr. Bukele cited low rates of financial inclusion as a driver for his decision, the World Bank rejected El Salvador’s request to implement bitcoin as legal tender and the IMF went out of its way to comment that the move raises “macroeconomic, financial and legal issues”. ([pg 144](#))

**Despite China's strong sentiment against bitcoin, it marched along quickly with trials of its digital currency,**

**the Digital Yuan.** After beginning the initial experiments in 2020, the People’s Bank of China (PBOC) increased the number of provinces trialing out the new platform for domestic use in April. Additionally, that same month, the PBOC joined the BIS’s Multiple CBDC Bridge, which tested cross-currency transfers across China, Singapore, Hong Kong and Thailand. ([pg 143](#))

**The United States has officially become the largest hub for Bitcoin mining operations and businesses.** As a result of China’s mining ban in June 2021, Foundry USA Pool has risen to become the second largest Bitcoin mining pool. And along with Foundry USA Pool’s growth is the Bitcoin network hash rate increase in North America and Kazakhstan. ([pg 16](#))

**Institutions joined the digital gold rush.** After bitcoin reached record highs in the last weeks of 2020, an array of companies began allocating to kick off the new year of 2021. Tesla, SpaceX, Square, Microstrategy, and Patent Group are some of the institutions that allocated some of their balance sheet to bitcoin. ([pg 147](#))

**Cryptocurrency market is the focal point of the regulators around the world.** As many regulators throughout the world struggle to incorporate crypto into existing regulatory frameworks, some have moved to ban crypto-related activities outright. Among these, China took center stage in 2021 by moving to ban crypto mining in the summer, a move they soon followed with a comprehensive ban of cryptocurrency transactions in the fall. ([pg 150](#))

# 1 State of the Market

Lars Hoffmann, Steven Zheng, and Lucas Jevtic

## State of the Market:

Lars Hoffmann, Steven Zheng, and Lucas Jevtic

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

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

### A look back at 2021 by the numbers

*Disclaimer: Q4 numbers include data until November 30, 2021. Price performance measures data up until November 30, 2021.*

#### Market performance

2021 was a record-breaking year for cryptocurrencies, with many, including bitcoin and ether, reaching new market price highs. The total crypto market capitalization in 2021 also reached a record \$3 trillion after recrossing \$1 trillion in January and \$2 trillion in May.

Bitcoin, the clear market leader in terms of total market value, broke its previous all-time high and nearly 100% in 2021 while adding roughly \$545 billion to its market capitalization — versus Gold: -2.5%, S&P500: 26%, and Nasdaq: 31% in the same time period. In terms of yearly highs, bitcoin reached \$69,000 in early November, a year-to-high return of over 140%. Notably, all top ten cryptocurrencies by market capitalization, excluding stablecoins, had positive returns. Moreover, most cryptocurrencies in the top ten outperformed bitcoin with wide margins — including ether, even more than the previous year.

Layer-1 (L1) protocols and doge-themed “memecoins” were the breakout winners in 2021. The L1 rally (see [“Layer-by-Layer”](#) section) was driven primarily by Solana on the back of intense usage conditions on Ethereum which led to increasingly expensive gas prices.

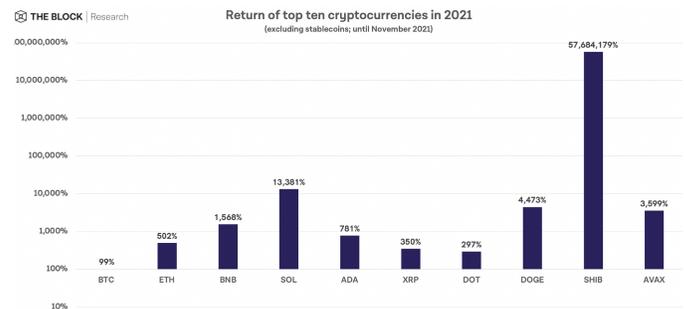


Figure 1: Return of top-10 cryptocurrencies in 2021  
Source: TradingView

The start of the year also saw Binance Smart Chain (BSC) take off paired with the growth of its native decentralized exchange PancakeSwap, which boosted Binance’s cryptocurrency Binance Coin (BNB), as BNB was the native gas token on BSC. Later into the year, we saw Cardano and Avalanche flourish, with the former launching smart contracts and the latter seeing a growing decentralized finance (DeFi) ecosystem continue to develop. Paired with L1 protocols, we also saw the skyrocketing growth of doge-themed “memecoins” with Dogecoin kicking off the year with the support of Tesla CEO Elon Musk’s backing and Shiba Inu following soon after. In 2021, Shiba Inu’s cryptocurrency, SHIB, grew over 632,000 times in price. That is, a \$100 purchase of SHIB in January would be worth \$63 million at the time of this report.

**Return of top ten cryptocurrencies in 2021**  
(excluding stablecoins and SHIB; until November 2021)

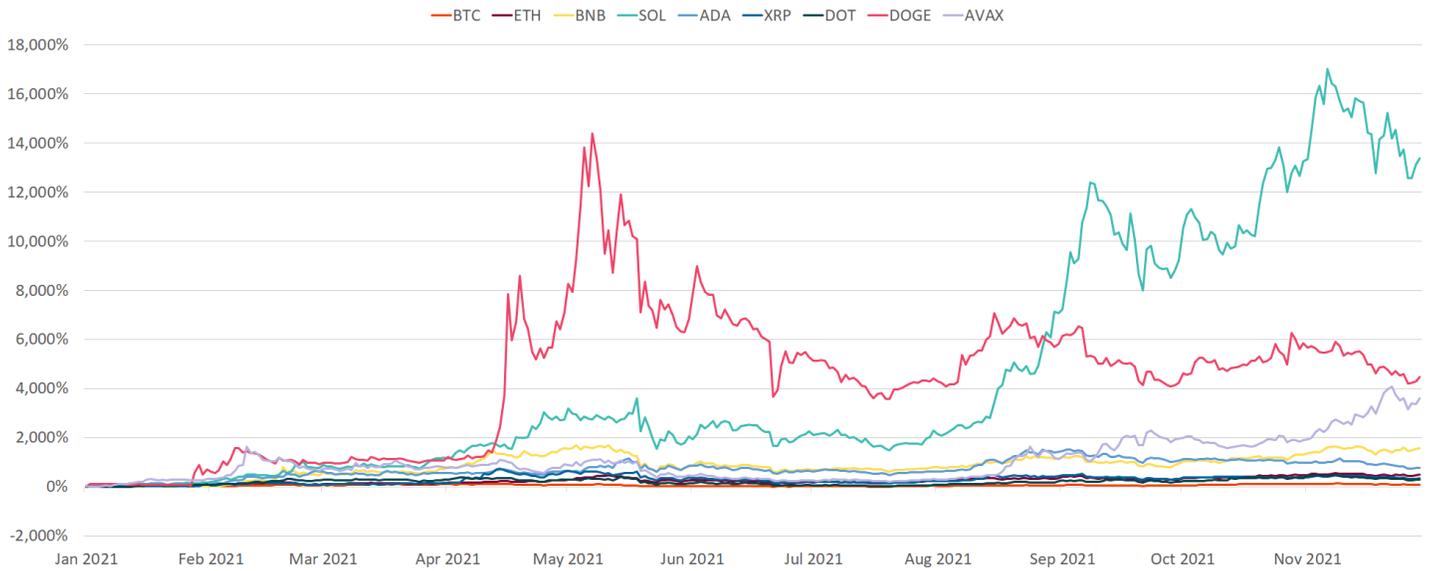


Figure 2: Return of top-10 cryptocurrencies in 2021  
Source: CoinGecko

Year-to-date, bitcoin’s dominance (bitcoin market value/total digital asset market value; figure 3) has declined from 70% to 43% at the time of writing this report – with a temporary low of 40% in May. The decline in dominance is significantly contributed by the earlier mentioned growth of Layer 1 protocols and their tokens.

reached a record \$7.5 trillion between Bitcoin and Ethereum in 2021, a 435% increase from the previous year.

Overall, Bitcoin’s on-chain volume increased by 317% year-on-year (from \$1 trillion in 2020 to \$4.2 trillion in 2021), while Ethereum’s on-chain volume increased by 729% year-on-year (from \$403 billion to \$3.3 trillion).

**Bitcoin market share dominance**  
(until November 2021)

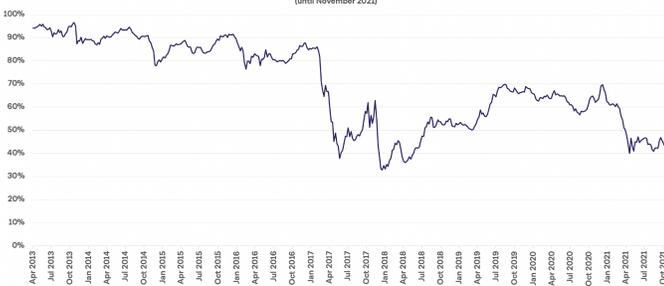


Figure 3: Bitcoin market share dominance Aug 2013 - Oct 2021  
Source: TradingView

**Quarterly adjusted on-chain volume of Bitcoin and Ethereum**  
(until November 2021)



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

**Adjusted on-chain volume**

Total adjusted on-chain volume (on a public blockchain), which is a proxy for economic throughput,

Throughout 2021, on aggregate, Bitcoin’s on-chain volume exceeded Ethereum’s by ~1.2 times. In comparison, Bitcoin’s on-chain volume was 2.5 times

the size of Ethereum’s in 2020, showing that the latter’s economic activity is growing at a faster pace than the former.

As of the end of November, despite increases in total adjusted on-chain volume, Bitcoin’s on-chain transaction count remains about 27.8% below its December 2017 high of ~379,000 (30DMA). However, Ethereum saw a record high on-chain transaction count high of ~1.5 million (30DMA) in May.

### Stablecoins

In 2021, stablecoins continue to prove to be one of the growing handful of cryptocurrencies that have found product-market fit and broader institutional acceptance, with Centre, the firm behind USDC, is [planning](#) to go public through SPAC. Since the

beginning of the year, the aggregate stablecoin supply has grown by 388% — from \$29 billion to over \$140 billion, a record high.



Figure 6: Quarterly adjusted on-chain volume of Bitcoin and Ethereum  
Source: The Block Research

Stablecoin usage also saw record numbers in 2021. Annual stablecoin adjusted transaction volume (a payment flow from one address to another on a public blockchain) crossed \$5 trillion in 2021, an over 370% year-over-year growth relative to 2020 volumes.

### Quarterly adjusted transaction volume of stablecoins (until November 2021)

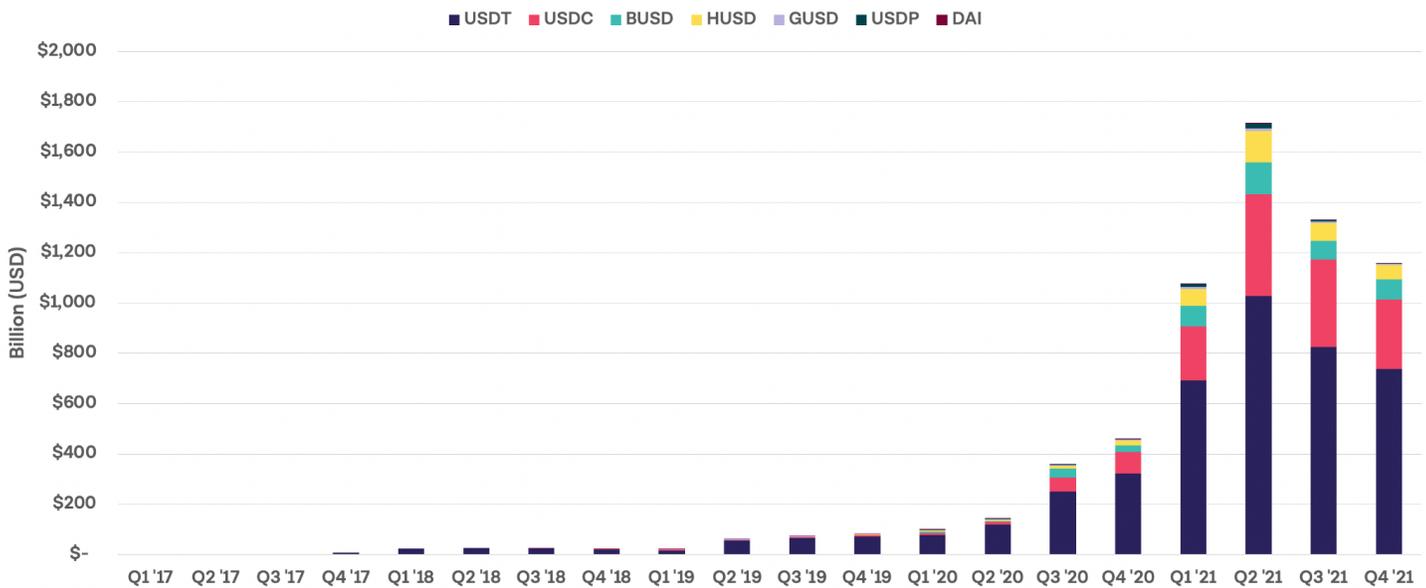


Figure 5: Quarterly adjusted transaction volume of stablecoin  
Source: Coin Metric

## State of mining

2021 has proven to be an unusual year for Bitcoin mining. At a high level, the geographic shift and decentralization away from China for Bitcoin's hash rate is perhaps unprecedented.

Historically, due to the cheap energy, low overhead cost and the proximity to major manufacturers, Bitcoin mining had been an activity dominated by investors in China. That was until when the regulatory hammer dropped in May, which was not like any so-called China ban ever before.

First, here's a quick timeline of the important events:

- **May 21** – The Chinese central government published a high-level meeting memo that mentioned Bitcoin trading and mining crackdown.
- **May 25** – Inner Mongolia was the first province that reacted to the central government's call by enforcing eight measures to further drive out Bitcoin mining activities.
- **June 9** – Power supplies for industrial-scale Bitcoin mining farms in Xinjiang's Zhundong economic zone were ordered to shut down. Qinghai followed the lead and did the same.
- **June 18** – 26 bitcoin mining firms in Sichuan were ordered to shut down.

All told, industry people believed that approximately six gigawatts of capacity that had previously powered up mining facilities in Xinjiang, Inner Mongolia, Sichuan, Yunnan, had shut down after June. Chinese mining investors had to either unplug machines and relocate overseas or sell their equipment. That led to

the hash rate plunge for both Bitcoin and Ethereum as shown below:

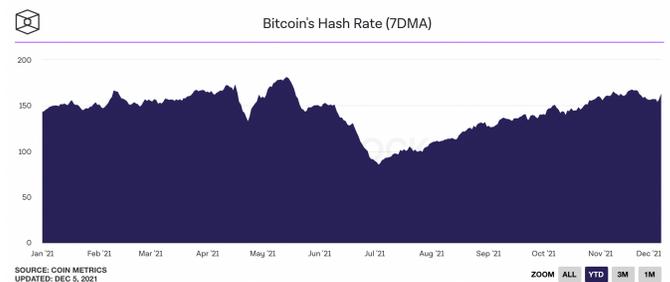


Figure 7: Bitcoin's hash rate (7DMA) in 2021  
Source: The Block Data Dashboard

Bitcoin's hash rate, a measure of miners' performance, reached a new all-time high of 166 million TH/s (30DMA) in April. But it dropped by nearly 50% over the course of May to July. Year-to-date, Bitcoin's hash rate has increased by 19.6% on a 30DMA basis.

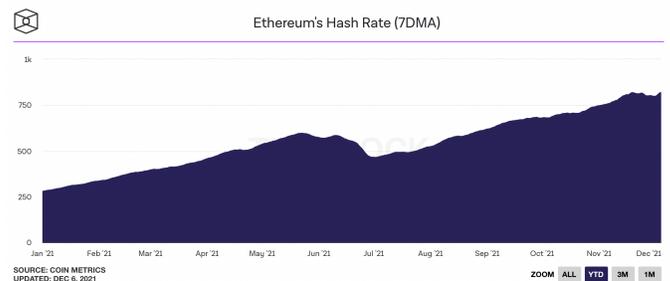


Figure 8: Ethereum's hash rate (7DMA) in 2021  
Source: The Block Data Dashboard

Similarly, Ethereum's hash rate took a hit in June but quickly recovered and surpassed its August 2018 all-time of 274 TH/s (30DMA) and reached a record 819 TH/s (30DMA) at the end of November. Year-to-date, Ethereum's hash rate has increased by 187% on a 30DMA basis.

Some Chinese investors have also chosen to keep mining secretly at a much smaller scale with GPUs. That explained why Ethereum's hash rate recovered much faster than Bitcoin's.

For existing Bitcoin mining investors elsewhere in the world, the months after June hence became more productive than ever due to the mining difficulty ease following the hash rate plunge.

For 2022, China’s crackdown has created an opportunity for overseas bitcoin mining operations and has already led to an infrastructure boom in North America, Russia, Central Asia and Europe.

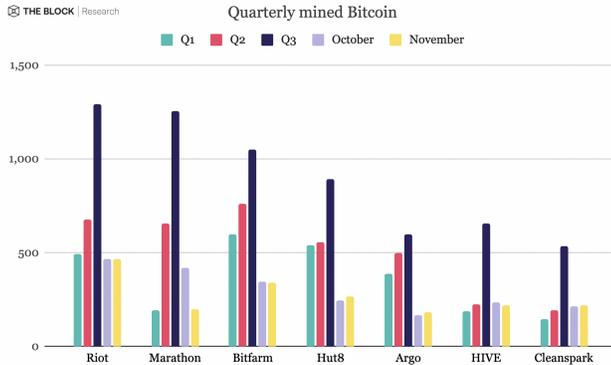


Figure 9: Quarterly mined bitcoin  
Source: SEC filings compiled by The Block Research

As a result, the market share of the world’s top ten Bitcoin mining pools has also reshuffled, with Foundry USA Pool rising up to the second-largest Bitcoin mining pool by real-time hash rate. And along with Foundry USA Pool’s growth is the Bitcoin network hash rate increase in North America and Kazakhstan. In October, the United States officially became the largest hub for Bitcoin mining operations and businesses.

That’s because the initial hosting availability globally after China’s crackdown could not take in all the unplugged mining equipment there that was looking for new homes. Hence the supply shortage has shifted from previously mining equipment prior to the crackdown to now power capacity globally.

During the second half of 2021, at least 12 public and private mining companies went on a fundraise frenzy, with each raising anywhere between \$50 million to \$650 million through IPOs, convertible notes, and equity issuances. Among them, there are new industrial-scale players that joined the mining market this year, such as energy-turned Bitcoin mining companies Stronghold Digital and Terawulf.

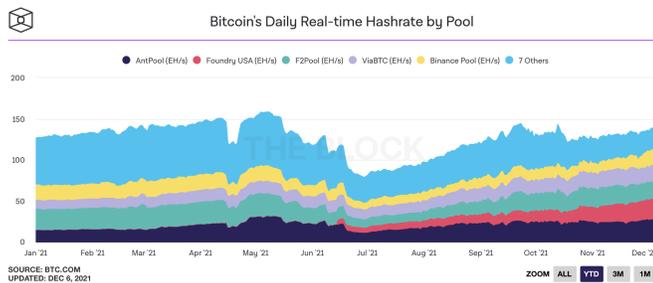


Figure 10: Bitcoin’s daily real-time hashrate by pool in 2021  
Source: The Block Data Dashboard

The goal is to order more equipment from manufacturers and build up power capacities for 2022. If everything goes well as planned — that is major mining companies do not default on their monthly dues for miners or Chinese manufacturers don’t encounter serious regulatory or logistic issues – then Bitcoin hash rate in North America will first pass previous all-time-highs and grow massively in 2022.

Based on SEC disclosures made by 20 public (and pending listing) mining companies, they collectively have more than half a million units of the newest generation of Bitcoin ASIC miners on order that are due for shipments between now and December 2022.

### Miner revenue

Miner revenue is estimated under the assumption that miners sell their bitcoin and ether immediately, which is not exactly accurate as some companies retain a portion of their mined cryptocurrencies.

Year-to-date, Bitcoin miners have generated a total of \$15.3 billion in revenue, representing a year-on-year increase of 206%, a record year. The increase can be attributed to the skyrocketing price of bitcoin in 2021, reaching new highs.

Despite fears that the implementation of EIP-1559 (for more see our [DeFi](#) section) would cause miners to move their hash rate to a competing fork and result in lower revenue, Ethereum miners have generated a total of \$16.5 billion in revenue, representing a year-on-year

increase of 678%, a record revenue year. The increase can be attributed to significantly higher revenues generated from transaction fees, which increased in response to outsized NFT activity in the second to third quarter (for more, see our [NFT](#) section). Ethereum miner revenue share from fees has held steady at 27.8% from 28% in 2020.

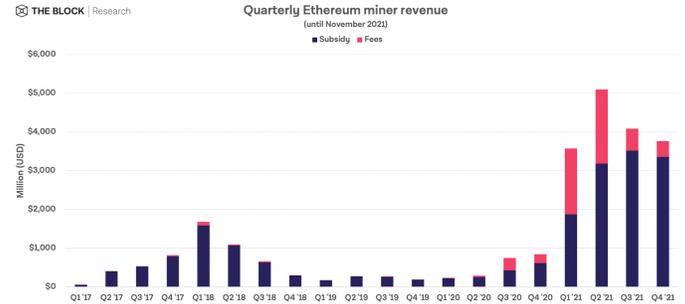


Figure 12: Quarterly Ethereum miner revenue  
Source: Coin Metrics

### Quarterly Bitcoin miner revenue (until November 2021)



Figure 11: Quarterly Bitcoin miner revenue  
Source: Coin Metrics

### Spot volumes

The year began with cryptocurrency spot volumes breaking through previous highs recorded in December 2020. According to The Block's legitimate volume index, from December 2020 to January 2021 volumes rose 138% to \$917 billion. Fuelled by the January to April bull-run volumes continued to rise, approaching all-time highs in May of \$2.2 trillion. The latter half of the year was spent in recovery as volumes steadily grew from \$651 billion in July back to \$1.4 trillion in November.

Binance remains dominant with 66% of spot trading volume occurring on their exchange in 2021. Their spot trading market share continues to grow, increasing

from 57% to 66% year-to-date and reaching highs of 74% in April.

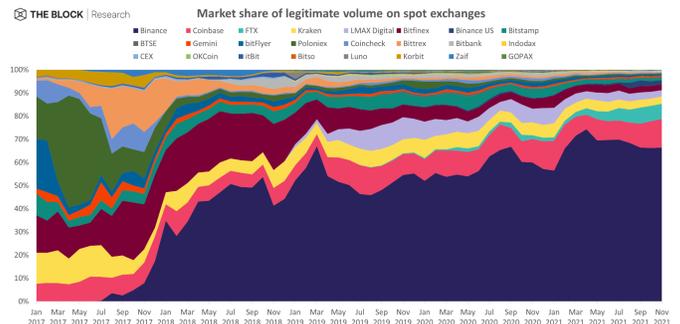


Figure 14: Legitimate Volume Share on Spot Exchange 2017 - 2021  
Source: CryptoCompare, The Block Research

As of November, Binance's (66%) main competition are Coinbase (12.3%), FTX (6.6%), Kraken (3.2%), LMAX Digital (2.7%), and Bitfinex (2.5%).

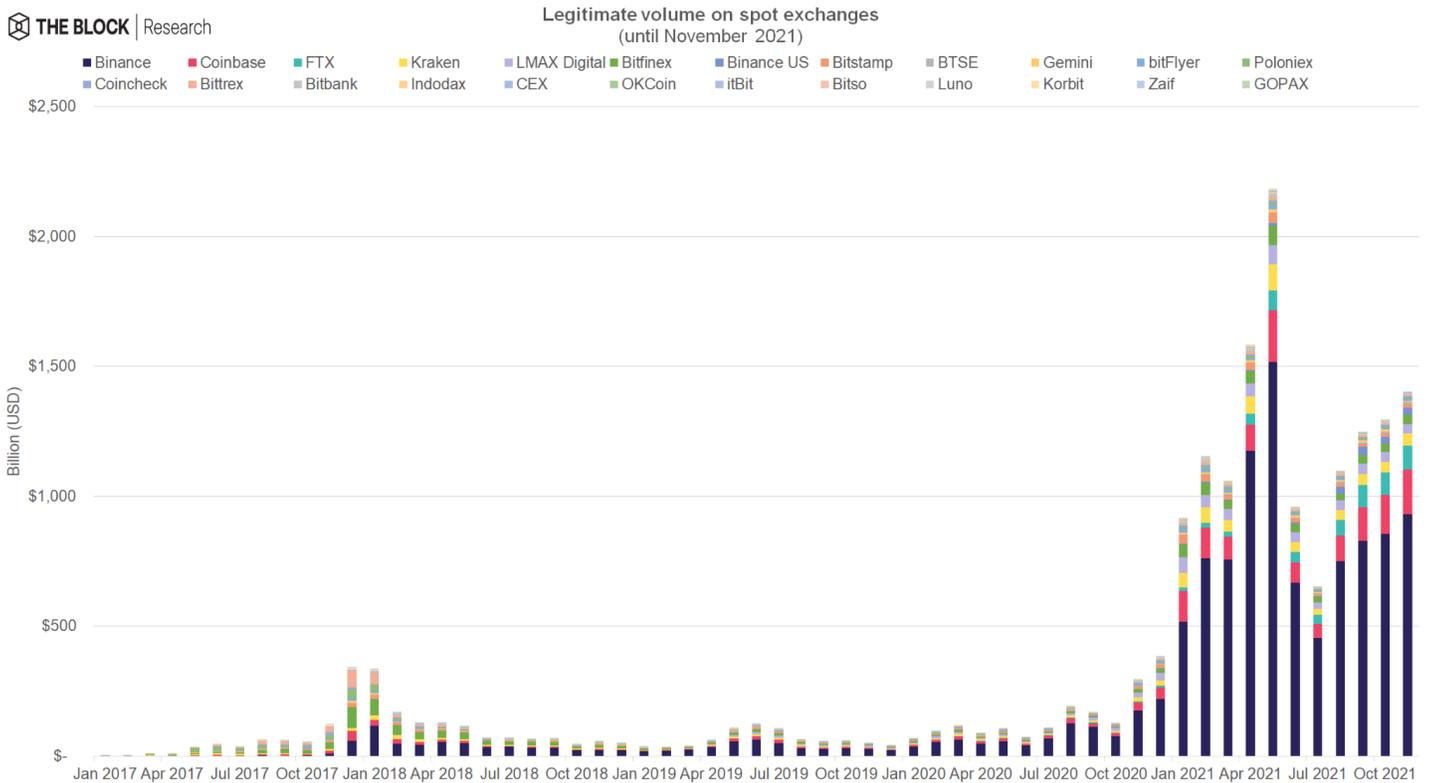


Figure 13: Legitimate Volume on Spot Exchange 2017 - 2021  
Source: The Block Research, CryptoCompare

Share of trade volume by pair denomination  
(until November 2021)

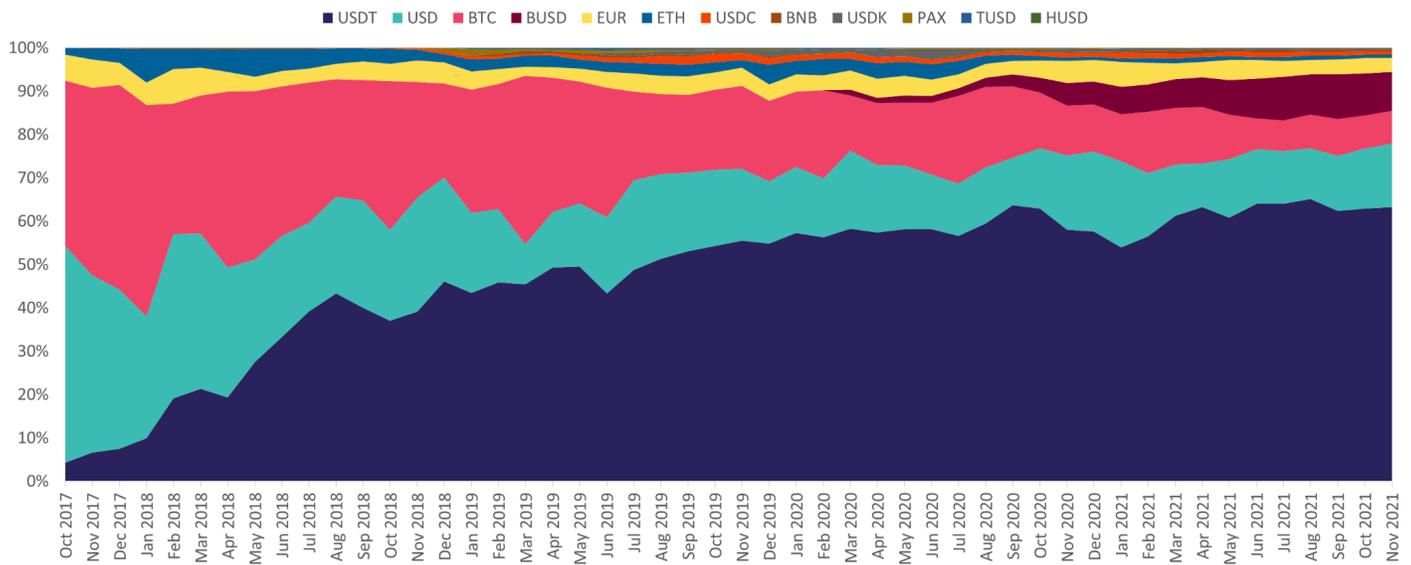


Figure 15: Legitimate Volume on Spot Exchange 2017 - 2021  
Source: CryptoCompare, The Block Research

As with the previous year, Tether continues to maintain its dominance as the most popular trading pair denomination for centralized exchange trading. In fact, in August, USDT’s share of trade volumes hit an all time high of 63%, meaning 63% of spot trading volumes were denominated in the controversial stablecoin. In November, USD and BTC pairs were the second and third largest pairs at 14.8% and 7.5%, respectively. The market has firmly voted for USDT with other stable coins only representing roughly 10%; BUSD is the largest contender at 8.9% spot volume share.

**Grayscale**

Grayscale’s Bitcoin Investment Trust (GBTC) continues to be the largest bitcoin fund in existence, owning over 646,000 BTC (approximately 3.1% of bitcoin’s total supply) as of November 2021. In line with Bitcoin’s 95% growth year-to-date, the market price of GBTC has returned 42% since January. Average daily trading

volumes reached all-time highs of \$652 million seen in Q1 2021.

On February 23, GBTC began to trade consistently at a discount for the first time in its history. This trend reversal may be attributed to a wider offering of bitcoin ETFs becoming available, such as spot products in Canada. As of November, GBTC is trading at an ~14% discount to its net asset value (NAV).

A few companies were hit hard by this unexpected change. In particular, BlockFi’s core revenue stream relied on arbitrage strategies based on the belief that GBTC would continue to trade at a premium. When GBTC started trading at a discount, BlockFi found themselves locked into a soured trade that had accrued up to a 20% loss.

On October 19, Grayscale filed with the Security Exchange Commission (SEC) to convert GBTC to an exchange-traded fund (ETF). This filing hopes to further

legitimize GBTC, increase access to the product, and importantly force it to trade closer to its NAV. However, SEC approval looks unlikely for GBTC, especially after their rejection of VanEck’s spot ETF application in November 2021.

Grayscale’s Ethereum Investment Trust (ETHE) has also traded at a discount since late February. Previously, premiums were averaging 550%, but Ethereum's growth, wide-scale adoption, and availability of alternative investment vehicles led to the premium disappearing. In a similar vein, daily average trading volumes also saw significant and continued increases.

Year-to-date Grayscale ETHE returned ~184% at market price compared to Ethereum’s ~526% returns. This discrepancy is due to premiums evaporating, going from +103% on December 31, 2020, to -0.3% as of November 30, 2021. Average trading volume increased with all-time highs of \$239 million seen in Q2 2021.

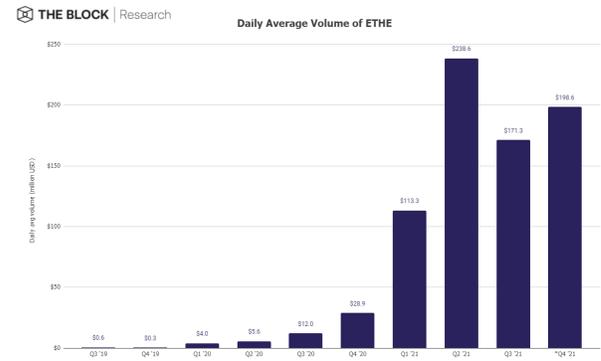


Figure 17: Daily average volume of ETHE 2017 - 2021  
Source: FactSet, The Block Research

### Bitcoin derivatives

The digital asset derivatives market exploded over the past year. November 2020 average bitcoin futures dollar volumes were \$869 billion when aggregated across all major exchanges. Since then, average monthly dollar volumes have surpassed \$1 trillion and peaked at \$2.5 trillion in May before closing at \$1.4 trillion in November 2021.

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 assets market. Usually, large players prefer to trade via established exchanges that have the infrastructure, regulatory benchmarks, and trade execution familiar to these institutional traders.

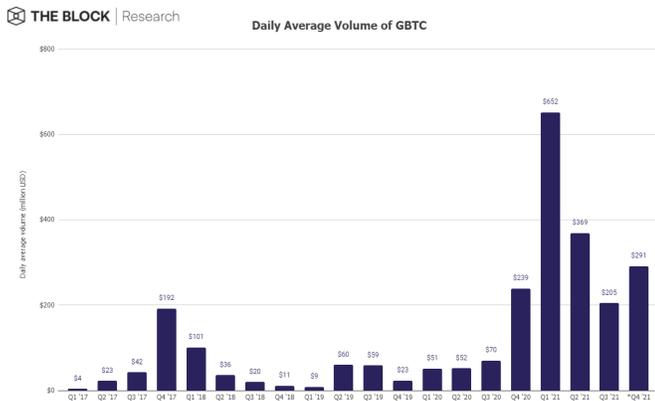


Figure 16 Daily average volume of GBTC 2017 - 2021  
Source: FactSet, The Block Research

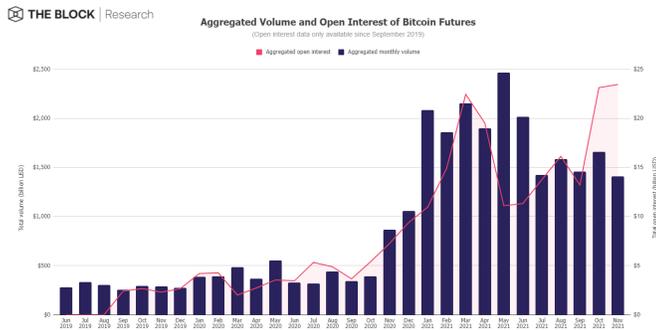


Figure 18: Aggregated volume and open interest of Bitcoin Futures 2019 - 2021  
Source: skew, The Block Research

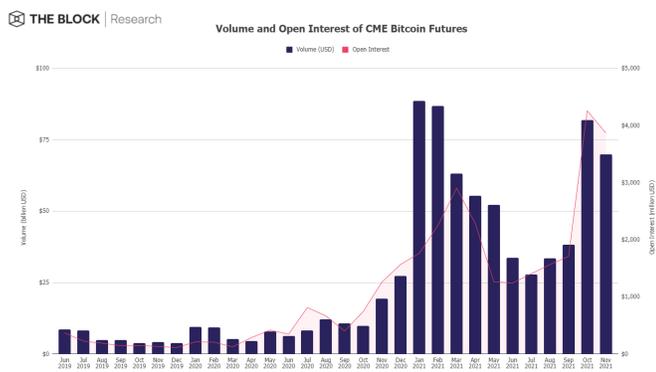


Figure 19: Volume and open interest of CME Bitcoin Futures 2019 - 2021  
Source: skew, The Block Research

CME remains a reliable metric for "institutional" trading activity in BTC and ETH derivatives. For institutional traders, traditional hedge funds, and large asset managers, CME is the most native product for gaining exposure to bitcoin. Additionally, high capital requirements drive away retail flow. However, in May of this year, CME launched the BTC mini futures in an attempt to attract smaller traders.

Year-to-date, CME BTC Futures open interest rose 146%, from \$1.6 billion to \$3.9 billion. In October, futures volumes and open interest soared past previous peak levels in April 2021. Despite the sharp price increase, traded volumes and liquidity remain high. Increased flows in October can largely be attributed to the approval of three futures ETFs: the ProShares, Valkyrie,

and VanEck Bitcoin Strategy ETFs. The ProShares Bitcoin Strategy ETF (BITO) debuted on October 19. Traders witnessed day one volumes of ~\$1 billion, the second-highest on record. A day later, bitcoin broke through April’s all-time highs, reaching \$66,974. The second launch, Valkyrie’s ETF (BTF), started trading this month, making a smaller splash in the market with \$78 million intraday volumes.

The most recent, VanEck’s Bitcoin Strategy ETF (XBTF), boasts fees of 0.65%, 30 basis points lower than the ProShares and Valkyrie’s offerings. Trading on XBTF began on November 16; its first-day volumes of ~\$5 million were dwarfed relative to its predecessors. The Proshares, Valkyrie, and VanEck are the only available bitcoin ETFs on US markets. All gain exposure through using CME Bitcoin Futures. From the SEC’s point of view, these futures are the safest choice for bitcoin exposure. The reasoning behind this rationale is:

1. CME is US regulated by CFTC.
2. CME has enough trading volume to maintain efficient price discovery.
3. The futures are cash-settled, meaning funds do not need to hold any bitcoin.

For CME, this is a huge leap forward as they are the only US-based exchange that regulators are comfortable with. Judging by the SEC’s continued rhetoric this year regarding spot and off-shore exchanges, it looks likely to stay that way for some time.

There are 6 ETFs awaiting approval by the SEC, with more expected to follow. Vanilla futures ETFs are likely to be approved as their structures do not differ from those already green-lighted. The outlook for short exposure and leverage products remains uncertain.

In an interesting turn of events, Bitwise announced the withdrawal of its futures ETF application on November 10th. CIO Matt Hogan conveyed the message via Twitter, stating that “Ultimately, what many investors want is a spot bitcoin ETF” and that “Bitwise will continue to pursue that goal, and we will look for other ways to help investors get access to the incredible opportunities in crypto”.

Name (Ticker)	Exchange	Fees	Filing date	Deadline
ProShares Bitcoin Strategy ETF (BITO)	NYSE Arca	0.95%	August 4, 2021	October 18, 2021
VanEck Bitcoin Strategy ETF (XBTF)	NYSE Arca	0.65%	August 10, 2021	October 25, 2021
Valkyrie Bitcoin Strategy ETF (BTF)	NASDAQ	0.95%	August 11, 2021	October 25, 2021
Galaxy Bitcoin Strategy ETF			August 17, 2021	November 1, 2021
AdvisorShares Managed Bitcoin ETF			August 20, 2021	November 3, 2021
Valkyrie XBTO Bitcoin Futures Fund	NASDAQ		August 23, 2021	April 30, 2022
Bitwise Bitcoin Strategy ETF (BITC)			September 14, 2021	November 28, 2021
BlockFi Bitcoin Strategy ETF (BBBB)	Choe BZX		October 8, 2021	December 22, 2021
ARK 21Shares Bitcoin Futures Strategy ETF (ARKA)	Choe BZX		October 13, 2021	December 27, 2021
Valkyrie XBTO Levered BTC Futures ETF *	NASDAQ		October 26, 2021	January 9, 2022
Direction Shares ETF Trust **	NYSE Arca		October 26, 2021	January 9, 2022
AXS Bitcoin Strategy ETF			October 27, 2021	January 10, 2022
AXS Short Bitcoin Strategy ETF **			October 27, 2021	January 10, 2022

Approved  
 \* Leverage 1.25x Long ETF  
 \*\* Short exposure ETF

Figure 20: Bitcoin ETF application status in 2021  
Source: The Block Research

Amid ETFs developments and wider institutional adoption within futures markets, options aggregate monthly volumes and open interest have quietly increased 53% and 81%, respectively, year-to-date. Perhaps not as impressive as 2019-2020 which saw volumes increase by 1,700%, it still signifies a growing demand for these products and continued cash flow into these markets.

Large spot price swings meant this was a year of highs and lows. Volumes reached all-time highs of ~\$35 billion in April before crashing down to ~\$11 billion in July, the lowest seen since October 2020. These movements are comparable to those seen in the similarly sized CME futures market.

Deribit continues to dominate the options market. Their share of bitcoin options open interest has continued to increase over the past year. As of November 30, 2021, Deribit has ~\$10.9 billion of BTC options open interest, which comprises ~93% of total open interest.

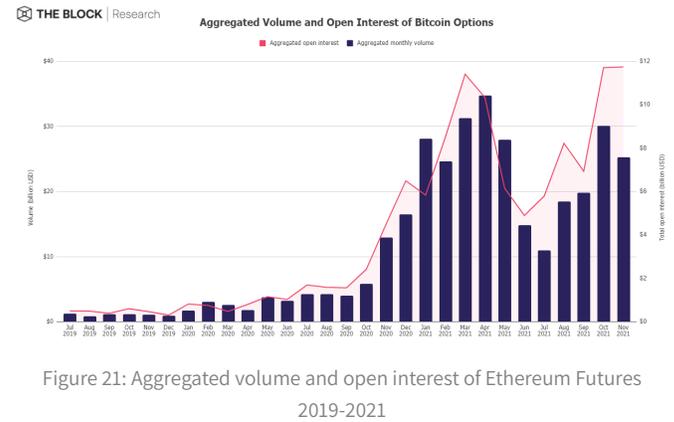


Figure 21: Aggregated volume and open interest of Ethereum Futures 2019-2021  
Source: skew, The Block Research

### Ethereum derivatives

Ethereum aggregate monthly futures volumes saw a 196% uptick from December 2020 to January 2021. Volumes have since stabilized at the \$750 billion mark, barring the month of May, which saw increases of 94% to all-time highs of ~\$1.7 trillion. Year-to-date, open interest has grown by 480%, with all-time highs in November of \$11.9 billion; aggregate monthly volumes have risen 192%.

On February 8, CME became the first traditional US-regulated exchange to offer Ethereum futures. Once again, these contracts serve as a barometer for institutional interest. While CME accounts for 18% of bitcoin futures open interest as of November 2021, its impact on the Ethereum derivatives market has been more subdued, with only 9.8% of open interest. Lower demand for CME Ethereum futures is likely related to the lack of developments regarding Ethereum ETFs. If

the SEC approves an Ethereum ETF, it would likely gain exposure through CME’s markets.

as of November 2021.

**Growth in the U.S. regulation efforts**

The growth of the cryptocurrency industry and decentralized finance protocols, paired with increased regulatory scrutiny from the United States government, has led to a rise in monetary sanctions against cryptocurrency companies this year.

Examining the growth of blockchain-related mentions in press releases by the Securities and Exchange Commission (SEC) along with the Commodity Futures Trading Commission (CFTC), we found that monetary sanctions from the U.S. government’s two largest market regulators grew 25-fold, with most of the growth coming from the CFTC.

For our data set, we manually filtered press release databases for terms related to cryptocurrencies and blockchain. We also filtered the releases for law enforcement and not public announcements to ensure irrelevant releases were not included in the data set. Figure 21 and Figure 22 show that monetary sanctions for the SEC grew from \$41 million in 2020 to \$562 million in 2021, a 13X increase. There is, however, a caveat, as 2021’s record year was because of a single \$539 million settlement against three media companies that illegally offered digital asset securities. For the CFTC, monetary sanctions grew from ~\$9 million to \$716 million, an over 80-fold growth. Similar to the SEC, CFTC’s monetary sanction growth was driven by outliers. Specifically, a \$571 million judgment against a UK individual who ran a fraudulent bitcoin trading scheme and a \$100 million penalty against BitMEX.

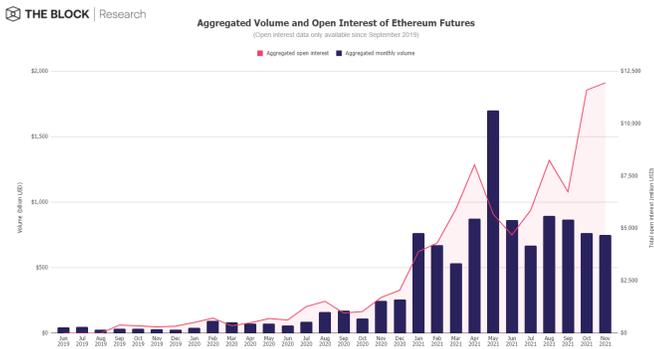


Figure 22: Aggregated volume and open interest of Ethereum Futures 2019-2021  
Source: skew, The Block Research

Ethereum options saw strong growth in 2021. Year-to-date, aggregate monthly open interest rose by 722% and aggregate monthly volumes by 662%, with all-time highs in May reaching \$16.7 billion in volume. Unlike the futures market, options have steadily recovered from monthly volume lows in July of \$4.5 billion to finish off the year at \$14.7 billion as open interest also reached all-time highs of \$7.4 billion as of November.

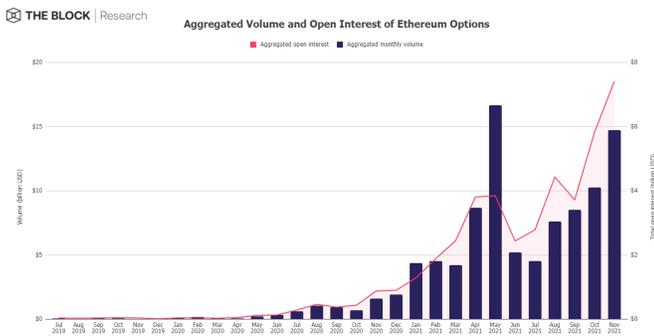


Figure 23: Aggregated volume and open interest of Ethereum options  
Source: skew, The Block Research

Similarly to bitcoin options, Deribit holds almost all of the market share, accounting for 98% of open interest

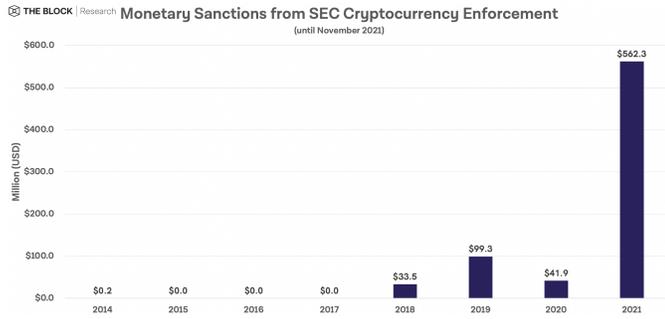


Figure 24: Monetary Sanctions from SEC cryptocurrency enforcement 2014 - 2021  
Source: The Block Research

2021 has been an active year for U.S. crypto regulation. In addition to adding crypto-related tax amendments to its trillion-dollar infrastructure bill, U.S. regulators have been quickly ramping up their enforcement efforts against crypto companies. The appointment of Gary Gensler as the new chairman of the SEC will likely bring on more scrutiny to the crypto industry. While the crypto industry was optimistic that they found a friend in Gensler, given his blockchain educational background, the new SEC chairman has come out with an aggressive stance on crypto regulation, stating that he wants to make sure the space does not “undermine the stability of the system.”

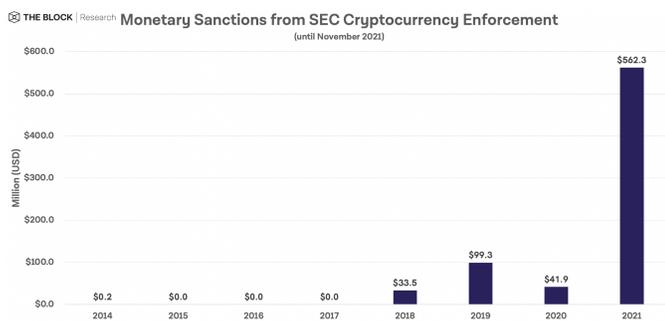
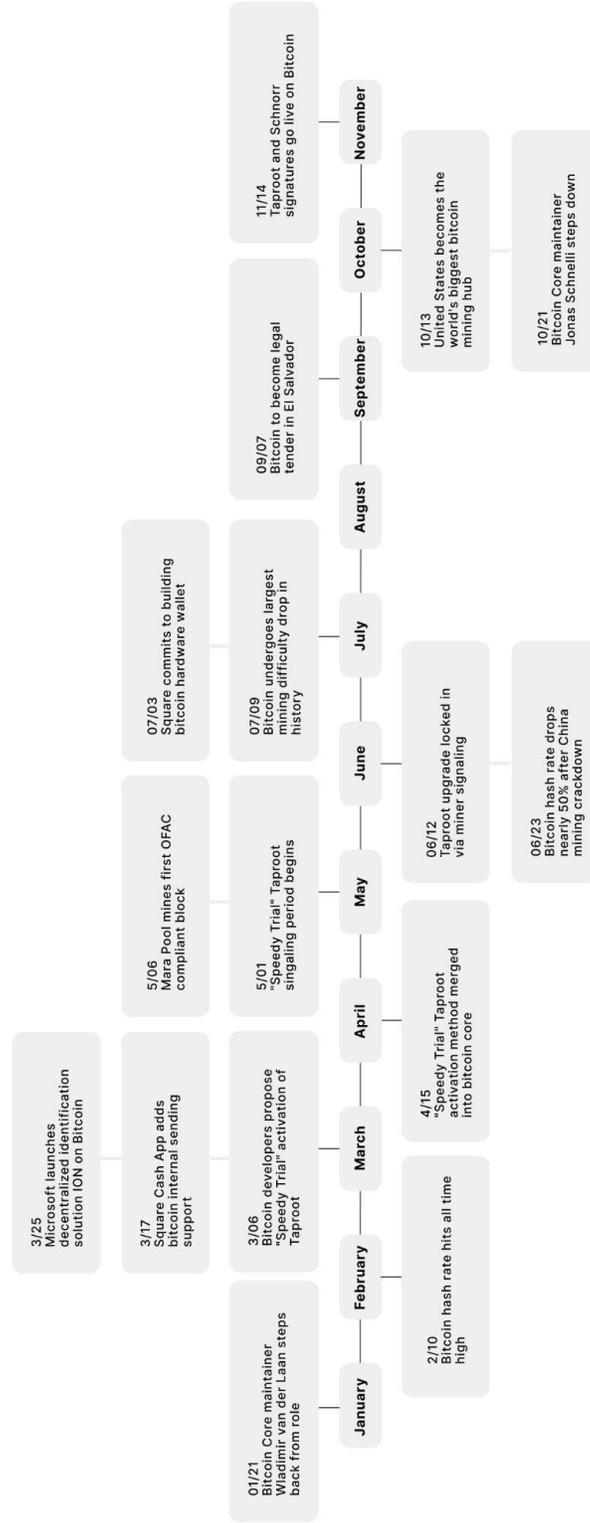


Figure 25: Monetary Sanctions from CFTC cryptocurrency enforcement 2014 - 2021  
Source: The Block Research

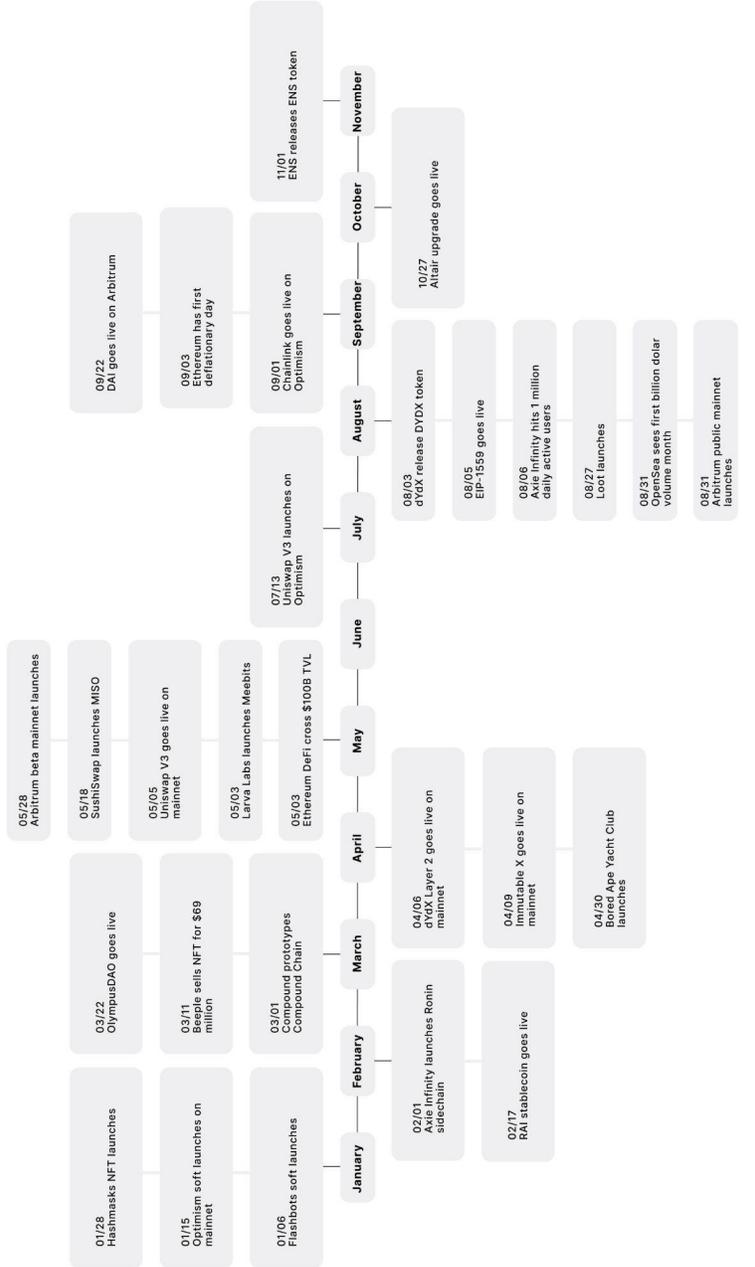
# Appendix: A look back at 2021 by the numbers

## WHAT HAPPENED WITH BITCOIN IN 2021



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WHAT HAPPENED WITH ETHEREUM IN 2021



# 2 Digital Asset Investment: 2021 Overview

John Dantoni

# Digital Asset Investment: 2021 Overview

*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

- Roughly \$25.1 billion in venture funding was allocated across 1,703 crypto/blockchain deals in 2021
- M&A transactions were at a record high for the sector with dollar volumes increasing 730% to \$6.1 billion year-on-year
- The most dominant investment trends in 2021 included Decentralized Finance, NFTs/Gaming, and Web3

## Summary of Venture Funding in 2021

2021 was a defining year for the blockchain and cryptocurrency sectors where it matured from a nascent industry

to a budding industry that lays host to a diverse set of mid to later-stage firms that are generating revenue. Unlike the previous cycles — most recently, 2017, the sectors were prepared and had the infrastructure in place to service the demand from institutions, traditional investment funds, asset managers, family offices, and high net worth individuals.

Throughout 2021, the publicly-traded companies MassMutual, MicroStrategy, and Tesla added Bitcoin to their balance sheets, as well as asset managers such as Blackrock, Goldman Sachs, Morgan Stanley, and State Street added or expanded their offerings surrounding the asset class.

The institutionalization of the sector also flowed over to the private markets, in which historic levels of venture capital were allocated to crypto companies. This year, there was more private investment allocated to crypto companies than the previous six years combined, which in aggregate equated to roughly \$14.4 billion. Year to date, the industry received more than

2021 CRYPTO/BLOCKCHAIN INSIGHTS	
FINANCING	M&A
<p>APPROXIMATELY</p> <p><b>\$25.1 Billion</b></p> <p>IN FINANCING VOLUME</p> <hr/> <p><b>1,703</b></p> <p>TRANSACTIONS</p>	<p>APPROXIMATELY</p> <p><b>\$6.1 Billion</b></p> <p>IN M&amp;A VOLUME</p> <hr/> <p><b>201</b></p> <p>TRANSACTIONS</p>
<p>Venture funding in 2021 went parabolic for the crypto sector with a 709% YoY increase in total funding and a 120% YoY increase in the number of deals</p>	<p>M&amp;A dollar volume increased roughly 730% YoY and the \$6.1 billion this year equates to roughly double the amount than the sector's previous eight years combined.</p>

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Figure 26: Financing and M&A summary 2021

Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

## Venture & Private Investment (YoY)

Crypto & Blockchain Sub Verticals (Includes some Data Management/SaaS/Business Intelligence Platforms)

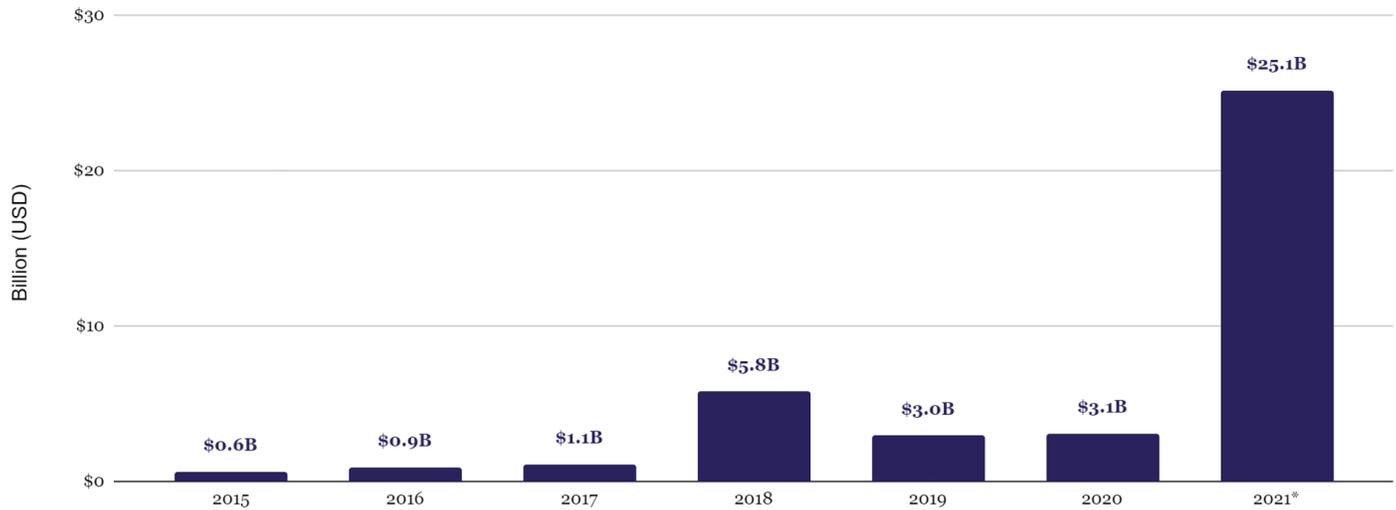


Figure 27: Yearly Venture & private investment 2015-2021  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

\$25.1 billion in private investment across 1,703 total deals. Compared to 2020, there was roughly a 126% increase year-on-year in the number of deals and a 719% increase year-on-year in total funding.

The Block Research analyzed all 1,703 deals that occurred this year, identified the firms' subsequent verticals and sub-categories to compartmentalize all of the trends that occurred throughout the year, and forecast what we expect heading into the new year.

### The occurrence of later-stage deals and growth capital

One of the leading indicators that quantify the maturation of the crypto sector in 2021 is the occurrence and frequency of mid to later-stage deals and companies utilizing growth capital as a funding

option. Year to date, there have been 38 later-stage deals (Series C to E), 78 Series B rounds, and an additional 10 deals involving growth capital for expansion. Later-Stage deals this year had an average deal size of \$176.4 million and a median of \$126.5 million. Meanwhile, Series B rounds had an average deal size of \$97.4 million and a median of \$48 million.

Throughout the year, valuations for these round types continued to increase and by Q3, the average size of Series B rounds went from \$40.7 million to \$133 million. The oversubscription for this deal type was heightened by the new and increased interest of the sector by traditional finance firms, asset managers, family offices, and hedge funds. Mid to later-stage companies generating revenue have been attractive prospects for these investor classes.

**Blockchain/Crypto Fundraises in 2021 (YTD)**

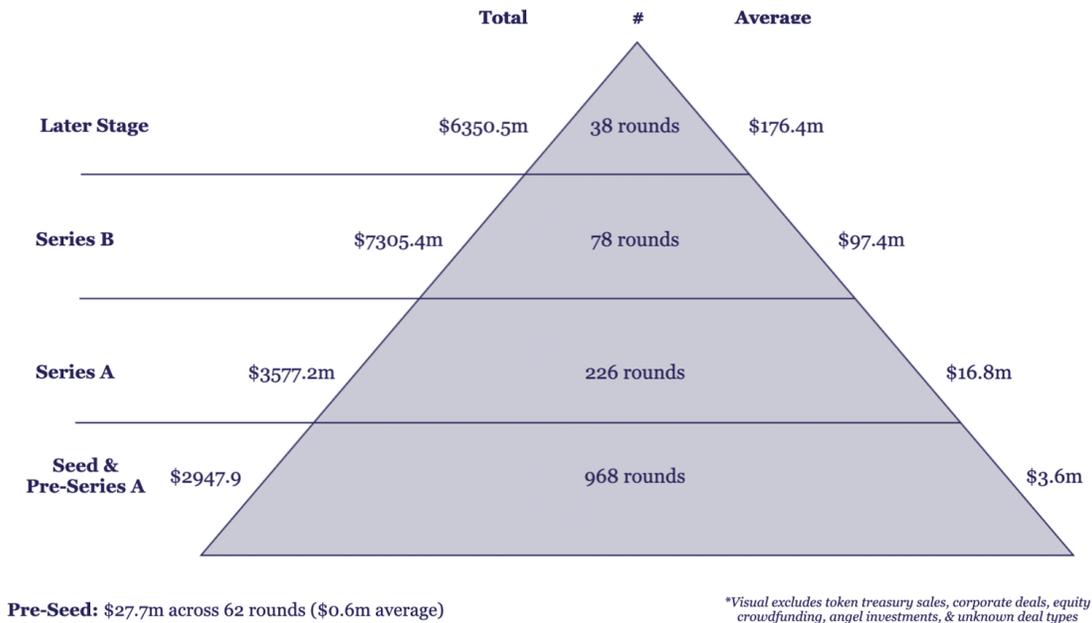


Figure 28: Blockchain/Crypto Fundraises in 2021  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

**Crypto/Blockchain Series B deals in 2021**

The average deal size for Series B rounds more than tripled from Q2 to Q3 and the median roughly doubled due to high demand

	Deals	Average (\$m)	Median (\$m)	Total Funding (\$m)
Q1' 21	12	\$48.6	\$30.0	\$534.9
Q2' 21	24	\$40.2	\$29.4	\$965.7
Q3' 21	24	\$133.0	\$60.0	\$3,058.1
Q4' 21	18	\$161.6	\$50.3	\$2,746.7

Figure 29: Crypto/Blockchain Series B deals in 2021  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

Due to this demand, by Q3, the average size of Series B rounds had increased from \$40.2 million to \$133 million, and its median had roughly doubled from \$29.4 million to \$60 million. Despite the same number of Series B rounds in Q2 and Q3 (24), more than three times the amount of capital was raised in the batch of Series B rounds during the third quarter.

The explosion in larger deal sizes in 2021 can be seen further when comparing the sizes to the previous year. In 2020, there were only 4 deals that were greater than

\$100 million in size. Year-to-date, that number has grown to 48 deals, or a 2,300% increase year-on-year. Deals in the \$50-<\$100 million range encountered similar growth. Deals in this range have increased from 3 in 2020 to 56 during 2021.

CRYPTO/BLOCKCHAIN VENTURE FUNDING BY SIZE				
2020	NUMBER OF DEALS		Q1' 21	2021
+ \$100 M	4		48	48
\$50-<\$100 M	3		56	56
\$25-<\$50 M	16		69	69
\$10-<\$25 M	47		169	169
\$5-<\$10 M	65		228	228
\$1-<\$5 M	231		670	670
\$0-<\$1 M	172		188	188
Unknown	236		272	272
Average	12.7	Median 2	Average 17.6	Median 3.4

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Figure 30: Crypto/Blockchain venture funding in 2021 by size  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

Compared to 2020, all of the deal size ranges had substantial increases in frequency outside of the \$0-<\$1 million range.

### Later-stage rounds by vertical

Prior to this year, most later-stage firms were either part of the Trading/Brokerage vertical or provided crypto financial services. Historically, crypto exchanges and trading platforms have had one of the most lucrative and proven business models of generating the majority of their revenue from trading fees.

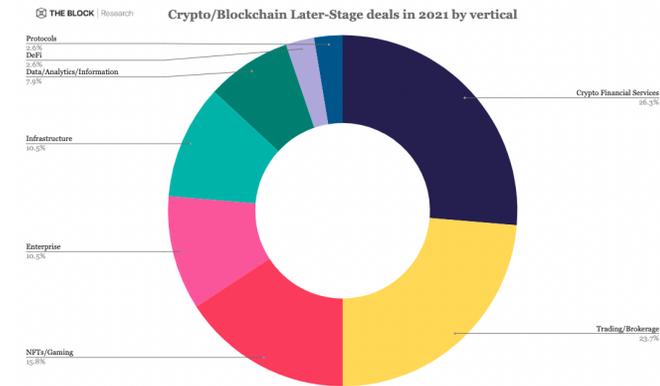


Figure 31: Crypto/Blockchain Later- Stage deals in 2021 by vertical  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

While the Crypto Financial Services and Trading/Brokerage verticals still made up slightly more than half of all later-stage deals that occurred, verticals like NFTs/Gaming are beginning to make up a higher concentration, which had 6 later-stage deals this year.

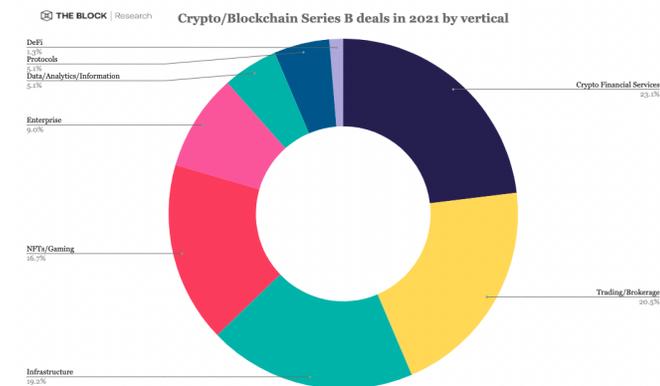


Figure 32: Crypto/Blockchain series B deals in 2021 by vertical  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

At the mid-stage level, we are seeing further diversification, where the Infrastructure vertical made up roughly 20% of Series B rounds and NFTs/Gaming accounted for slightly more than 17%.

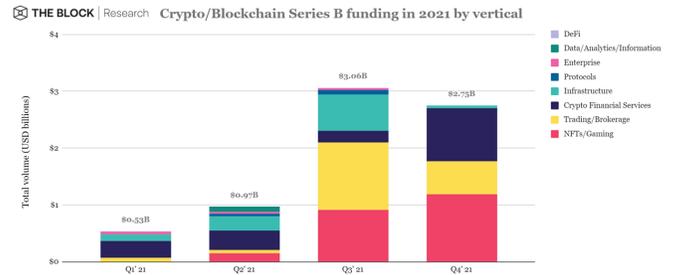


Figure 33: Quarterly Crypto/Blockchain Series B funding in 2021 by vertical  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

As for the funding of Series B rounds in dollar terms, the NFTs/Gaming firms received the most funding, receiving over \$2.2 billion, and Infrastructure companies received the third most in dollar terms, receiving nearly \$1.5 billion.

Mid-stage rounds for Infrastructure were predominately made up of firms that provide mining and staking services. The rising popularity of smart contract competitors to Ethereum that operate as Proof-of-Stake (PoS) blockchains has created a higher demand for companies that cater to node and staking support for these networks. The prospects of staking services as a revenue generator have been further exemplified by Coinbase’s Q3 filings, where the exchange’s staking quarterly revenue grew from \$3.3 million to \$81.5 million over the span of a year.

For mining, The increasing values of digital assets, the regulatory crackdown by the Chinese government on mining facilities, and an increased focus on the potential environmental impact of mining have fueled new investment opportunities in Mining & Node infrastructure. Subsequently, mining powered by alternative energy sources wasted energy, and

alternative locations like North America were attractive investments.

For NFTs/Gaming the success and popularity of non-fungible tokens and blockchain gaming has resulted in 8 companies in this vertical reaching unicorn status, all occurring this year. Additionally, the early success and revenue generated from gaming studios like Dapper Labs and Sorare or marketplaces like Opensea generating fee revenue from the sale of NFTs have investors believing this too can be a sustainable revenue model.

This is exemplified by recent comments by the CEO of the public crypto exchange Coinbase. During its third-quarter earnings call, Brian Armstrong expressed that it believes NFTs can be as big or bigger than the fungible token markets.

### An explosion of crypto unicorns

The increasing frequency of mid to later stage rounds has resulted in at least 65 companies in the blockchain/crypto sector reaching unicorn status or a firm with a valuation of \$1 billion or more. In October 2019, the research firm Huran found a total of 11 unicorns in the blockchain industry. Over two years, there has been nearly a 491% increase in the number of companies reaching unicorn status.

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.

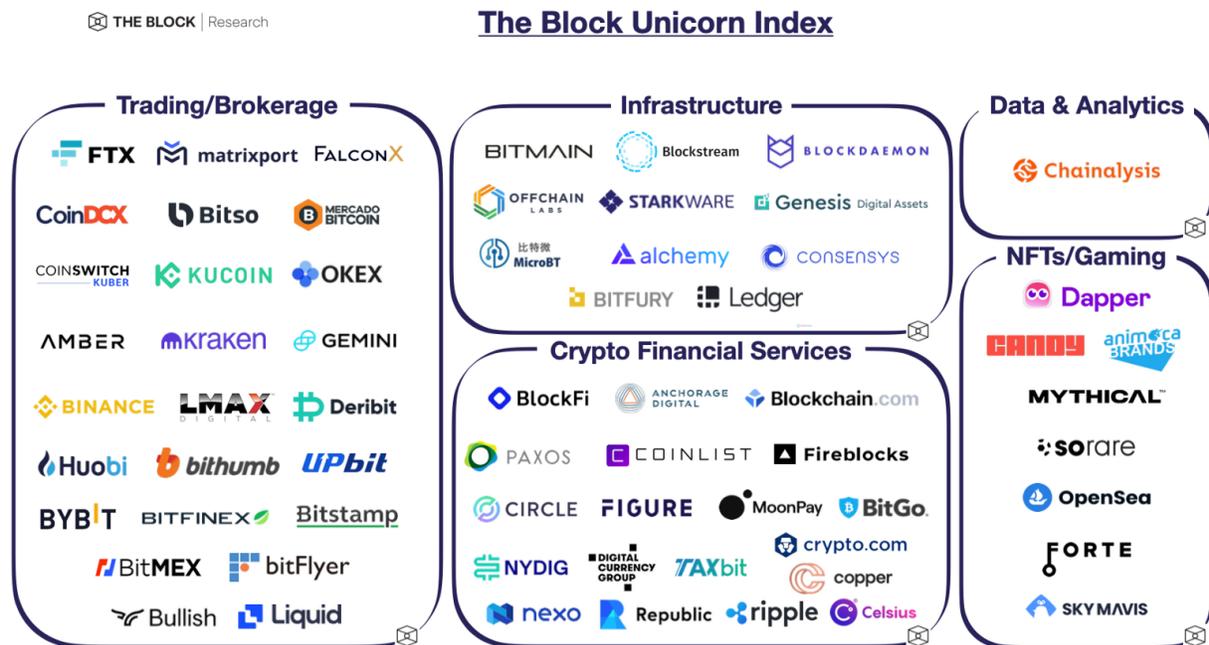


Figure 34: The Block Unicorn Index  
Source: The Block Research

### Top 15 funding deals all time

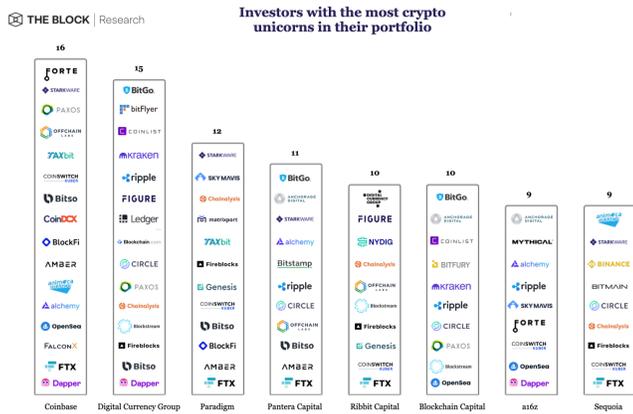


Figure 35: Investors with the most crypto unicorns in their portfolio  
Source: The Block Research

TOP 15 VENTURE FUNDING DEALS ALL TIME						
DATE	COMPANY	AMOUNT (\$M)	PRE-MONEY VALUATION (\$M)	CATEGORY	SUB-CATEGORY	HEADQUARTERS
7/20/2021	FTX	900	17,100	Trading/Brokerage	Pure Exchange	Bahamas
10/12/2021	Celsius Network	750	2,750	Crypto Financial Services	Credit & Lending	England
11/12/21	Forte	725	-	NFTs/Gaming	Gaming	United States
9/20/2021	Sorare	680	3,620	NFTs/Gaming	eSports/Sports/Betting	France
11/22/2021	Moonpay	555	3,000	Crypto Financial Services	Payments/Payment Services	United States
5/28/2021	Circle	440	N/A	Crypto Financial Services	Payments/Payment Services	United States
9/21/2021	Genesis Digital Assets	431	N/A	Infrastructure	Mining/Node Infra	United States
8/8/2018	Bitmain	422	14,580	Infrastructure	Mining/Node Infra	China
10/21/2021	FTX	420.69	24,580	Trading/Brokerage	Pure Exchange	Bahamas
11/18/2021	Gemini	400	6,700	Trading/Brokerage	Pure Exchange	United States
6/10/2021	Ledger	380	1,120	Infrastructure	Browser/Wallet	France
3/11/2021	BlockFi	350	2,650	Crypto Financial Services	Neobank	United States
7/27/2021	Fireblocks	310	1,690	Crypto Financial Services	Institutional/Asset Mgmt.	United States
3/10/2021	Dapper Labs	305	2,170	NFTs/Gaming	Game Studio	United States

15th largest is tied five ways with \$300m raises by Bakkt, Blockchain.com, Bullish Global, Coinbase, and Paxos

THE BLOCK Research

Figure 37: Top-15 venture funding deals all-time  
Source: The Block Research

When analyzing the firms that have a confirmed date when they reached unicorn status, before this past year, there were only a total of 10 companies. This year alone, there have been four times that amount, with 40 blockchain firms. Compared to 2020, the number of blockchain unicorns has increased by 1,900% year-on-year.

The combination of the increased frequency of mid to later-stage rounds and rising valuations also resulted in many of these subsequent deals qualifying as one of the largest in the sector’s history.

The Block Research analyzed the top 15 deals in the sector’s history, however, it excluded the 15th due to it being tied five ways, in which all of Bakkt, Blockchain.com, Bullish Global, Coinbase, and Paxos have conducted \$300 million raises. Of those raises, four of the five also occurred in 2021, with Coinbase the only one in the group that completed their round in a different year (2018).

Among the largest 14 raises in the crypto sector’s history, thirteen of the fourteen occurred in 2021. Bitmain’s \$422 million raise in 2018 is the only other deal that didn’t occur this year that remains. As the year progressed, so did the larger raises, with four of the qualifying deals occurring during the first two quarters, and then five occurring in each of Q3 and Q4.

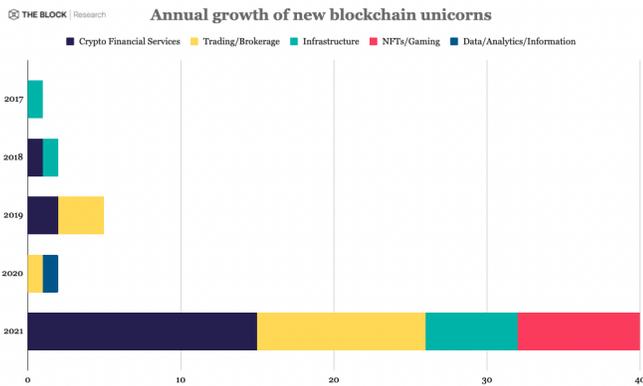


Figure 36: Annual growth of new blockchain unicorns  
Source: The Block Research



**Crypto/Blockchain deals in 2021 by vertical (QoQ)**

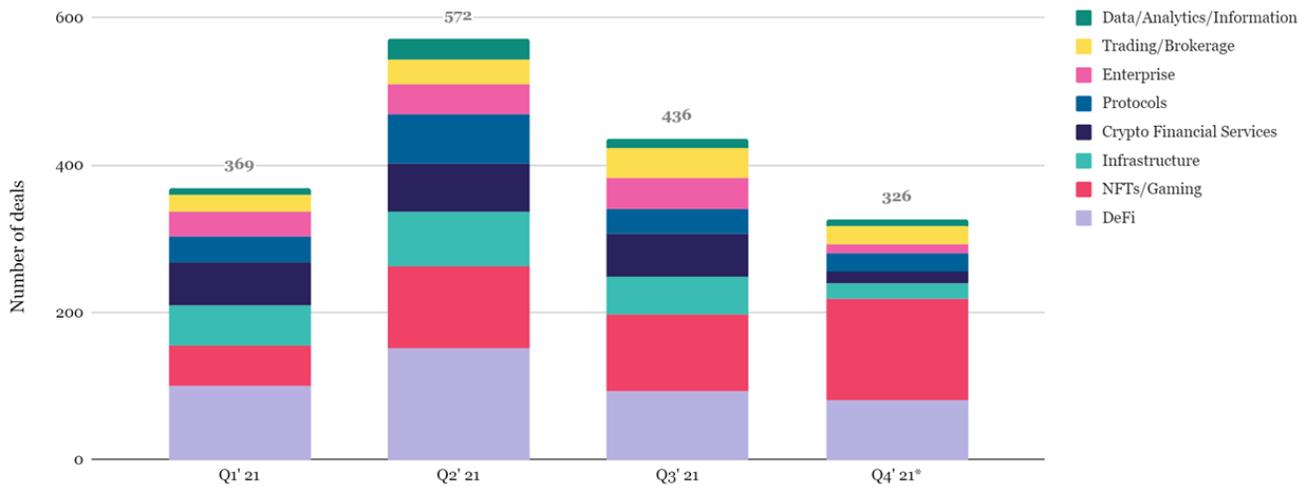


Figure 39: Quarterly Crypto/Blockchain deals in 2021 by vertical  
 Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

and protocols and the vertical had an average and median deal size of \$5.4 million and \$2.7 million, respectively.

As the year progressed, potential regulatory uncertainty and concerns, in addition to the attention of investors switching to the NFTs/Gaming vertical, resulted in the frequency of DeFi deals reducing in the second half. From Q2 to Q3, DeFi deals declined roughly 38%, and through the first two months of Q4, there have been 81 deals.

Despite the slow down, DeFi still consistently remains one of the two most popular verticals by investors, and there’s been more of a focus on investments that may be more immune to any potential regulatory clampdowns.

For example, near the end of Q3, there was a revival in investment in decentralized stablecoin projects, likely due to expected clampdowns by the SEC on centralized stablecoins like USDC and Tether, and the current reliance of ecosystems like DeFi on them.

For this reason, there’s been a resurgence in algorithmic stablecoins and or stablecoin projects that don’t attempt to track the price of the US dollar on a 1:1 basis. Some stablecoin projects that raised funds include UXD Protocol, Float Protocol, and Angle Labs.

**NFTs/Gaming**

The growth in usage of NFTs and the enormous price appreciation of certain collectibles have attracted an influx of private investors, analogous to what occurred in the DeFi vertical.

NFTs can potentially provide new ways for content creators to monetize their work, often through social tokens, digital art pieces, collectibles, or in-game items. In addition, NFTs may look to disrupt other areas, including ticketing, monetization, music, domain names, and fashion/luxury goods.

Year to date, the NFTs/Gaming vertical within the crypto sector has received the third most in private funding, receiving nearly \$5.0 billion in venture funding

Blockchain/Crypto deals in 2021 (YTD)

Crypto & Blockchain Sub Verticals (Includes some Data Management, SaaS, Business Intelligence Platforms)

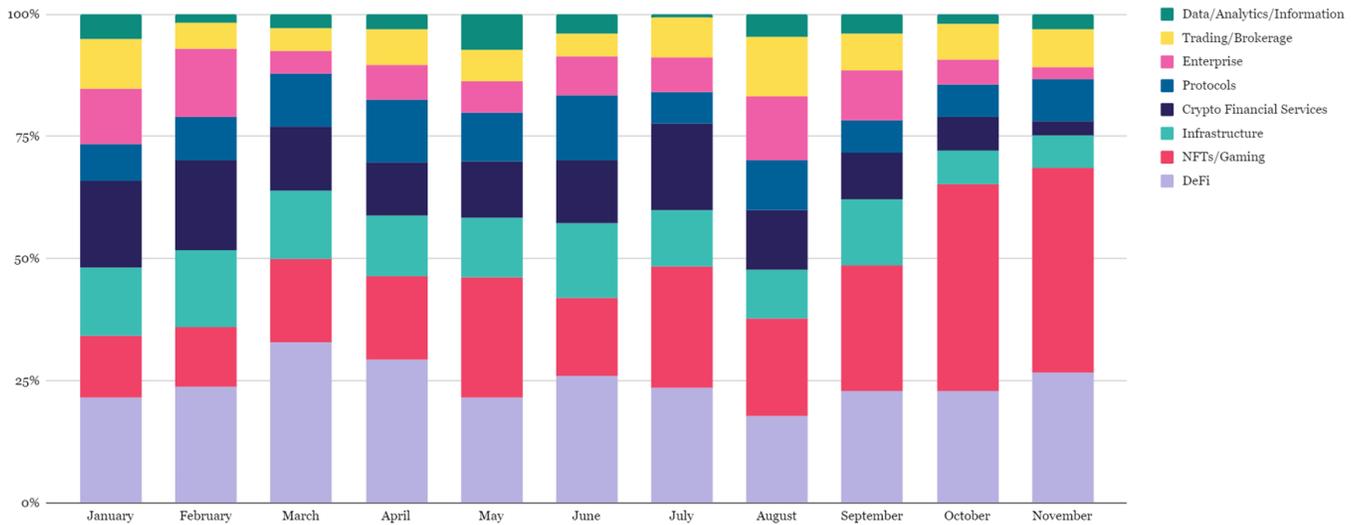


Figure 40: Blockchain/Crypto deals in 2021  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

across 406 deals. The average deal size for the vertical has been \$14.9 million and the median deal size has equated to \$2.7 million.

As the year progressed, so did the interest surrounding NFTs and blockchain gaming, with its number of deals more than doubling from Q1 to Q2, to it being the most popular deal type for the past four consecutive months. With one month remaining in Q4, there have already been more NFTs/Gaming deals in Q4 than Q3 (103 to 137), and in both October and November, roughly 42% of all deals that occurred were in firms that cater to non-fungible tokens or gaming.

Earlier in the year, some of the driving forces for the vertical included unique digital collectibles, art, PFPs (profile pictures), and the subsequent marketplaces like Opensea that enabled the purchasing, selling, and trading of these collectibles. More recently, interest from investors has turned toward NFT projects that can potentially provide more utility in aspects like advertising, content monetization, and gaming.

As an expansion from the NFTs/Gaming sector, Decentralized Autonomous Organizations (DAOs) and social tokens, and clubs began to pick up interest from investors across the industry.

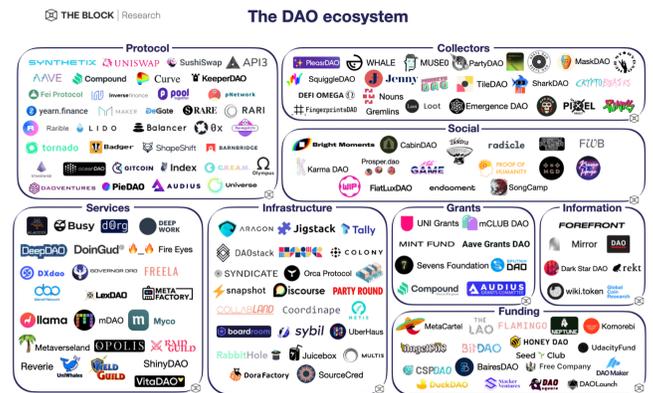


Figure 41: The DAO ecosystem  
Source: The Block Research

DAOs and Social tokens challenge how content is monetized to how humans coordinate and work together on the internet. DAOs can be anything from a governance token and process for a DeFi protocol, a “social club” or discord channel where a certain

amount of tokens is required, to even Community-driven investing groups where members pool capital together to invest in emerging crypto opportunities.

When observing this vertical more granularly and by its sub-categories, roughly 47% of its raises this year have involved blockchain gaming in some capacity. More granularly, areas of focus have been new games/studios, marketplaces specifically catered for gaming NFTs, and DAO-focused gaming guilds/clans to increase the accessibility and make it easier for new players to join play-to-earn-styled games.

Funding rounds in 2021 involving gaming guilds

Project	Deal Date	Amount (\$M)	Round Type	Select Investors
Avocado Guild	11/24/21	\$18	Series A	Animoca Brands, Solana Capital, Three Arrows, QCP Solaria, Polygon Studios, Hashed, Kinetic
UmiX Gaming	11/23/21	8	Unknown	LD Capital, AL21, Master Ventures, Akabuki, Pluto Digital Assets, Symphix, Script, Banner Capital
GuildFI	11/11/21	6	Seed & Pre-Series A	Defiance Capital, Hashed, Plantera, Coinbase, Abameca Research, Animoca Brands, Dapper Labs
Yield Guild Games	8/19/21	4.6	Unknown	Andreessen Horowitz, Kingsway Capital, Infinity Ventures Crypto, Atlasar Ventures
Yield Guild Games	6/16/21	4	Series A	BITORAFT Ventures, A Capital Ventures, IDEO, ColLab, Mechanism Capital, Parafi Capital
Astro Guild	11/16/21	3	Series A	CSPDAO, DeltaHub Capital, GDA Capital, Haxinge Capital, OIG
Pulsebox	11/22/21	3	Seed & Pre-Series A	Deepfi Digital, QCP Solaria, Framework Ventures, Daffi Capital
Good Games Guild	10/18/21	1.7	Seed & Pre-Series A	ONEK, MajesticBlock, LD Capital, Banca Capital, Twin Apex Capital, AL21 Capital, Avesa Ventures
Yield Guild Games	3/3/21	1.3	Seed & Pre-Series A	Deepfi Digital, Solara Capital, Blocktower, gumi Crypto

Figure 42: Funding rounds in 2021 involving gaming guilds  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

One potential issue with play-to-earn style games is that they may require certain items and or digital assets as a prerequisite, which can subsequently price out potential players. Gaming guilds such as Yield Guild Games or Avocado Guild intend to close that barrier by acting as a “guild” or community where owners of these assets can lend them to players and earn a share of the profit generated. In the graphic above, we have highlighted some of the notable raises this year conducted by gaming guilds.

Play-to-earn (P2E) style games, also commonly called “GameFi,” have become popularized by the success of the blockchain-based game Axie Infinity by the blockchain studio Sky Mavis. The game has been a success in regions such as the Philippines, where players can generate an income just by playing its

game. While gaming has been billed as a potential use case for blockchain technology for years now, this year was a turning point for its development due to the progression of layer-2 technologies and alternative layer-1 platforms that provide the throughput needed for games.

The types of games in development that have attracted investment include role-playing games, but also trading card games like the sci-fi card game Parallel. In October, the project raised \$50 million at a \$500 million valuation led by Paradigm.

A unique dynamic that blockchain-based card games provide is that cards could potentially be “nerfed” and or “buffed” if a particular card was made too strong. With popular trading card games that are physical such as the series Magic the Gathering, certain cards have needed to be banned from tournaments due to their stats/traits being made too strong during their conception.

Digital card collectible games will be worth following into 2022, as if any of these projects gain a little traction, there is a large addressable market to be tapped into. In 2020, the publisher of “Magic: The Gathering”, Wizards of the Coast, and parent company Hasbro, Inc., announced that it earned a record \$816 million in revenue.

### The rise of a multi-chain future and L1s

One of the main trends throughout 2021 has been the increased usage of layer-1 smart contract platforms that are an alternative to Ethereum or layer-2 platforms that provide better scaling. To learn more about this progression and activity that has occurred on specific layer-1 networks, please refer to [Layer-by-Layer sections](#) of our report.

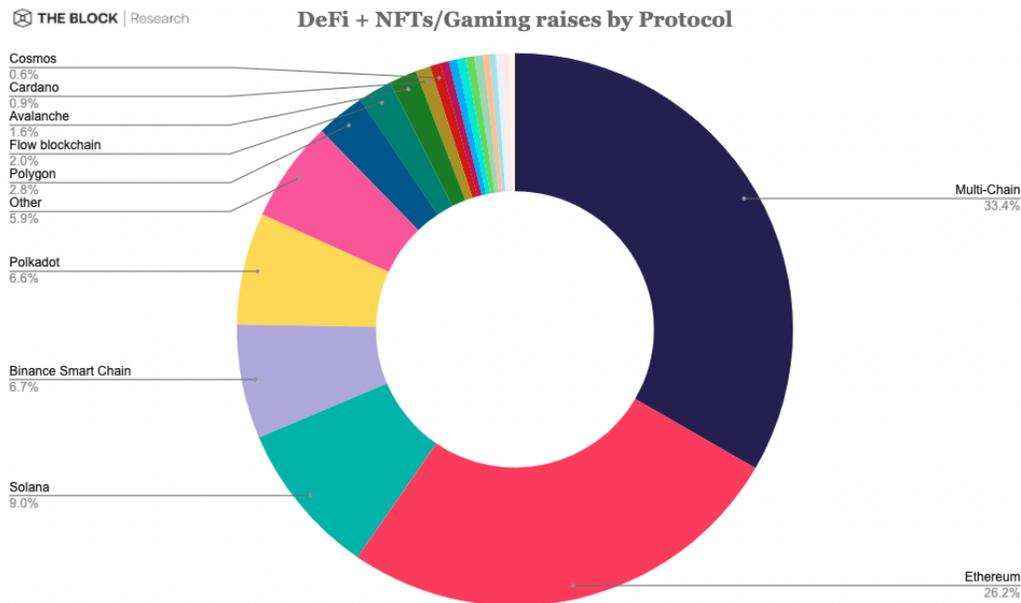


Figure 43: DeFi and NFT/Gaming raises by protocol in 2021

Source: The Block Research

As opposed to previous cycles where alternative blockchain networks were often incomplete projects advertising themselves as “better, faster, etc.” relative to blockchain networks like Ethereum and Bitcoin, the usage metrics and investment in these alternative ecosystems during this year suggest that some may be here to stay.

The prospects of a multi-chain future have resulted in investors funding projects that are designed to support multiple blockchain networks, are designed to natively be on one of Ethereum’s layer-2 networks, or are specifically for a blockchain network that is entirely different than Ethereum.

To track this progression, The Block Research analyzed all DeFi and NFTs/Gaming projects that raised funds this year, which in aggregate, equates to 836 deals, and

observed what blockchain protocols that they intend to support.

Between DeFi and NFTs/Gaming projects, roughly 33% that raised funds this year intend to support multiple blockchains. The majority of these projects that bill themselves as “Multi-Chain” are EVM-compatible, which means that they support Ethereum, its subsequent layer-2 technologies, and other compatible layer-1 networks like Avalanche, Binance Smart Chain, Fantom,

Despite the increased investment and attention surrounding alternatives to Ethereum, investment in its ecosystem was still strong and it received the most investment where more than a quarter of DeFi and NFTs/Gaming deals are projects focused on Ethereum.

Compared to DeFi, the NFTs/Gaming vertical has been more heavily weighted towards Ethereum. Newer sub-categories within this vertical that are gaining traction, like social tokens and DAOs, have predominantly come from the Ethereum ecosystem. However, we expect areas such as gaming to flourish for alternative Layer-1s and Layer-2 solutions.

then capital began to allocate towards projects building on other Layer-1 ecosystems.

Outside of Ethereum, the Solana ecosystem has garnered the most interest from investors. The blockchain network which launched in April 2020, was given a substantial boost when the cryptocurrency exchange FTX announced in July 2020 that its joint decentralized exchange project Serum would be built on top of Solana. Also, during Q2 of last year, Solana Labs, the developer of Solana, raised \$314.15 million in a [private token sale](#) round that was led by Andreessen Horowitz (a16z) and Polychain Capital.

Between DeFi and NFTs/Gaming raises, there've been 73 Solana-based funding deals, whereas the next highest is Polkadot, which had 53 funding deals.

Other blockchain networks that garnered at least 5 investments in their ecosystems include Avalanche, Binance Smart Chain, Cardano, Cosmos, Flow blockchain, and Polygon.

### Web 3

In addition to DeFi and NFTs/Gaming, one of the most popular investment trends has been towards projects that would be classified as Web3. For our investment vertical classifications, projects that would fall under this category would include identity, data management, ownership, monetization and storage, as well as community-owned and operated organizations enabled by blockchain technologies.

One of the primary trends for Web3 investments has been toward projects developing decentralized social networks. One of the primary issues or concerns with social networks is that content producers have often been subject to the terms and conditions of whichever site they are using, and have been subject to either

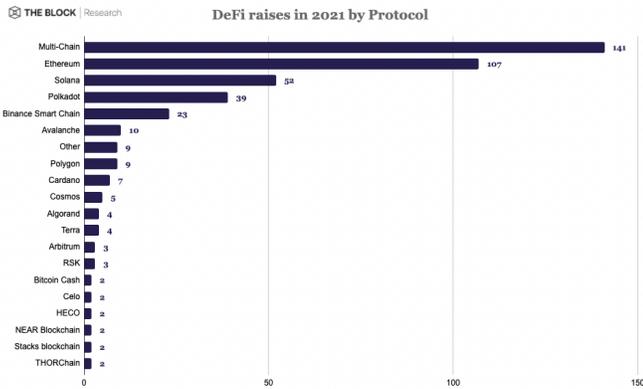


Figure 45: DeFi raises in 2021 by protocol  
Source: The Block Research

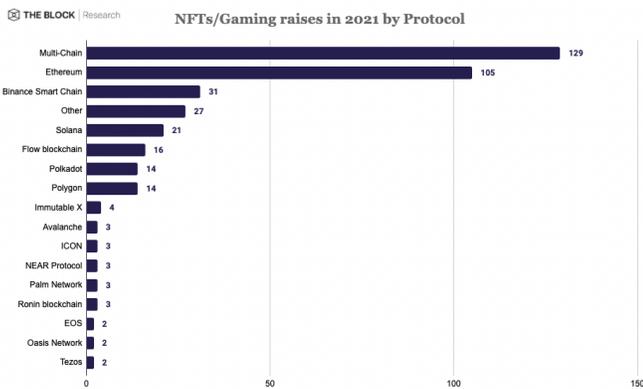


Figure 44: NFTs/Gaming raises in 2021 by protocol  
Source: The Block Research

The current NFTs/Gaming landscape mimics DeFi in its early stages, where much of the newer projects and innovation first began on Ethereum, but then expanded or ported over to networks like Binance Smart Chain and Polygon gained due to their EVM compatibility, and

being censored, banned, and or demonetized. Demonetization can be directly linked to the monetization of these platforms, and their main revenue stream coming from advertisements. Information and content that may be controversial, conflicting, and or distasteful can be demonetized due to advertisers not wanting to be associated with that content.

Decentralized social networks can potentially restructure incentives and monetization methods of these platforms, as they can be decentralized protocols rather than centralized companies that are subject to censorship or complaints from their customers. Rather, content creators will have the ability to directly engage with their audiences in a peer-to-peer manner on these networks rather than through a third party.

The largest raise from one of these social networks included the social media platform DeSo (formerly BitClout), which raised a total of \$200 million during its token sale to investors, including Andreessen Horowitz (a16z), Coinbase Ventures, and Sequoia. Other open protocols for content and social media that received funding included RSS3, Solcial, Torum. Similar to social networks, other protocols that support streaming like Livepeer, an Ethereum-based streaming platform, secured a \$20 million funding round led by Digital Currency Group during the third quarter.

In addition to social networks, other areas of focus have included decentralized file storage and telecommunications. The growth in the NFTs/Gaming sector has led to interest in data storage solutions like Arweave, as one of its primary use cases to date has been storing the metadata content of NFTs (image, gif, video, or sound).

For telecommunications, the blockchain project Helium raised \$111 million during its token sale, in which Andreessen Horowitz, Alameda Research, Ribbit Capital, 10T Holdings, and Multicoinal capital took part. The decentralized telecommunications network that provides a 5G wireless network intends to introduce new incentive structures that provide internet access.

Also, for Web3 projects to succeed, interoperability and seamlessly switching between applications and blockchain networks will be essential. For this reason, cross-chain protocols that are attempting to provide this layer of communication also received funding throughout the year. Some of these projects include Axelar, LayerZero, deBridge, and Also, XMTTP that raised \$20 million for its communication protocol that will enable communication between cryptocurrency wallets. See [Web3 section](#) to learn more.

## Crypto financial services

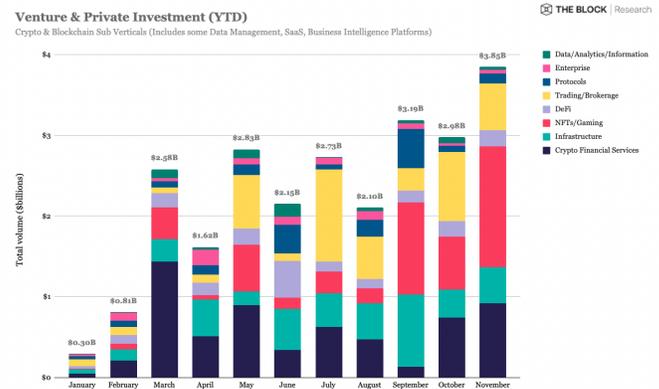


Figure 45: Ventures & private investment in 2021  
Source: Crunchbase, Dove Metrics, Pitchbook, The Block Research

Firms that fall under Crypto Financial Services received the most funding out of any vertical during 2021. In total, the vertical received slightly more than \$6.3 billion across 198 deals. The average deal size for vertical was \$36.2 million and the median deal size was \$6.0 million.

Throughout the year, the vertical had 20 deals that raised \$100 million or more.

Some of the verticals notable raises that provide payments infrastructure and or provide fiat onramps into the crypto ecosystem include Circle's \$440 million funding round, Moonpay's \$555 million raise, Eco's \$60 million raise, and raises by the firm's Ramp and Xanpool.

Both Ramp Network and Xanpool, which raised funds, enable fiat to crypto onramps that can be integrated by cryptocurrency businesses, exchanges, marketplaces, wallets, and applications.

The increased institutionalization of the space also resulted in new funding for firms that provide crypto financial services to this investor class. Some of these raises include Fireblocks \$310 million raise, Paxos raising \$300 million, NYDIG raising \$100 million and then an additional \$200 million, Amber Group's \$100 million raise, Bitwise's \$100 million raise, and Copper's \$50 million raise.

Crypto lending services have been in a murky regulatory situation in the U.S., with these offerings potentially being labeled as unregistered securities. As an example, the publicly traded crypto exchange Coinbase this year decided to nix the launch of its lending product after being informed by the SEC that it could result in a lawsuit. Despite these concerns, firms that provide lending services continued to receive funding internationally.

The neobank BlockFi completed a \$350 million Series D round. In Europe, London-based Celsius Network completed a \$750 million raise and Finland-based Tesseract raised \$25 million during its Series A. Ledn, a lending company that caters to Latin America, received a \$30 million funding round. Vaultd, a Singapore-based

crypto lending platform also completed a Series A round, in which it raised \$25 million led by Peter Thiel's Valar Ventures.

Also, within crypto financial services, there was a focus on investment in firms and projects that act as a bridge for decentralized applications or enable more compliant access to DeFi.

One example of this convergence of Decentralized Finance and centralized companies includes Meow Technologies. The firm provides corporate treasurers with the ability to access crypto yields by partnering with crypto lending desks to make short-term high-yield loans. As a result, the firm attracted \$5 million in investment from notable investors like the US exchanges Coinbase and Gemini and the trading desk Jump Capital.

## Trading/Brokerage

The Trading/Brokerage vertical received the third most funding during 2021, in which roughly \$4.5 billion was allocated across 118 companies that fall under this vertical. The most significant raise was conducted by the cryptocurrency exchange FTX, which raised a \$900 million round that valued the firm at \$18 billion. The firm also completed an additional \$420.69 million in late October in a Series B-1 funding round.

The exchange provides separate platforms for international customers and a US-focused exchange. FTX has conducted aggressive marketing campaigns to capture market share away from US exchanges like the publicly traded Coinbase. To date, the exchange has extended partnerships with the MLB, TSM eSports, purchased naming rights to the Miami Heat's arena and brought on famous sports figures like Tom Brady, Steph Curry, and Aaron Jones.

Another major raise by a US-based exchange included Gemini, which completed a \$400 million funding round at a valuation of \$7.1 billion. The growth equity round was the exchange’s first usage of raising outside capital since the Winklevoss twins founded the firm in 2014. The funding is reportedly to help Gemini finance the building of a more decentralized metaverse

Another trend for the crypto sector and exchange platforms sector is that we are beginning to see the maturity of cryptocurrency exchanges that cater to developing regions or other areas viewed as prime growth areas for digital assets.

**Crypto exchange raises in developing regions**

Investment continues to flow into crypto exchanges catering to developing regions primed for growth and expansion



Regions: Africa, Latin America, Southeast Asia, and the Middle East

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Company	Deal Date	Amount (\$m)	Deal Round	Headquarters
CoinSwitch Kuber	10/6/2021	\$300	Series C	India
Bitso	5/5/2021	\$260	Series C	Mexico
Mercado Bitcoin	7/1/2021	\$200	Series B	Brazil
CoinDCX	8/10/2021	\$90	Series C	India
Mercado Bitcoin	11/30/2021	\$50	Extended Series B	Brazil
Zipmex	8/31/2021	\$41	Series B	Singapore
Mercado Bitcoin	1/21/2021	\$38	Series A	Brazil
Pintu	8/9/2021	\$35	Extended Series A	Indonesia
BitOasis	10/6/2021	\$30	Series B	Dubai
CoinSwitch Kuber	10/6/2021	\$25	Series B	India
Lemon	7/27/2021	\$16	Series A	Argentina
YellowCard	9/27/2021	\$15	Series A	Africa
CoinSwitch Kuber	1/13/2021	\$15	Series A	India
PDAX	8/17/2021	\$13	Unknown	Philippines
Buenbit	7/13/2021	\$11	Series A	Argentina
CoinMENA	11/8/2021	\$10	Seed & Pre-Series A	Bahrain
Kiktrade	4/9/2021	\$8	Seed & Pre-Series A	Hong Kong
Rain	1/18/2021	\$6	Series A	Bahrain
Pintu	5/26/2021	\$6	Series A	Indonesia
Zipmex	1/12/2021	\$6	Series A	Singapore
Buaha	11/23/2021	\$4	Seed & Pre-Series A	Nigeria
Kiktrade	6/10/2021	\$4	Angel	Hong Kong

Figure 49: Crypto exchange arises in developing regions  
Source: Architect Partners, Pitchbook, The Block Research

Throughout the year there was continued investment in Africa, Latin American countries, Southeast Asia, and the Middle East.

Companies that fall under this category entering mid to even later-stage include raises by Bitso, BitOasis, CoinSwitch Kuber, Mercado Bitcoin, Zipmex, Ripio, and CoinDCX.

CoinDCX’s \$90 million raise made it the first Indian crypto exchange to become a unicorn status with a valuation of \$1.1 billion.

**Mergers & Acquisitions**

For the second consecutive year, M&A transactions were at a record high for the sector. The 201 acquisitions that occurred topped the previous high last year, when 85 transactions took place. That growth represents roughly a 131% increase in M&A activity year on year.

For the purpose of this research, The Block Research did not include transactions that were special purpose acquisition company (SPAC) deals, that have been increasing in frequency in both the general and crypto markets as a way for firms to go public.

Crypto mergers and acquisition volumes have so far surpassed \$6 billion this year, which is roughly a 730% increase year on year. Not only is the \$6 billion a record in transaction volume, but it also equates to roughly double the amount than the sector’s previous eight years combined.

M&A activity this year had thirteen top-ticket purchases that qualify as some of the largest ever within the industry. Similar to private funding deals, 80% of the top 15 largest acquisitions in the sector’s history occurred this year.

M&A ALL-TIME					
DATE	TARGET	ACQUIRERS	AMOUNT (\$M)	CATEGORY	TARGET COUNTRY
05/05/2021	BitGo	Galaxy Digital	\$1200	Crypto Financial Services	United States
04/08/2021	Whinstone	Riot Blockchain	\$651	Infrastructure	United States
08/30/2021	Allentro	DHS Consulting	\$575	Trading/Brokerage	United States
09/27/2021	Bitfield	Northern Data	\$575	Infrastructure	United States
11/02/2021	Bitkub Capital Group Holdings	Siam Commercial Bank	\$537	Trading/Brokerage	Thailand
02/26/2018	Poloniex	Circle	\$400.0	Trading/Brokerage	United States
10/29/2018	Bitstamp	NXMH	\$400.0	Trading/Brokerage	England
03/31/2020	CoinMarketCap	Binance	\$400.0	Data/Analytics/Information	United States
07/15/2021	LMAX Group	J.C. Flowers & Co.	\$300	Trading/Brokerage	United States
08/04/2021	Hermez	Polygon	\$250.00	Infrastructure	India
05/06/2021	Simplex	Nuvei	\$225	Crypto Financial Services	Canada
03/08/2021	Curv	PayPal	\$200	Crypto Financial Services	United States
10/01/2021	IBG	ICOA	\$185	DeFi	United States
09/10/2021	Polychain Labs	Coinbase	\$160	Infrastructure	United States
06/30/2021	COCX.io	MAJIC	\$153	Trading/Brokerage	United States

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Figure 50: M&A all-time

Source: Architect Partners, Pitchbook, The Block Research

Galaxy Digital’s acquisition of the crypto custodian BitGo for \$1.2 billion is the largest acquisition to date, and solidified Galaxy’s dedication in becoming a full-suite brokerage to compete with offerings by competitors such as the likes of Coinbase.

The second-largest raise this year and also in the sector’s history was Riot Blockchain’s purchase of the North American Bitcoin miner Whinstone for \$651 million. The other major acquisition that included a mining facility was Northern Data’s \$575 million purchase of Bitfield.

DHS Consulting completed a \$575 million purchase of the digital asset trading group Allentro. With the acquisition, DHS intends to launch a fully automated facility to provide two-way prices in the funding market.

THE BLOCK | Research **Crypto/Blockchain M&A transactions and dollar volume (YoY)**

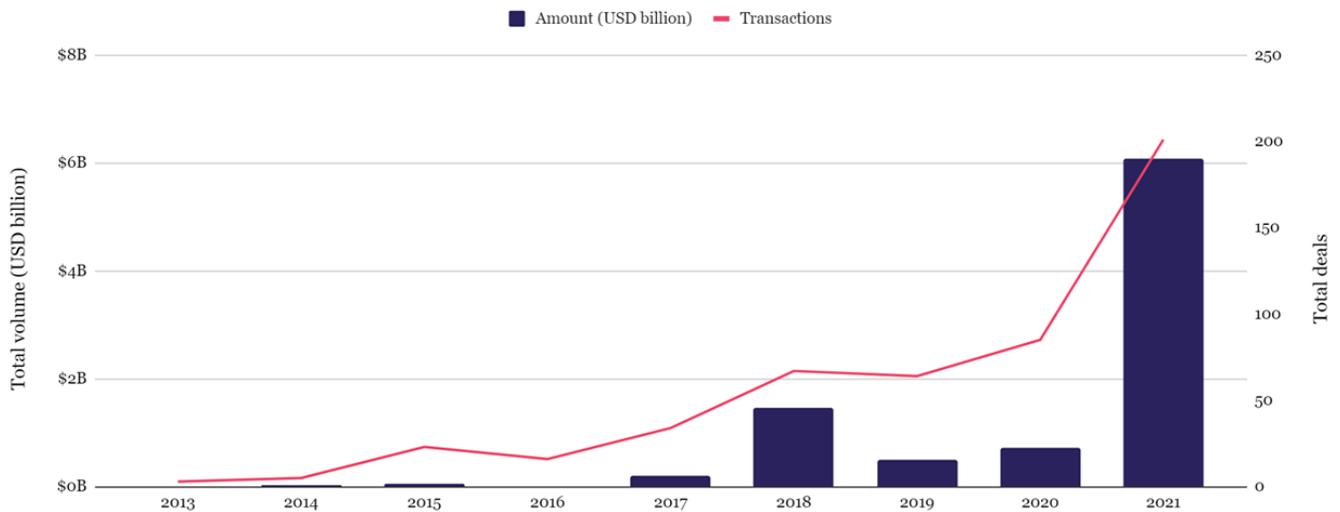


Figure 51: Yearly Crypto/Blockchain M&A transactions and dollar volume 2013-2021

Source: Architect Partners, Pitchbook, The Block Research

J.C. Flowers & Co. acquired a 30% stake for \$300 million in LMAX Digital, the institutional cryptocurrency exchange operated by LMAX Group.

The crypto exchange Coinbase, was also active with acquisitions where it conducted the most out of any firm this year with eight and has been the most aggressive participant in M&A historically with a total of

27 acquisitions. This year, the exchange's acquisitions included the firms RouteFire, Bison Trails, Skew, Zabo, ATS Wallet, Polychain Labs, Agara, and BRD wallet.

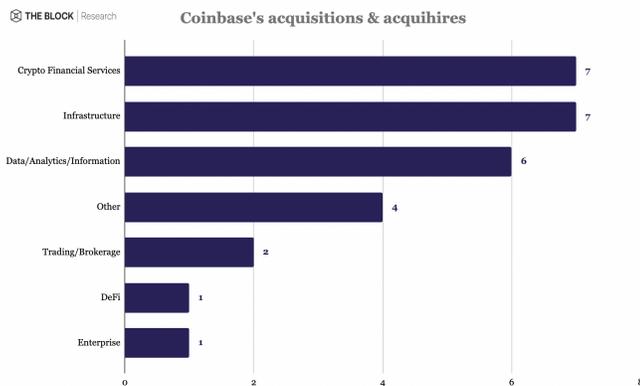


Figure 52: Coinbase's acquisition & acquihires  
Source: The Block Research

The firm's acquisitions of the trade execution platform Routefire and the data & analytics providers Skew and Zabo signaled its continued focus and dedication to strengthening its institutional offerings. The readily available data on the activity and health of digital asset markets and other education materials offered by Skew and Zabo will be complementary features to its ability to execute larger-sized trades for its clients.

As noted previously in our report, Coinbase's staking quarterly revenue grew from \$3.3 million to \$81.5 million over the span of a year, and for this reason, the exchange made two major staking acquisitions that signal its dedication to strengthen this arm of its business. The firm acquired the staking infrastructure providers Bison Trails and Polychain Labs for an estimated \$80 million and \$160 million, both of which have been some of the largest staking providers for numerous blockchain networks.

While less active than Coinbase, other crypto exchanges were also active with acquisitions. The crypto exchange Gemini made its first acquisitions this

year, acquiring Blockrize to assist with the launch of its crypto-rewards credit card and Shard X to enhance its custodial services. The firm also acquired defunct predictions market platform Guesser to help bolster its offerings surrounding DeFi and the adoption of its stablecoin GUSD.

While not an exchange, NYDIG, which competes with Coinbase's institutional offering in servicing high net worth clients looking to purchase bitcoin, also made acquisitions of its own to expand its services. While most institutional offerings are looking to expand the number of digital assets it supports through trading and staking, NYDIG's actions reflect that it is predominantly focused on only Bitcoin and its subsequent ecosystem. The firm acquired the data & analytics provider Digital Assets Data, the commercial lender for the bitcoin mining industry Arctos Capital, and the bitcoin payments application Bottlepay. The acquisition of Bottlepay will allow NYDIG to integrate Bitcoin's Lightning Network into its existing full-stack Bitcoin platform.

# 3 Institutional Custody: 2021 Overview, 2022 Outlook

Carlos Reyes and Greg Lim



# Institutional Custody: 2021 Overview, 2022 Outlook

*Carlos Reyes and Greg Lim*

A look at institutional-grade custodial solutions, fundraising and M&A activity, the technologies used to secure customers' digital assets, and additional value added services.

## Quick Take

- 2021 was a record year for fundraising and M&A activity. Fundraising was nearly three times larger than 2018, the previous record year. Acquisitions of BitGo for \$1.2 billion and Curv for \$200 million by Galaxy Digital and PayPal respectively were standouts.
- Custodian-focused companies are building value added services on top of their custody solutions to diversify their revenue streams and remain competitive.
- Leading technologies such as multi-signature, multi-party computation, and hardware security modules are used in combination with proprietary solutions.

## Foundational Layer Set in 2021

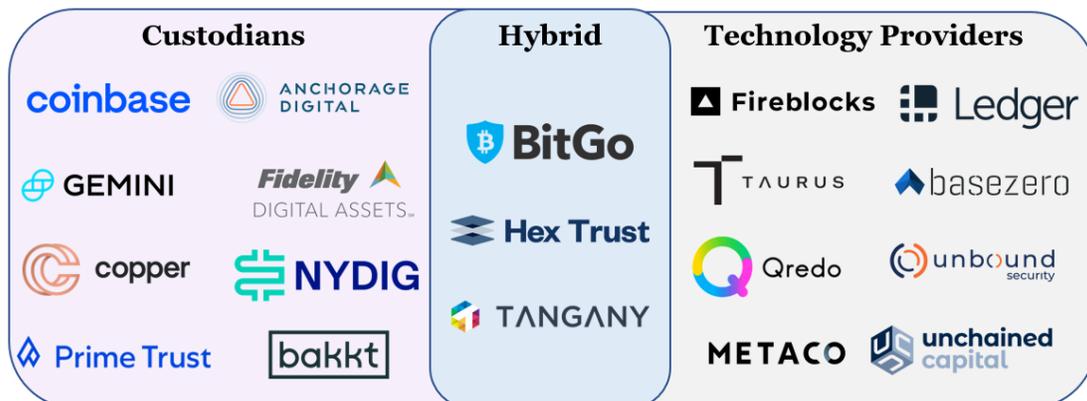
As institutional investors continue to enter the digital asset space, demanding sophisticated products and

services, the recognition of custody as a foundational layer has greatly increased. In May 2021, Galaxy Digital acquired custodian BitGo for \$1.2 billion, the digital asset industry's first billion dollar acquisition. Galaxy Digital CEO Mike Novogratz stated their acquisition of BitGo bolstered their prime brokerage and DeFi services.

Custodians are also fortifying their value-added services, such as trading and lending, as a way of increasing and diversifying their revenues. On the other hand, financial service firms like Galaxy Digital and Genesis are building out their custodial capabilities. While many firms are collaborating with custodians, some like the previously mentioned firms are turning to M&A to bring custody in-house.

Equally important is the increasing self-custody sophistication. For larger institutions, the counterparty and / or balance sheet risk of a third-party custodian may be too great. They may also have investment strategies that may be ineffective if combined with third-party custody. Providers such as Fireblocks and Ledger act as service providers that deliver specialized software, hardware, and other resources such as training, to enable customers to securely self custody their digital assets.

### The Custody Provider Landscape



Source: The Block Research, Ledger Vault. Represents select industry participants and is not an exhaustive list.

Broadly speaking, modern institutional-focused digital asset custody firms fall into one of three categories:

- Direct custodians
- Technology providers who enable customers to self-custody
- Hybrid companies

The line between direct custodian and technology provider is not a strict one. Companies can and do offer both direct custody and self-custody services. The choice between utilizing a direct custodian or self-custodying through a technology provider has real implications for a company in terms of security, operations, and regulatory compliance among other considerations.

In 2022, the investments into digital asset custody are likely to bear fruit in the form of enhanced service offerings and continued innovation into the technologies that enable digital asset custody. The space will also continue to grow as traditional financial

institutions such as BBVA, BNY Mellon, and U.S. Bank among others, enter or expand their digital asset offerings, including custody, either directly or by partnering with an existing custodian.

### Investments and acquisitions

While Galaxy Digital’s acquisition of BitGo and PayPal’s acquisition of Curv were leading headlines for the custodial industry due to the size and importance of these deals, investments and acquisitions into the digital asset custody industry reached a high point in 2021. In fact, many custody-focused firms themselves acquired firms to bolster their own services. Custodians such as NYDIG and Gemini completed acquisitions in order to improve areas such as reporting and data analytics capabilities or custody-related technological capabilities. For example, this January NYDIG acquired Digital Assets Data, an enterprise-grade data, research, and analytics company, and in June Gemini acquired ShardX for their secure multi-party computation (MPC) cryptographic technology.

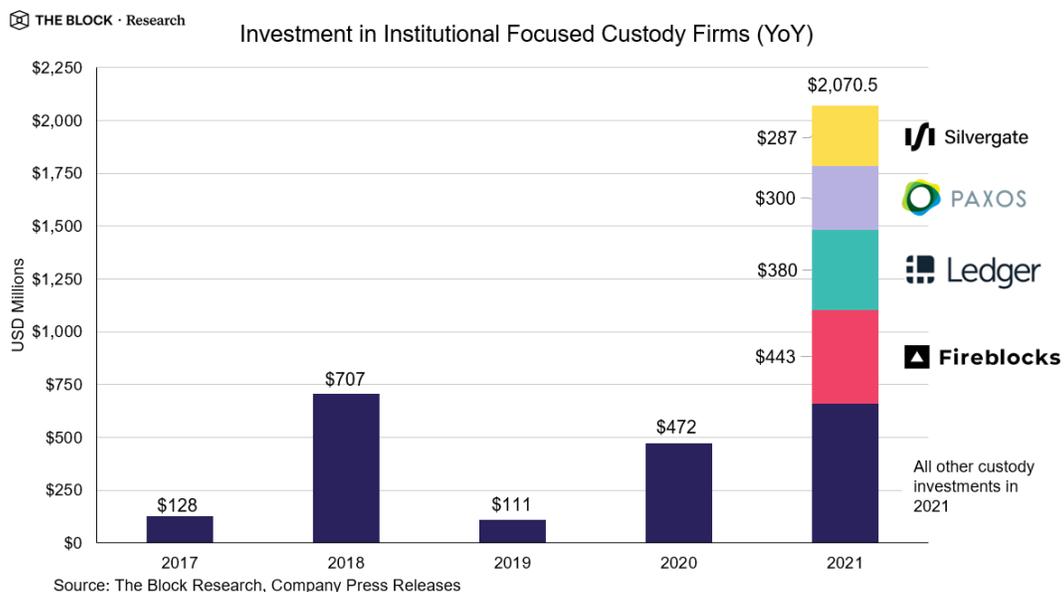


Figure 53: Yearly Investment in institutional focused custody firms 2017 - 2021

2021 marked a high point for investment into institutional-focused digital asset firms. Fundraising in 2021 was nearly three times larger than the 2018 amount, the previous record year. Fireblocks and Ledger led the fundraising with \$443 million and \$380 million respectively in 2021 alone.

Investment in the custodial space is also coming from within the digital asset landscape. More recently, the DeFi and centralized finance (CeFi) growth resulted in a new source for custodian service demand. CeFi, the term refers to companies such as BlockFi, Celsius, Nexo and others that offer customers returns on their digital asset deposits.

Leading CeFi platform Celsius acquired custodian GK8 for \$155 million earlier this year to improve their in-house capabilities. BlockFi and Nexo rely on direct custody services and technology providers to safeguard customer funds. These platforms gather billions of dollars in user funds and are among the largest dollar value custody customers.

## Leading technologies

In the current custodial landscape, there are three leading technologies that enable both direct custodians and technology providers. These technologies are:

- Multisignature (Multisig)
- Multi-Party Computation (MPC)
- Hardware Security Modules (HSM)

Each of these technologies has its advantages and limitations, and all three are being used to secure hundreds of billions in digital assets. These technologies do not exist in a vacuum and custodians

often layer them with each other and in combination with their proprietary platforms. For example, keys used in a multisig setup can be secured with an HSM, or an MPC provider can enforce multisig-like rules via their platform policy configurations requiring multiple signers to authorize transactions. Though MPC is largely unsupported by current HSMs, MPC can be used in combination with technologies like Intel's SGX which have some of the same properties as a traditional HSM.

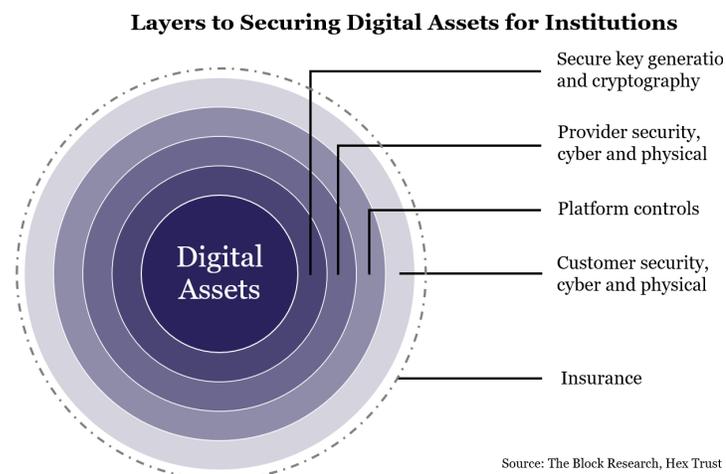
Platform policy configurations are a particularly important aspect of all institutional-grade offerings. These allow customers to create rules around transactions and reports on their activities. Some examples of often seen rules include transactional value limits or conditions, whitelisting, time delays, and sourcing (i.e. only from hot wallets, or certain parties can only withdraw from certain sub-accounts or asset types).

Companies may also utilize each other's services to strengthen their offerings. For example, a direct custodian may specialize in cold storage and contract with a technology provider to help improve the security of their hot wallet implementations. This allows the custodian to focus on their core business while retaining the optionality of choosing a provider that best matches their hot wallet needs.

Given the amount of funding flowing into custody in 2021, custodial-focused companies are likely to refine their technological implementations through internal development and M&A activities and invest in expanding their value-added services.

## Holistic approach

Custodian solutions are not a single technology or feature, but instead a multi-layered approach. By combining the latest in secure key generation and storage, with physical and cyber security, as well as customer education and outside structures such as insurance, custody-focused firms are able to meet the high demands of their institutional clients. At the same time, they strive to find new ways of adding value to their services and providing new products to help their customers maximize their digital asset strategies.



## Multichain future

With the explosive growth of DeFi on Ethereum and the rapid development of competing Layer-1 platforms such as Binance Smart Chain, Solana, Cardano, Polkadot and more, custody is becoming a crucial adopter of multichain operations. While the largest institutional players are more cautious when it comes to adopting digital assets, institutional demand for non-Bitcoin assets continues growing.

Ethereum leads this trend of [increased institutional demand](#) for additional digital assets. For example,

institutional platform Bakkt [announced](#) that they would begin allowing their customers to buy, sell, and hold ETH on their platform.

As Ethereum transitions from proof-of-work to proof-of-stake, and other blockchains with unique technological characteristics gain traction, digital asset custody firms must rapidly and safely adapt to meet customer demands. This includes understanding the unique security profile of each new blockchain added, including additional products built on top of a specific blockchain.

In terms of asset support, it is easier for technology providers to enable the support of additional blockchains and their respective tokens. Though direct custodians also offer support for hundreds of digital assets, they also bear the reputational and regulatory risk should they support troublesome assets. There are also non-technological multi-chain considerations for both direct custodians and technology providers. Some of these considerations include:

- Liquidity
- Compliance and/or regulatory clarity
- Development history and capacity
- Decentralization, validators, and network stability

## Diversifying revenue streams and unique offerings

The rapid development of the robust custodial solutions has allowed both digital asset custody firms and their clients to offer value added services built upon secure custody. In addition to providing new revenue streams, these services further strengthen the financial and competitive positions of the companies

that offer them. The most frequently seen value added services are trading and lending as standalone and prime brokerage offerings. DeFi is currently being explored as another avenue for expanding value added service offerings.

Digital asset custody firms are also constantly developing unique products and services to further stand out from their competitors. Some of these unique offerings include:

- **Copper Clear Loop:** Allows customer assets in custody to be utilized for trading on centralized exchanges with balance changes settled afterwards
- **Fireblocks Digital Asset Transfer Network:** Connects customers with each other, and with exchanges and protocols allowing rebalancing across exchanges and instant settlements among customers
- **SEBA Bank:** Offers customers asset tokenization and storage of their newly created tokens.<sup>1</sup>

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## 2022: A tighter regulatory environment

An ever-present and ever-evolving topic in the digital asset industry, regulators have also had their hand in shaping the institutional custody industry. Institutional custody will likely continue to see new entrants in 2022, but the industry will also face a tighter regulatory environment.

In the U.S., certain types of institutions like investment advisers are required to utilize qualified custodians. In legal terms, advisers refer to companies, including mutual funds, that engage primarily in investing, reinvesting, and trading in securities, and whose own securities are offered to the investing public.

Meeting these regulatory requirements can also aid in securing government and other forms of public contracts, for example, BitGo, a qualified custodian, [was selected](#) to safeguard digital assets for the U.S. Marshals Service. Furthermore, upcoming legislation regarding stablecoins, digital assets, and digital asset service providers may place additional requirements on custody firms.

Internationally, as data continues to be commoditized and recognized as increasingly valuable, some regulators are considering tightening regulations to ensure they maintain sufficient oversight over their local financial institutions. For digital asset custodian firms serving international markets, this may result in increased local licensing requirements and requirements to establish local branch offices. For technology providers, the regulatory burden is not as high as with direct custodians given that the end customer is ultimately responsible for complying with relevant regulations.

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<sup>1</sup> Examples provided by SEBA include: equity, precious metals, fine art, and copyrights among others.

# 4 Layer by Layer: 2021 Overview of Layer-1 and Layer-2 Platforms, 2022 Outlook

Kevin Peng, Arnold Toh, and Rebecca Stevens

# Layer-1 and Layer-2 Platforms

*Kevin Peng, Arnold Toh, and Rebecca Stevens*

A look at the competitive landscape of Layer-1 and Layer-2 platforms and their ecosystems, the impact of incentives, and strategies L1s are taking to optimize for performance, growth, and connectivity. Also, key developments and trends in cross-chain bridges.

## Quick Take

- Layer-1 blockchains have seen significant growth throughout 2021, capturing market share from Ethereum and employing varied strategies to build their own ecosystems.
- Incentives, funding, and continued development of key infrastructure like cross-chain bridges have played a pivotal role in the growth of Layer-1 and Layer-2 platforms.
- Layer-1 blockchains are currently positioned as the top alternative to Ethereum, but development of Layer-2 solutions is starting to speed up as well.

## 2021 Overview of the competitive landscape of Layer-1 Platforms

One of the prevailing trends of 2021 has been the growth of layer-1 (L1) blockchains and their ecosystems, particularly in relation to the growth of the current leading smart contract platform, Ethereum. As stated in our [State of the Market section](#), Layer-1 protocols were one of the breakout winners for general top-10 cryptocurrencies this year. Zooming in on the price returns between the layer-1 platforms cryptocurrencies against ETH, they have significantly outperformed ETH's price gains, led by Fantom (FTM), Solana (SOL), and Terra (LUNA).



Figure 54: Layer-1 native token price performance in 2021  
Source: CoinGecko

Price performance aside, L1s this year saw a dramatic increase in quantifiable user activity, largely driven by the emergence of DeFi ecosystems across the various L1 platforms. With a continually growing list of DeFi protocols to choose from, users deposited a record amount of capital into decentralized applications like decentralized exchanges (DEXs), lending protocols, yield aggregators, and derivatives exchanges.

On Ethereum alone, total value locked (TVL) in DeFi protocols rose from about \$16.1 billion at the start of 2021 to \$101.4 billion as of November 30, representing a gain of about 530% over the course of the year. DeFi TVL in L1 ecosystems overall grew even quicker, adding over \$166 billion since the start of the year for a gain of about 974%.

Whereas Ethereum remained home to nearly all capital locked in DeFi at the start of 2021, its share of DeFi TVL has been chipped down to 63% as of November 30. This emergence of alternative L1 ecosystems has occurred during a period of continued crypto market growth, including for Ethereum. With Ethereum transaction volumes repeatedly reaching new all-time highs between January and May amidst a broader crypto market surge, users of the largest smart contract platform began to experience significant issues with the network's scalability early in the year.

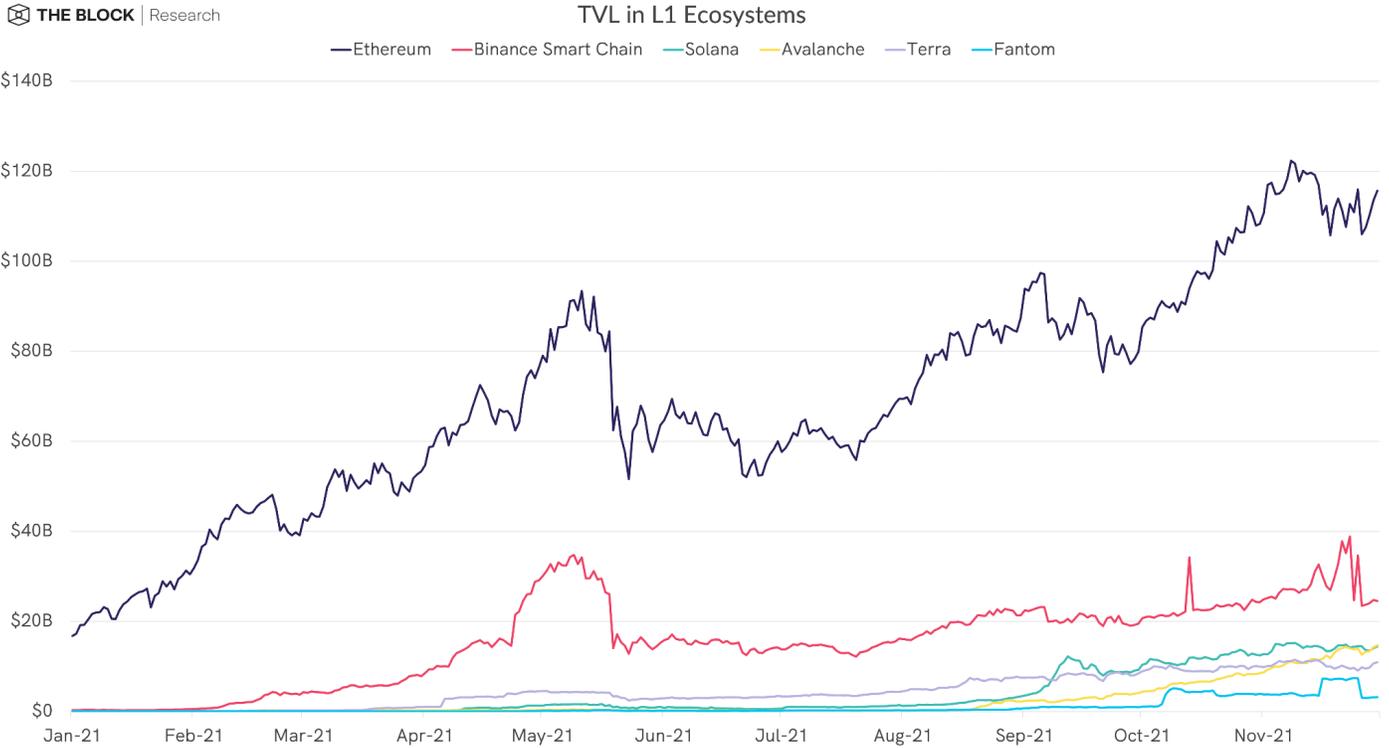


Figure 55: Total value locked in layer-1 ecosystem 2021  
Source: DeBank, The Block Research

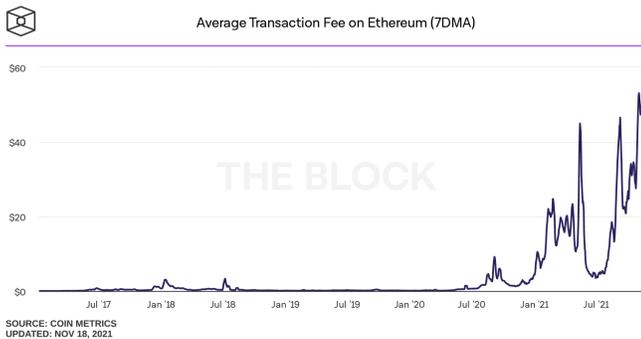


Figure 56: Average transaction fee on Ethereum (7DMA) 2017 - 2021  
Source: DeBank, The Block Data Dashboard

Average transaction fees on Ethereum rose to record-high levels in the first half of the year, at times leaving users paralyzed with exorbitant gas fees and long confirmation times during times of extreme network demand. Priority gas auction (PGA) bots and

increasing MEV activity since January also contributed to prolonged [high gas costs](#) early in the year.

In this environment of significant network demand and rapidly increasing costs, non-Ethereum L1s with comparatively lower fees began to take center stage as users sought alternatives for activities they typically performed on Ethereum. EVM-compatible chains like Binance Smart Chain (BSC) were particularly well-positioned to absorb a significant fraction of new and existing DeFi users, offering the opportunity to experiment in a new, but familiar ecosystem without the barrier to entry of high capital costs.

Beginning in February, the BSC ecosystem grew dramatically, reaching a peak of \$34.8 billion in TVL on May 9, then representing about 26% of DeFi TVL.

Alongside TVL, BSC saw a sharp increase in daily users, and also saw a record-high of about 8 million average daily transactions in the month of May.

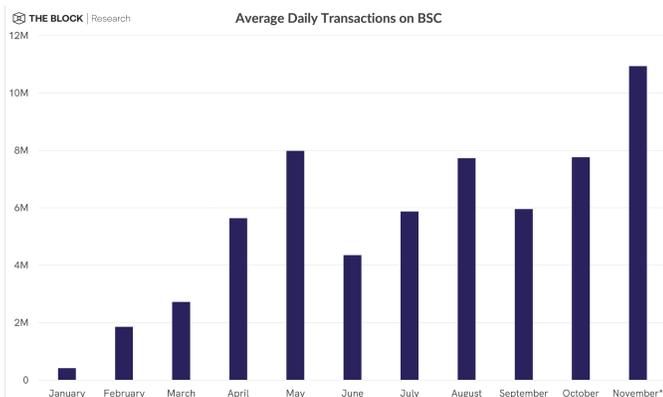


Figure 57: Average daily transaction in 2021

Source: BSCScan

With a broad crypto market drawdown that began in mid-May, these metrics tracking BSC adoption and usage fell dramatically, only recently regaining prior all-time high in TVL on November 14. Notably, the ecosystem experienced a prolonged [series of exploits](#) throughout Q2 as well, highlighting the fragility and risk of a large number of protocols on the network that originated as unaudited forks of Ethereum DeFi protocols (see [DeFi exploits section](#) for more information). Still, BSC's explosion of growth this year gave rise to a sort of blueprint for other emerging L1s, sparking the idea that establishing primitive DeFi protocols like DEXs and lending platforms in a new L1 ecosystem can be crucial for attracting active users and developers.

Even as of this writing, BSC's main DEX PancakeSwap consistently processes some of the highest trading volume among DEXs, behind only Uniswap on most days. As the main source of on-chain trading activity, DEXs in particular have become a focal point for nascent L1 ecosystems, providing an important tool for

users looking to begin exchanging value on any particular blockchain.

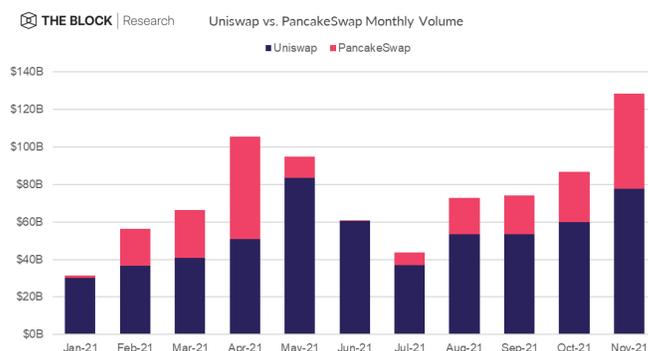


Figure 58: Uniswap vs. PancakeSwap monthly volume in 2021

Source: CoinGecko

That being said, one of the greatest challenges that protocols continue to face today is the issue of fragmented liquidity. Even with EVM compatibility, newer L1 ecosystems looking to attract liquidity face an uphill battle as users often require compelling reasons to move assets that may already be earning yield on another platform. As it turns out, one of the best ways to attract liquidity providers is to simply incentivize them.

To learn more about DeFi, see [the DeFi section](#) of our report.

## Incentives and funding

In the second half of the year, EVM compatible chains saw a sharp increase in users and activity, partly due to the large increase in incentives offered through L1 teams and their treasuries. Of these programs, one of the most noteworthy is perhaps the Avalanche Foundation's "[Avalanche Rush](#)" program, launched on August 18 with a directive to scale its DeFi ecosystem by distributing 10 million AVAX tokens (worth ~\$180M at the time) to liquidity providers of Avalanche protocols.

Since then, at least 8 other incentive programs of \$100 million or more have been announced by other L1 funds, including the [Fantom Foundation](#), [Terraform Labs](#), and the [Algorand Foundation](#). Most of the programs are focused on fostering the growth of DeFi in their respective ecosystems, although each program varies in its exact goals and scope, as well as its token distribution method. Whereas the Avalanche Rush program is primarily structured as liquidity mining rewards for ecosystem participants, other programs like Fantom’s 370 million FTM incentive program are more specifically geared towards funding developers. In the Fantom program, awarded developers who are able to meet certain performance criteria over a period of time can use their rewards however they’d like, including for liquidity incentives.

Layer 1 Disclosed Funding Rounds				
Related Organization(s)	Type	Date	Amount Raised	Investors
Algorand Inc.	Seed Round	2/15/2018	\$ 4,000,000	Union Square Ventures, Pillar Union Square Ventures, Polibus, Eterna, NGC, Lemniscap
Algorand Inc.	Venture Round	10/24/2018	\$ 62,000,000	
The Algorand Foundation	Token Sale	6/19/2019	\$ 60,000,000	
<b>Total Funding</b>			<b>\$ 126,000,000</b>	
Ava Labs	Series A	2/1/2019	6,000,000	A16Z, Abstract Ventures, MetaStable, Polychain Bitmain, Galaxy Digital, Initialized Capital, NGC, Dragonfly
Avalanche Foundation	Token Sale	6/25/2020	\$ 12,000,000	
Avalanche Foundation	Token Sale	7/22/2020	\$ 42,000,000	
<b>Total Funding</b>			<b>\$ 60,000,000</b>	
Binance	Token Sale	7/1/2017	\$ 15,000,000	Sequoia, Limitless Crypto Investments, Fancify Capital, Others
Binance	Series A	9/1/2017	\$ 10,000,000	
<b>Total Funding</b>			<b>\$ 25,000,000</b>	
Interchain Foundation	Token sale	4/15/2017	\$ 17,000,000	Paradigm, Bain Capital, 1confirmation
Techedmint	Series A	3/19/2019	\$ 6,000,000	
<b>Total Funding</b>			<b>\$ 23,000,000</b>	
EthSuisse	Token sale	8/30/2014	\$ 16,000,000	
<b>Total Funding</b>			<b>\$ 16,000,000</b>	
Parity Technologies	Seed	4/23/2016	\$ 750,000	Ethereum Foundation
Web3 Foundation	Token Sale	10/27/2017	\$ 145,000,000	
Web3 Foundation	Token Sale	1/1/2019	\$ 60,000,000	
Parity Technologies	Grant	1/7/2019	\$ 5,000,000	
Web3 Foundation / Parity Token Sale	Token Sale	7/28/2020	\$ 43,000,000	
<b>Total Funding</b>			<b>\$ 253,750,000</b>	
Solana Labs	Series A	7/30/2019	\$ 20,000,000	Multicoin, Slow Ventures, Rockaway Ventures, Others
Solana Labs	Token Sale	3/25/2020	\$ 1,800,000	
Solana Labs	Token Sale	6/9/2021	\$ 314,000,000	A16Z, Polychain Capital, Alameda Research, Coinfund, Others
<b>Total Funding</b>			<b>\$ 335,800,000</b>	

Figure 60: Layer-1 disclosed funding rounds  
Source: The Block Research

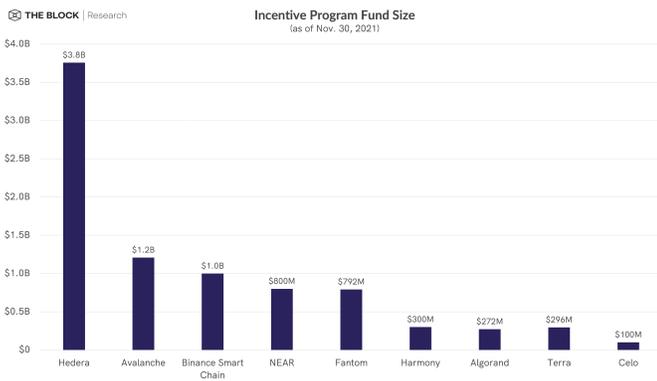


Figure 59: Incentive program fund size by layer-1 platforms  
Source: The Block Research

The Avalanche and Fantom programs both distribute funds in their native tokens, alongside others including Hedera, Algorand, and Terra. As a result, the dollar amount of these incentive programs can vary depending on the market, especially as tokens are redistributed to a wider group of holders. These rewards are typically derived from the treasuries of the various teams, which are funded by early investors through seed rounds or token sales.

This year, investment firms increased their bets on specific L1 ecosystems, whether through investments in specific projects or through native token sales. For instance, as highlighted in our [Funding and M&A](#) section, Solana Labs raised \$314.15 million in a private token sale led by a16z and Polychain Capital in June. Avalanche also [announced a raise](#) in September of \$230 million led by Polychain Capital and Three Arrows Capital. For more specific information on L1 teams and their token distributions, check out The Block Research’s [Layer-1 Platform Report](#).

Regardless of incentive token distribution or funding method, the most important to each L1 team is the degree to which users and developers choose to stake time and capital in their particular ecosystem. One way to measure this is to look at the change in ecosystem TVL over time, which provides a general sense of DeFi protocol growth. However, as we have noted in [previous reports](#), DeFi protocols in a particular ecosystem can often hold an outsized amount of native

L1 TVL Growth Normalized to Price

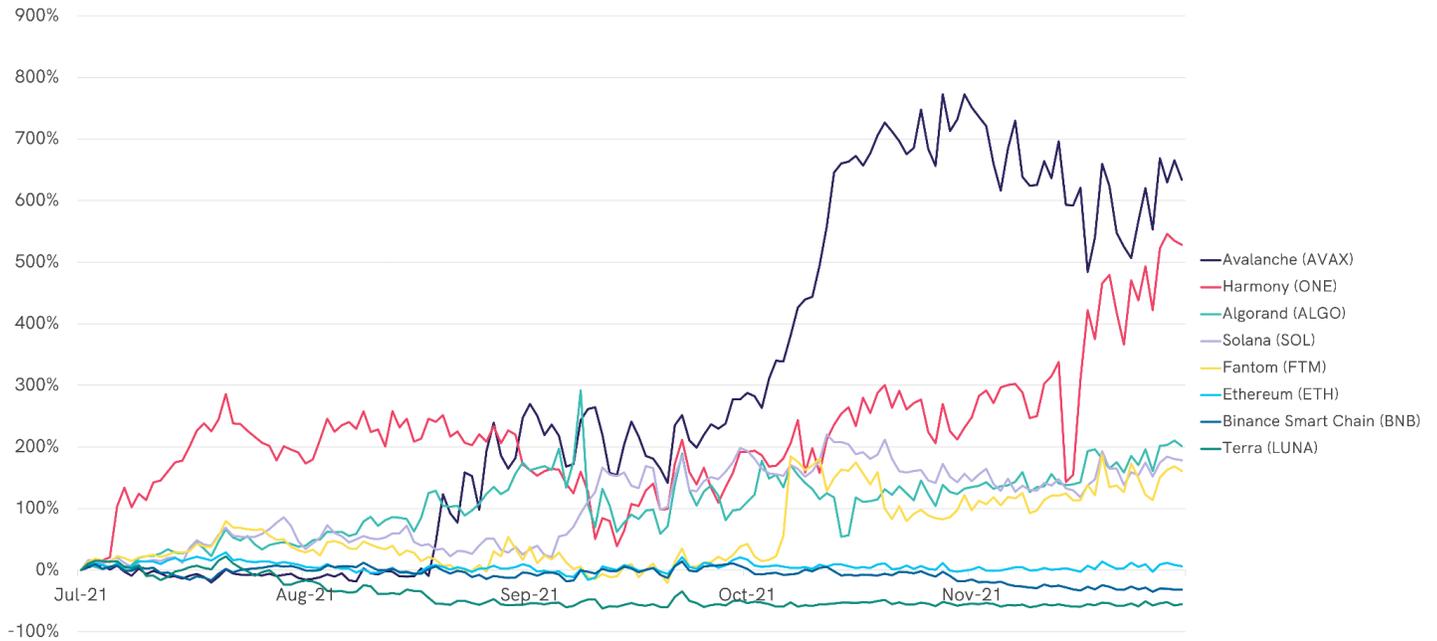


Figure 61: Total value locked growth normalized to price by layer-1 platforms July - November 2021  
Source: CoinGecko, DefiLlama

network tokens (e.g., SOL on Solana), which increases the impact of token price changes on overall ecosystem TVL.

By normalizing TVL growth for ecosystems by the price of the corresponding native tokens, we can get a relatively more accurate picture of how much new capital has entered an ecosystem, as opposed to USD gains dictated primarily by token price performance.

Since the start of Q3, just before the wave of L1 incentive programs began, TVL in Avalanche’s ecosystem has grown more than every other major L1 ecosystem in percentage terms when normalized by price. Interestingly, Avalanche’s TVL saw its first big jump immediately following the announcement of the Rush program, and it has been able to retain a significant portion of its TVL over the past few months.

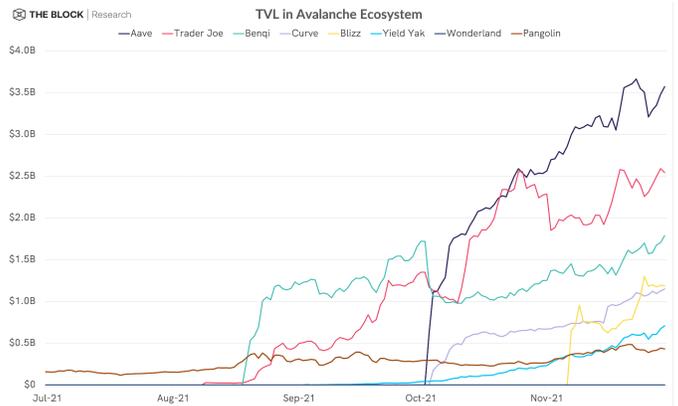


Figure 62: Total value locked in Avalanche ecosystem July - November 2021  
Source: DefiLlama

Since the beginning of Q3, Avalanche’s TVL has increased by over \$13.5 billion as of this writing in November 2021. Part of this success in attracting capital could be attributed to the EVM compatibility of Avalanche’s C-Chain, upon which effectively all DeFi

protocols on Avalanche are currently built. With users and developers able to use familiar Web3 tools like Metamask and Solidity to interact with Avalanche, the barriers for entry to the ecosystem are relatively low, particularly for existing Ethereum users.

Avalanche's growth in the second half of the year has also been made possible by the Avalanche Bridge, which significantly lowered the cost of bridge transfers since its [upgrade](#) in late August. As of this writing, the Avalanche Bridge has continued to offer AVAX airdrops to users of the bridge above a minimum \$75 threshold, ensuring that bridgers to Avalanche can begin using the network immediately without first acquiring AVAX separately for gas. For a deeper dive into developments regarding cross-chain bridges this year, see our [Cross-chain Bridge discussion](#) in the latter part of this section.

### Competition in growing layer-1 ecosystems

Coupled with Avalanche's EVM compatibility, the relative ease of transferring value from Ethereum to Avalanche has fostered especially strong competition in the growing ecosystem. For instance, the Pangolin DEX was the largest protocol by far in terms of TVL on Avalanche for many months, but the launch of Trader Joe in mid-August with its clean interface and liquidity mining rewards shook up the ecosystem, with the newer DEX overtaking Pangolin's TVL by September.

For over a month, Trader Joe and the lending protocol Benqi sat comfortably at the top of the TVL rankings in the Avalanche ecosystem, with both protocols holding over \$1 billion by the start of October. However, the arrival of incumbent DeFi protocols from Ethereum, Aave and Curve, in early October marked the start of a new phase of competition within the Avalanche

ecosystem. Armed with fresh liquidity incentives provided through Avalanche Rush, Aave's TVL on Avalanche quickly ballooned, surpassing Benqi and Trader Joe's for the first time within just a few days of launch.

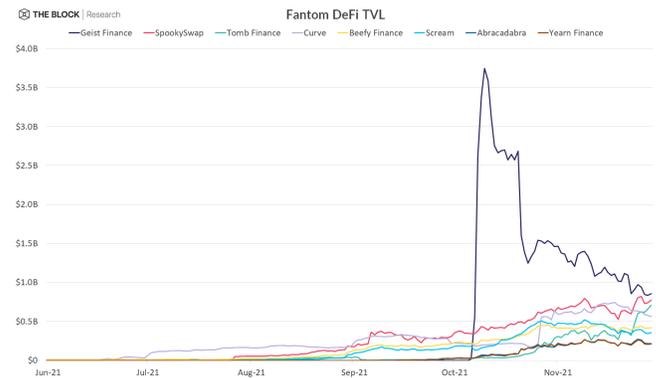


Figure 63: Total value locked in Fantom by top-8 DeFi protocols  
June - November 2021  
Source: DefiLlama

A similar situation is unfolding in the Fantom ecosystem, where TVL recently reached a peak of \$6.2 billion on November 9th. Like in the Avalanche ecosystem, DeFi incumbents that have seen significant adoption on Ethereum are now beginning to move into the Fantom ecosystem as well. As of November 30, Curve is now the 4th largest protocol in the Fantom ecosystem by TVL after initially launching on Fantom [in June](#) with CRV liquidity rewards. On September 1, [FTM rewards](#) on Curve also went live, further promoting usage of the stableswap protocol through Fantom's incentive program.

Interestingly, DeFi incumbents like Curve and Aave have been able to directly benefit from rewards distributed through the Avalanche and Fantom incentive programs, underscoring the desire for these L1 teams to attract established, big-name DeFi protocols to their ecosystems, even at the potential

## SpookySwap vs. SpiritSwap TVL and Volume

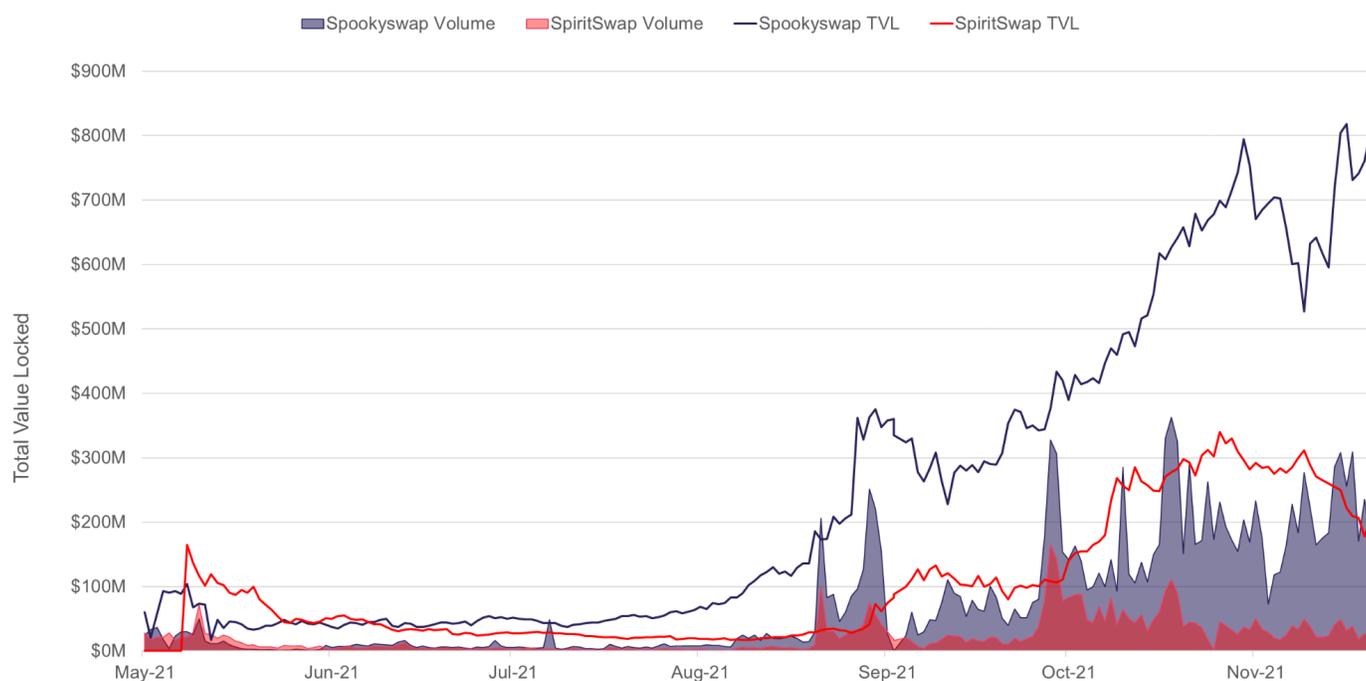


Figure 64: SpookySwap vs. SpiritSwap by total value locked and volume

May - November 2021

Source: CoinGecko, DefiLlama

expense of native protocols. In fact, a proposal to deploy Aave on the Fantom network was passed on [October 18](#), citing the availability of FTM rewards for Aave through such a strategy and setting up the protocol for deployment in the near future.

This year, the battle for DeFi protocol dominance in the Fantom ecosystem has remained tight, with leading Fantom-native DEXs SpiritSwap and SpookySwap swapping positions as the top DEX on Fantom over the course of the year, both in terms of TVL and volume.

Within these burgeoning DeFi ecosystems, one trend that has become clear this year is that competition amongst protocols is continually evolving, leaving the field open for protocols to establish significant network effects and community. With well-known,

Ethereum-native DeFi protocols now beginning to launch across a number of L1 ecosystems, protocols native to these L1s are facing one of their greatest challenges to date in terms of retaining and growing their user base.

In newer, smaller L1 ecosystems like Harmony, there is naturally more opportunity for DeFi protocols to quickly capture significant market share in the absence of a clear frontrunner. With a relatively smaller user and capital base compared to the more popular EVM compatible L1s, Harmony's ecosystem of about \$542 million in TVL as of November 30 is primed for disruption as it continues to grow. Environments like Harmony's can also be conducive to innovation, giving builders the opportunity to experiment with ideas amidst a smaller playing field.

One noteworthy example of this innovation is the [DeFi Kingdoms](#) (DFK) protocol, which is now the largest protocol on Harmony as of November 30, with \$280 million in TVL that comprises about 51% of the TVL in the Harmony ecosystem. As a DeFi protocol that includes an Automated Market Maker (AMM)-based DEX and an NFT marketplace underlying an encompassing gaming UI, DFK is one of the more unique mixes of gaming and DeFi in the crypto landscape today. In fact, DFK's spot at the top of the TVL leaderboard on Harmony means that for many trading pairs in the ecosystem, DFK is able to offer the highest source of liquidity.

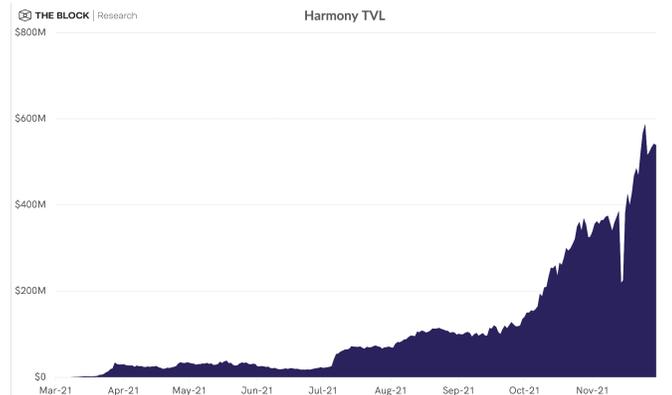


Figure 65: Total value locked in Harmony ecosystem  
March - November 2021  
Source: DefiLlama

Despite the fact that users must pass through a role-playing game (RPG)-styled interface in order to access its DEX and liquidity pools, DFK has been able to amass more TVL than the Harmony deployments of both SushiSwap and Curve combined as of this writing. In terms of trading volume on their DEXs, DFK and SushiSwap are more comparable, suggesting that some Harmony users looking to perform token swaps may still prefer the experience of a standard, no-frills DEX.

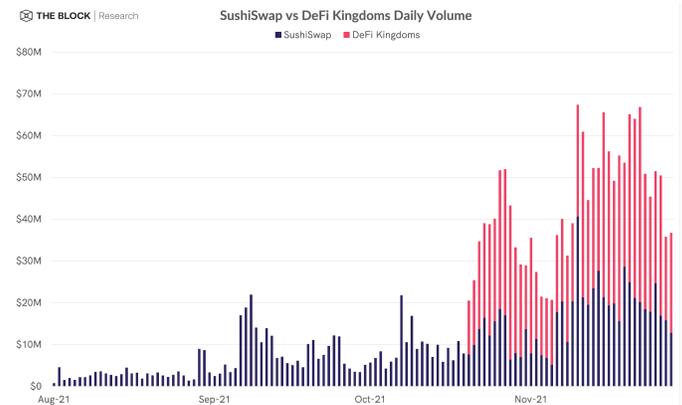


Figure 66: SushiSwap vs. DeFi Kingdoms daily volume  
August - November 2021  
Source: SushiSwap, DeFi Kingdoms

Even so, DFK's daily volumes have regularly surpassed that of SushiSwap on Harmony over the past few months, clearly demonstrating the potential for new DeFi protocols to capture a meaningful share of user activity in relatively smaller but growing L1 ecosystems. The most important question is whether DFK will eventually be able to maintain its dominance over more established protocols like Sushi in the face of future growth. For now, DFK continues to extend its lead over DeFi competitors in the Harmony ecosystem, seemingly unaffected even by Harmony's [decision](#) in September to offer \$2 million in token incentives to Curve users. Ultimately, although it is difficult to predict which protocols will have the greatest success within particular L1 ecosystems over time, one thing is clear: with ample room for growth and disruption, the composition of these young ecosystems can look dramatically different after just a few weeks.

### Beyond the EVM - Optimizing for performance and growth

Amidst the general increase in network demand and gas fees on Ethereum this year, EVM-compatible chains were well-positioned to capture the flow of capital from Ethereum to other L1 ecosystems as users and

developers sought low-fee alternatives with familiar UI and concepts. At the same time, the shift in attention to L1 alternatives also brought a renewed focus to non-EVM compatible blockchains, along with their differences in terms of performance, security, and design. More so than in previous years, the unique features of different network architectures, Sybil resistance, and consensus mechanisms were put to the test in a production environment as various blockchains reached critical milestones and began to see rising usage.

Sybil Resistance and Consensus Overview					
Platform	Sybil Resistance	Consensus Algorithm	Finality type	Priority	Chain Reorgs
Algorand	PoS	Pure Proof of Stake	Deterministic	Safety	Not Possible
Avalanche <sup>(1)</sup>	PoS	Avalanche	Probabilistic	Safety	Not Possible
BSC	PoA / dPoS	Proof of Staked Authority	Deterministic	Liveness	Possible
Cosmos Hub	PoS	Tendermint BFT	Deterministic	Safety	Not Possible
Ethereum	PoW	Nakamoto	Probabilistic	Liveness	Frequent
Ethereum 2.0	PoS	Gaspar	Deterministic	Liveness	Possible
Polkadot	PoS	Grandpa/Babe	Deterministic	Liveness	Possible
Solana	PoS	Tower BFT	Deterministic	Liveness	Possible

Source: The Block Research, Platform websites; (1) Avalanche consensus represents consensus for its DAG. Finality type, prioritization and chain re-orgs could differ for its linear blockchains

Figure 67: Sybil resistance and consensus overview  
Source: The Block Research Layer-1 Platform Report

In the aftermath of the explosive growth of DeFi and the overall crypto market in the early part of the year, many L1 chains began to develop DeFi ecosystems of their own, regardless of EVM compatibility or easy access to on-chain capital. In doing so, the original visions for L1 blockchains laid out in whitepapers in past years became closer to reality, allowing ecosystem participants to begin experiencing first-hand the strengths and weaknesses of the various L1s available today. With the ability to directly interact with native applications in many ecosystems, it became possible to more tangibly visualize the unique capabilities and challenges of each L1 network.

Given the proliferation of fundamental DeFi protocols like DEXs and lending protocols throughout L1 ecosystems, it can be easy to lose track of the major differences between chains that ultimately define their

strategy and value proposition. However, the flurry of product launches throughout 2021 has also highlighted some of the ways in which protocols tailor-built for specific blockchains can enable experiences that may not otherwise be possible elsewhere. One of the clearest examples of this synergy between application and blockchain is Serum, an orderbook-based DEX built on Solana.

Typically, DEXs like Uniswap and SushiSwap prevalent throughout DeFi are built with an AMM design, wherein passive liquidity pools allow traders to swap tokens based on the current ratio of the two tokens in a pool. Within the AMM category, [variations](#) of the standard constant product design have emerged over time, but they all still rely on automatically rebalanced liquidity pools that lack some of the core features of traditional central limit order books (CLOBs). For instance, users of AMMs are essentially required to market buy when making swaps, unlike in traditional order books, where matching engines execute trades when buy and sell orders overlap at user-specified prices.

Platform Performance Estimates					
Platform	TPS	Figure Source	Certainty Level	Block Time (sec)	Finality Time (sec)
Algorand	1,100	Mainnet Results	High	4.5	4.5
Binance Smart Chain	220	Mainnet Results	High	3	35
Ethereum	20	Mainnet Results	High	13	78
Solana	50,000	Testnet Results	Medium	0.4	2
Avalanche <sup>(1)</sup>	4,500	Testnet Results	Medium	-	2
Cosmos Hub	4,000	Testnet Results	Medium	7	7
Ethereum 2.0	100,000	Developer Estimate	Low	12	768
Polkadot	100,000	Developer Estimate	Low	6	12 - 60

Source: The Block Research, Platform Websites, Testnet Results; (1) Avalanche figures represent estimates for its DAG. Actual throughput and finality times could vary substantially depending on which chain transactions are executed on. Please see commentary below for a detailed explanation of the complexities behind these estimates.

Figure 68: Platform performance estimates  
Source: The Block Research Layer-1 Platform Report

Solana’s especially high throughput (estimated at 50,000 transactions per second) and low transaction fees compared to other L1s make it possible for Serum’s on-chain orderbook to function where it may be unfeasible and cost-prohibitive on other blockchains. In comparison, Ethereum and Avalanche have estimated

throughputs of about 20 TPS and 4,500 TPS respectively.

This ability to leverage the strength of its technical specs to enable applications that benefit from deployment in its ecosystem is likely one of the reasons Solana has been able to achieve the enormous growth it has seen this year. Despite the fact that Solana is non-EVM compatible, it has been able to amass a TVL of \$14.4 billion as of this writing, up from about \$153 million only 6 months ago and putting it behind only Ethereum and BSC. Solana's TVL growth is significant even when normalizing it against its great price appreciation this year, where the price of SOL has increased from \$1.84 at the beginning of the year to \$208.71 as of November 30.

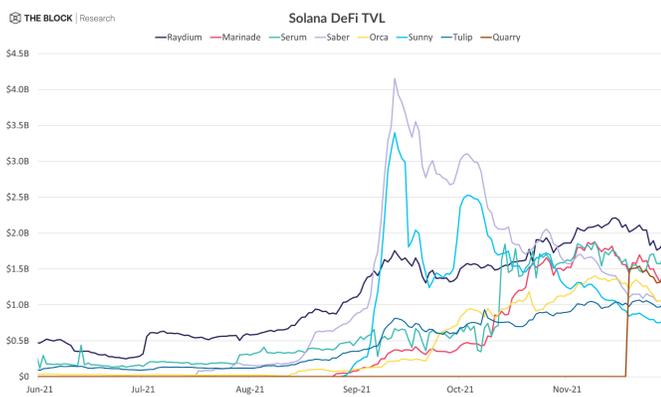


Figure 69: Total value locked in Solana by top-8 DeFi protocols  
Source: DefiLlama

Solana's DeFi ecosystem is led primarily by its DEXs, which make up the majority of the top protocols by TVL. At the top of the list is Raydium, an exchange that taps into Serum's order books to enable a trading experience similar to traditional centralized exchanges, while also offering liquidity pools that allow users to make AMM-based swaps as well. As one of the first DEXs to launch on Solana, Raydium has remained at the top of the Solana ecosystem in terms of TVL for most of the

year, and currently processes most of the trading volume in the ecosystem.

One protocol that has seen considerable growth in recent months is Marinade Finance, a liquid staking solution for Solana that allows users to stake SOL to earn protocol fees in exchange for mSOL, which can then be used throughout DeFi apps in the Solana ecosystem. Marinade's mechanism is similar to that of Lido Finance, a liquid staking solution that has seen considerable growth in the Ethereum and Terra ecosystems in the form of stETH and bLUNA. Interestingly, Marinade's growth has been in spite of Lido's deployment on Solana in early September with its own stSOL liquid staking solution. As of this writing, Marinade's TVL of about \$1.5 billion representing staked SOL is considerably larger than Lido's \$208 million. Given Lido's success on Ethereum and Terra, Marinade's ability to capture a significant majority of liquid-staked SOL market share is especially notable.

Marinade's ability to excel in the presence of a more established protocol like Lido on Solana can be seen as an instructive strategy for native protocols in ecosystems that are now facing challenges from ETH-based DeFi incumbents. Much of the value of liquid-staked products like mSOL and stSOL are derived from the extent to which they are integrated into other DeFi protocols in the ecosystem. Without sufficient liquidity or use-cases for these products, their value proposition drops greatly in relation to native SOL, which can be used throughout the Solana ecosystem. Part of Marinade's success, therefore, is likely due to the fact that it has been able to secure wider support for mSOL among Solana DeFi protocols than stSOL, making it currently a more attractive option for those looking to stake SOL.

Although Solana has seen a direct benefit to its DeFi ecosystem as a result of its technical advantages, it has also seen significant growth this year in its NFT ecosystem, where factors like network throughput are not necessarily as critical. Taking the often-volatile floor price of NFTs on Solana as their current market price, the total market cap for NFTs on Solana has now reached over \$820 million as of November 30.

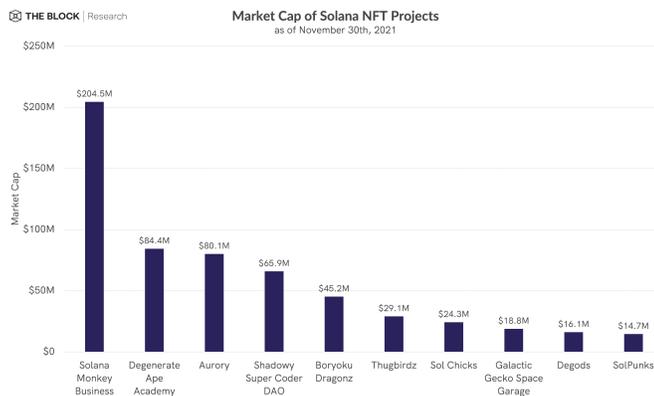


Figure 70: Market capitalization of Solana NFT projects as of November 30, 2021  
Source: Solanalysis

Whereas only a handful of NFT projects existed on Solana in June, the ecosystem is now home to about 70 projects with an assumed market capitalization of at least \$1 million. The growth of Solana's NFT ecosystem this year was made possible by some key infrastructure developments, one of which was the launch of the [Metaplex NFT](#) platform in June, which allows users to mint NFTs on Solana and create their own storefront or marketplace. The timely arrival of Metaplex's contract ecosystem underpinned the launches of major Solana NFT marketplaces like Solanart and Digital Eyes, which were ultimately critical in the growth of NFT activity on Solana as a whole.

One notable aspect of the rise in NFT activity on Solana this year was the interplay between Solana and Arweave, a decentralized storage solution that

[continually backs up](#) Solana's ledger data onto its own blockchain through the SONAR bridge. In relation to NFTs, Arweave also serves an important role as it is the [default storage solution](#) for all NFTs minted through Metaplex. In fact, one way to visualize NFT activity on Solana this year is to look at the transaction count history on Arweave.

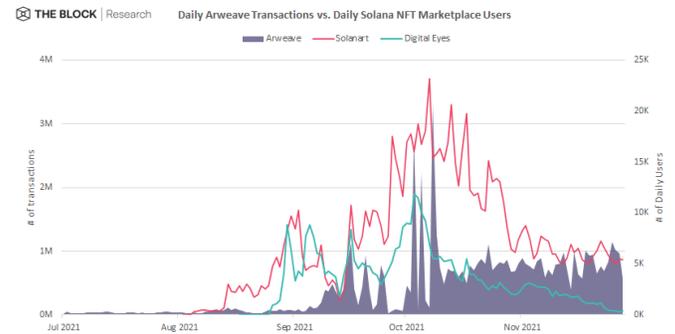


Figure 71: Monthly Arweave transaction vs. daily solana NFT marketplace users July-November 2021  
Source: Viewblock, Arweave, DappRadar

As the number of daily active users on NFT marketplaces Solanart and Digital Eyes began to pick up in late August, so did the number of transactions on the Arweave network. Daily transactions also hit a peak on October 7th, in line with the recent decline in active users of Solana's NFT marketplace since mid-October. As a whole, Arweave's unique symbiotic relationship with the Solana network is worth keeping an eye on in the future as L1 networks are expected to become increasingly interconnected over time.

The Solana ecosystem's significant growth this year can be attributed to the confluence of several key factors, including general crypto market growth, timely product, and infrastructure launches, and funding. However, the journey of its meteoric rise throughout 2021 was not free of challenges; at times the ecosystem was forced to contend with problems that could be considered catastrophic in a truly production-ready

decentralized network expected to support a significant portion of the world's financial assets.

One of the biggest challenges for the Solana network this year came in mid-September when the mainnet experienced a period of prolonged and [unexpected downtime](#) that did not begin to fully resolve until about [17 hours after](#) it began. Initial analysis of the incident pointed to a [sudden increase](#) in bot transactions during the Grape Protocol Initial Dex Offering (IDO), which led to an overload of the network's transaction processing queue and subsequent excessive memory consumption that disabled several nodes. Eventually, validators voted to restart the network, but not before Solana's DeFi protocols were put at major risk of malfunction that could have resulted in significant loss of user funds.

Solana's network downtime this year highlights the unique challenges of creating a new blockchain ecosystem, especially when it grows at such a rapid pace. One of the questions it raises is the issue of centralization; Solana effectively trades throughput for decentralization as its validators are much more computationally intensive to run compared to other L1s. During the downtime incident, validators were able to quickly reach consensus to resolve a critical issue, but one could also argue that such centralization presents a concentrated point of risk for the network.

Still, while the ultimate goal for L1s like Solana is to achieve greater decentralization over time, blockchains are run by people, teams, and governing bodies that continually innovate and allow the system to improve. For relatively new L1 chains, this means that occasional centralized actions may be necessary in the early days to ensure continued success. Blockchains today are ultimately evolving networks, and this fact is most clear

in the case of network upgrades, where developer decisions can have a massive impact on the future of the network. These upgrades can help optimize for a number of things, including performance, growth, and security. For instance, [Ethereum's London hard fork](#) in August this year brought sweeping changes to the network's transaction fee structure and monetary policy as EIP-1559 was implemented. Avalanche's Apricot Phase Four upgrade in September also introduced new block-based fees to the C-Chain, along with a new congestion control mechanism intended to combat malicious MEV activity on the network.

Sometimes, upgrades are implemented to optimize for growth, as we saw in the case of Tezos' [Granada mainnet](#) upgrade in August this year. Unlike with most other L1 platforms, the Tezos blockchain can be upgraded through an [in-protocol amendment process](#) that does not require a hard fork. In the Granada upgrade, Tezos' consensus algorithm was replaced to reduce block times from 60 to 30 seconds, and it also introduced the concept of "[liquidity baking](#)" to the network. With this feature, Tezos governance effectively voted to implement a protocol-native mechanism for incentivizing and attracting liquidity to the network.

To implement liquidity baking, Tezos created a constant-product market maker (CPMM) contract that acts similarly to a liquidity pool on AMMs like Uniswap. The contract encourages the addition of tzBTC to a tzBTC-XTZ pool that continuously generates XTZ rewards in the same way that XTZ is rewarded to Tezos bakers (stakers). As XTZ is added to the CPMM pool, it results in the [artificial inflation](#) of the price of tzBTC price in the pool, which then incentivizes arbitrageurs to add more tzBTC to the contract in exchange for relatively "cheap" XTZ.

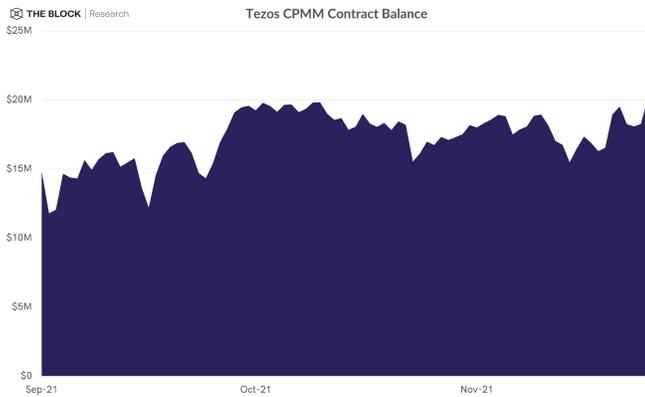


Figure 77: Tezos CPMM contract balance September - November 2021  
Source: DefiLlama

Since its introduction, the contract has been able to garner about \$20.2 million in total liquidity as of November 30, although its growth has remained relatively stagnant over the past few months. As we have touched on recently, [one issue](#) with the liquidity baking contract's specific support for tzBTC is the fact that tzBTC is comparatively more difficult to obtain for users looking to enter the Tezos ecosystem while remaining entirely on-chain. To do so, one would have to bridge assets through the Wrap Protocol bridge, and then swap for tzBTC. Instead, users may opt to simply bridge the commonly used WBTC for wWBTC, which as of November 30, has about [twice as much](#) liquidity as tzBTC on Plenty, Tezos' biggest DEX by TVL. As it stands, users may in fact have little reason to move their liquidity from the CPMM contract, limiting the effectiveness of the liquidity incentive mechanism.

Even so, Tezos' unique method of liquidity incentivization directly through a mainnet upgrade is a testament to how fluid today's blockchain architectures can be as they adapt to changing market needs. In this fast-paced crypto industry, it is often the case that protocol designs that were well-suited for a particular L1 ecosystem a year ago can become outdated after reaching a new level of growth or adoption. For newly

launched or growing blockchains, the ability to implement necessary changes relatively quickly can therefore be an important factor for remaining competitive and achieving continued growth.

One major L1 that underwent a significant upgrade this past year was Terra, with its [mainnet upgrade](#) to Columbus-5 on September 30. Terra's last mainnet upgrade to Columbus-4 in October 2020 [brought CosmWasm](#) smart contracts to Terra, which first gave developers the ability to develop applications in Rust for the Terra ecosystem. Just under a year later, the most recent update brought a number of changes that reflect the needs of Terra's now more matured ecosystem.

In the earlier Columbus-4 Terra protocol, a portion of all LUNA that was burned in order to mint UST (i.e. seigniorage) was redirected to LUNA stakers, as well as a [community pool](#) to fund general ecosystem initiatives. While this mechanism was initially beneficial for bootstrapping the growth of Terra's young ecosystem, the emergence of supporting initiatives like Terraform Capital and a [\\$150 million ecosystem fund](#) over the past year eventually reduced the need for seigniorage-funded community pools. As a result, Columbus-5 enacted a [new mechanism](#) for LUNA seigniorage whereby 100% of it is burned upon UST minting, creating a simpler and more direct relationship between LUNA and UST demand.

Over the long run, this change is expected to create much stronger deflationary pressure on LUNA with growing demand for Terra's UST stablecoin. As in the case of Ethereum's EIP-1559 upgrade, Terra's Columbus-5 upgrade this year is representative of the way L1s can actively adapt for growth in a rapidly changing market environment. In the next section, we

will look at some of the ways L1s are moving forward in preparation for an increasingly connected multi-chain world.

## Adapting for increased connectivity in a multi-chain world

One of the primary goals of the Terra platform is to expand the distribution of its UST stablecoin throughout the crypto ecosystem, regardless of the specific blockchain or protocol underlying its usage. In the Terra model, UST is minted in times of growing demand, where anyone can elect to burn LUNA in exchange for an equivalent dollar amount of UST at current market prices, effectively increasing the UST supply.

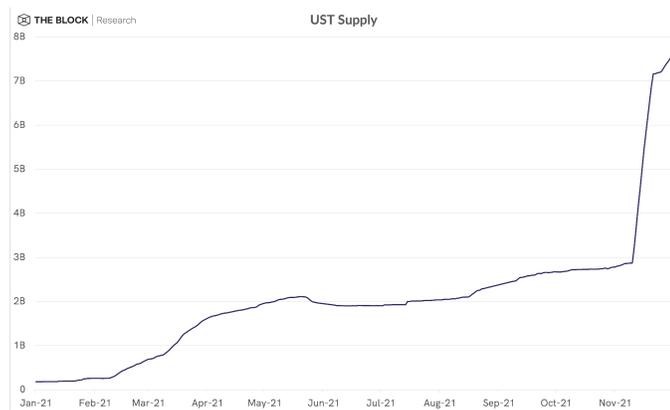


Figure 78: UST supply in 2021  
Source: CoinGecko

Over the course of 2021, UST supply has expanded dramatically, from about 182 million at the start of the year to about 2.7 billion on November 10, reflecting the steadily growing demand for the stablecoin throughout the year. As of November 22, the supply of UST has since shot up even more aggressively up to 7.2 billion for a gain of about 4.5 billion over just 12 days. However, rather than a natural spike in demand, the latest increase is instead a direct result of the passage

of Terra proposals 133 and 134 on [November 9](#), which designated 88.675 million LUNA (~\$4.5 billion at the time) to be burnt over the course of two weeks from the Terra community pool that had been built up prior to Columbus-5. The minted UST from the scheduled LUNA burn is expected to be used for a number of initiatives, including for funding a native insurance protocol for Terra called [Ozone](#), purchasing decentralized collateral reserves for UST, and funding the [multichain expansion](#) of UST.

Interestingly, another new feature implemented through the Columbus-5 upgrade is the diversion of LUNA/UST swap fees to LUNA stakers, instead of being burnt as in the previous mainnet version. In other words, LUNA staking yields are expected to increase with Columbus-5, particularly in periods with significant burns. In fact, the effects of the recent LUNA burns on staking rewards can already be seen.

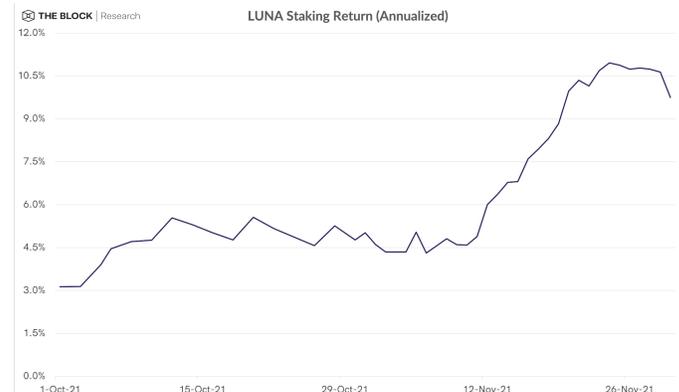


Figure 79: Luna staking annualized return October - November 2021  
Source: Terra Station

Since the LUNA swaps for UST began on November 10, the annualized staking yield for staking LUNA has more than doubled, with an expected annual yield of about 10.4% as of this writing. This yield increase is also expected to benefit Terra's two largest DeFi protocols by TVL Anchor and Lido, which collectively hold about

\$9.9 billion of the Terra ecosystem's \$12.7 billion in TVL as of November 30. Anchor's TVL is predominantly made up of bLUNA collateral, the liquid-staked LUNA offered by Lido, which means that the latest yield increase for staked LUNA on Terra should benefit users of both protocols and directly translate to further growth as well.

Aside from growth and protocol monetary policy, Terra's Columbus-5 upgrade also initiated an important new level of network interconnectivity with the [activation of IBC](#) transfers on October 21. As a blockchain built using the Cosmos SDK, Terra has the ability to communicate on-chain with theoretically any chain within the Cosmos ecosystem through the Inter-Blockchain Communication Protocol (IBC). With the ability now to transfer assets, Terra takes another step forward in terms of expanding the presence of UST, which is already available in several other L1 ecosystems like Ethereum and Solana in the form of wrapped UST (wUST).

For the Cosmos ecosystem, the activation of IBC transfers for Terra brings it closer to its vision of an interconnected system of IBC-enabled networks. As of this writing, there are now 25 blockchains with IBC activated in the Cosmos ecosystem. A look at the number of IBC transfers shows that Osmosis currently leads the active zones in the Cosmos network, followed by the Cosmos Hub and Crypto.org. Since its activation of IBC in late October, Terra has risen to fifth in the list of Cosmos' most active zones in November.

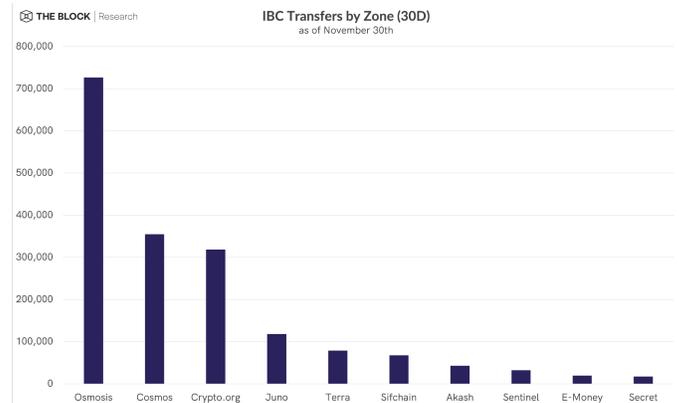


Figure 80: IBC transfers by zone (30 days) as of November 30, 2021  
Source: Map of Zones

Perhaps the clearest indication of Terra's spread into the Cosmos ecosystem is the rise in liquidity of Terra's native assets on Osmosis. As the DEX with the most volume and liquidity among IBC-enabled networks, Osmosis can be seen as a litmus test for general activity in the Cosmos ecosystem. As of November 30, UST and LUNA have collectively accrued about \$89 million in liquidity on Osmosis, behind only OSMO and ATOM, the native tokens of Osmosis and Terra and the Cosmos Hub respectively.



Figure 81: Total value locked in Osmosis ecosystem  
June - November 2021  
Source: DefiLlama

Along with their rising liquidity, UST and LUNA are now among the most heavily traded tokens on Osmosis, underscoring Terra's new presence in the Cosmos

ecosystem. For now, this presence is mostly limited to Osmosis, which has seen significant growth since its [launch](#) in June. Since then, TVL on Osmosis has grown to about \$615 million as of November 28, bolstered by an initial airdrop to ATOM holders and continued OSMO rewards for liquidity providers.

Osmosis's liquidity incentives are representative of some of the key differences between Osmosis and the Cosmos Hub, for which the AMM DEX was [originally envisioned](#) as a module. Ultimately, Osmosis was launched as an independent DEX on its own [IBC-enabled blockchain](#), citing the need to iterate quickly with its features, which would have been limited by the relatively slower pace of governance by Osmosis Hub stakeholders. Indeed, signs of these limitations can be seen in the Hub's own DEX implementation, the Gravity DEX. Launched on [July 13](#), the Gravity DEX has been able to gain considerably less liquidity than Osmosis, with about \$34 million in TVL as of this writing. Although the DEX itself was technically live in July, the front-end interface to access the exchange through the Emeris hub did not launch until over [a month later](#), highlighting the apparent difficulties in building out applications for the Cosmos ecosystem when constrained by the Hub's proposal and voting process.

As of this writing, there are still no additional incentives for providing liquidity on the Gravity DEX, a feature that is common throughout DEXs in DeFi as well as the Osmosis DEX. Only recently on November 9th did a proposal pass to add [budget and farming modules](#) to the Cosmos Hub, which would allow for the [distribution of ATOM inflation](#) for specific purposes and the ability to do so through a standard farming mechanism. Still, the actual implementation of these modules is not expected until [early 2022](#). As one might

expect, Osmosis's liquidity incentives through its OSMO token have given it a significant advantage over Gravity in attracting liquidity, demonstrating once more the effectiveness of rewards in promoting specific user behavior in DeFi.

In the future, the Cosmos Hub's role in the broader Cosmos ecosystem is set to become more defined as a central portal for interacting with IBC-connected chains. For example, the Hub will oversee the creation of the [Gravity Bridge](#), which will allow users to bridge ERC20 assets from Ethereum to Cosmos. As is the case with other ecosystems, such a bridge is critical in enabling the general adoption of the Cosmos ecosystem, providing a direct way to transfer value from the most established L1 ecosystems. In the upcoming [Vega upgrade](#), the Cosmos Hub will also add IBC router functionality, which would allow it to provide routing services for IBC-enabled chains and collect fees for doing so.

One of the biggest developments coming to the Cosmos ecosystem is the introduction of [Interchain Security](#) to the Cosmos Hub. In essence, this would allow a parent chain like the Cosmos Hub to produce blocks for a child chain, such as an IBC-enabled chain like Osmosis. Although not expected to be released until [Q2 2022](#), networks connected to the Cosmos Hub could inherit its security guarantees, lowering the general cost of security for IBC-enabled chains. In implementing this shared security model, the Cosmos ecosystem would start to look similar to the Polkadot network, which uses a main relay chain to finalize blocks for connected parachains.

This year, the Polkadot ecosystem has resembled a live experiment in its quest to build out an interconnected network of parachains secured by the Relay Chain.

Most of this activity has occurred on the Kusama network, which acts as Polkadot’s version of a testnet or canary network, allowing for fast iteration of theoretical concepts in a production environment before deployment on Polkadot. One of the most significant developments for the Polkadot ecosystem this year was the launch of the [first parachain auctions](#) on Kusama in June.

With the unique parachain slot auction process giving rise to parachains like Karura and Moonriver, users were able to see for the first time what an ecosystem of networks built on Substrate could look like in real time. Throughout the second half of the year, Kusama’s parachain auctions brought valuable attention and capital to winners of the parachain slots, effectively allowing the market to select for the most highly-desired financial primitives and products. Crowdloan participants locked up hundreds of millions of dollars in KSM to support their favorite parachain projects, demonstrating both the overall hype for projects in the ecosystem and the fluctuating interest in the auction process over time.

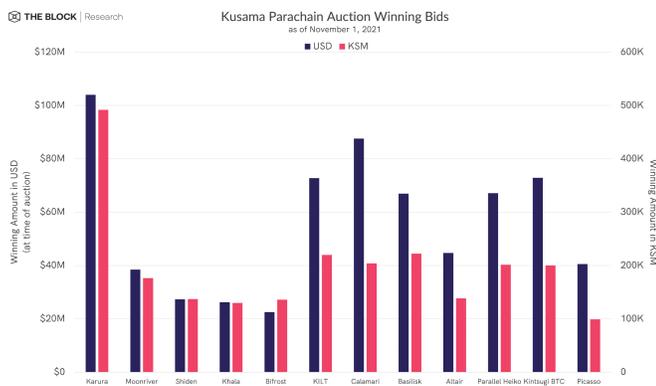


Figure 82: Kusama parachain auction winning bids in 2021  
Source: The Block Research

As of November 30, there are now 16 parachains on Kusama, including the Statemint parachain launched as a so-called “[common good](#)” parachain through

Kusama governance. While the EVM-compatible Karura parachain won the first slot with a record 491,752 KSM bid worth over \$100 million at the time of auction, the latest winning bids have continued to decline, with Genshiro taking the 15th parachain slot with a bid of 45,194 KSM. This trend is reflective of the outsized demand for specific, well-known projects like Karura, as well as the shifting interest towards Polkadot parachain auctions that officially began on November 11. So far, the trend on Polkadot for its parachain slots has looked similar to the story of Kusama, with Acala and Moonbeam winning the first two slots; Acala and Moonbeam are the sister networks of Karura and Moonriver on Kusama, respectively.

With the popularity of Acala and Moonbeam’s networks, users on Polkadot and Kusama appear to be signaling the importance of EVM compatibility for the future of these growing ecosystems. In fact, the use of the EVM has been so prevalent for bootstrapping L1 networks this year that even nascent DeFi ecosystems like Algorand’s seem to be looking to take a page out of the Ethereum playbook, although from a slightly different angle. The Algorand ecosystem saw its biggest foray into DeFi this year with [the launch](#) of the Tinyman DEX in October, though perhaps more significant overall is its introduction of the [Algorand Virtual Machine \(AVM\)](#). Through the AVM’s enhanced tools for developing protocols on Algorand, the network is clearly looking to replicate some of the success of Ethereum’s EVM in promulgating its smart contract platform.

As often seen in other L1 ecosystems, the ability for developers to compose DeFi primitives on Kusama-connected networks with the support of familiar Ethereum tooling has been helpful in both quickly launching products and acquiring users. Among

Kusama parachains launched this year, Moonriver showed the most demonstrable evidence of user activity, gaining over \$350 million in TVL in the five months since its deployment in June.

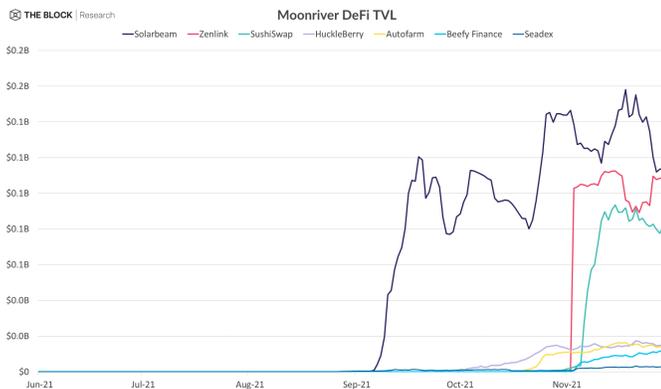


Figure 83: Total value locked in Moonriver by top-8 DeFi protocols  
June - November 2021  
Source: DefiLlama

Nearly a third of Moonriver's TVL is currently locked in the Solarbeam DEX, which offers inflationary native token SOLAR rewards for providing liquidity on the platform. One key aspect of the Solarbeam protocol is its integration of a [cross-chain bridge](#) between Ethereum and Moonriver, powered by the AnySwap protocol. With about \$284 million in TVL as of this writing, the AnySwap: Moonriver bridge is currently the greatest source of capital transfer between Ethereum and the Kusama ecosystem.

Transfers between parachains themselves are conducted through cross-chain message passing (XCMP), which uses the XCM format to allow parachains that share the same Relay Chain to exchange messages with one another. Similar to Cosmos's IBC, Polkadot and Kusama's XCM lies at the heart of their vision for an interconnected network of individual blockchains with shared security. In practice, XCMP can also be critical in ensuring that liquidity is shared between parachains

versus being fragmented across what would be effectively siloed chains.

An example of this important interconnectivity can be seen in Bifrost's recent collaboration with Karura launched on [October 19](#), wherein BNC rewards are offered for providing liquidity on the KaruraSwap DEX. Users can bridge their BNC between the Bifrost and Karura parachains through a [simple interface](#) utilizing XCMP in both applications. In a sense, this collaboration between Bifrost and Karura is reminiscent of the sort of composability that is core to the leading DeFi protocols today, with the added complexity of tokens being supported between different chains.

At the same time, the introduction of new cross-chain technologies like the XCM format employed by Polkadot and Kusama also bears with it unforeseen risks that are often difficult to predict. For instance, Karura and the Kusama ecosystem faced a significant issue on October 12 when an [attacker drained](#) about 10,000 KSM worth about \$3.2 million at the time from the Karura parachain account. The exploit was made possible by a mismatch between the Kusama network's upgrade to v2 of the XCM messaging standard while its parachains were still using XCM v1. In response, Kusama governance quickly disabled XCM transfers and passed a proposal that allowed them to force transfer the stolen funds back to the Kusama parachain account.

Such incidents and the drastic measures taken by Karura and Kusama governance in response underscore the level of risk that still exists in largely unaudited environments undergoing significant iteration. Even in canary networks like Kusama, there can still be significant incentive for attackers to exploit

new, vulnerable protocols given a large amount of funds locked up as potential reward. Still, such an incident highlights the utility of the Kusama network as a vital testing ground for Polkadot, which is expected to eventually secure far greater value.

For now, even as parachain slots are starting to be allocated on Polkadot, parachain auctions will continue on Kusama for the foreseeable future. With the passage of a [motion](#) on October 18 by Kusama governance, auctions will be conducted every week, extending Kusama's role as a canary network for Polkadot. What remains to be seen is how Polkadot's ethos of blockchain interconnectivity will evolve, and how it will extend to its relationship with other L1 ecosystems. Aside from Moonriver's bridge, there remain limited options for bridging assets to and from the Polkadot and Kusama ecosystems. For these ecosystems and beyond, cross-chain bridges will continue to play an increasingly important role in connecting liquidity throughout the modern crypto landscape.

## Major developments for cross-chain bridges

The emergence of cross-chain bridges in 2021 has been one of the most [important developments](#) contributing to the rise of various L1 ecosystems and the current multi-chain landscape. As the primary way to transfer assets between different chains in a permissionless way, these bridges have become important gateways for enabling the seamless flow of capital throughout the crypto ecosystem. Likewise, tracking the activity around cross-chain bridges is now a useful way to assess the usage and interest in certain ecosystems, whether over the short or long term.

Perhaps the biggest example of the central role of cross-chain bridges in today's crypto landscape is the dramatic rise of wrapped BTC assets on Ethereum. Since the beginning of the year, the amount of wrapped BTC on Ethereum has increased from about 140.0 thousand to over 316.6 thousand this year. At current market prices for BTC, this represents about a \$10 billion increase in BTC assets on Ethereum, likely to be used as productive assets in DeFi protocols. Most of the BTC on Ethereum exists as WBTC, which can only be minted by [centralized custodians](#) such as CoinList and Alameda Research. Other wrapped BTC assets like renBTC are backed by a decentralized network of nodes, but they are nonetheless backed 1:1 with actual BTC. For a more detailed look into BTC on Ethereum and other chains, see [Bitcoin in DeFi section](#) of this report.

Rather than looking only at the growth of wrapped assets, the best way to assess movement between L1 ecosystems is to look at the total value locked in the bridges that connect the various ecosystems. This year in particular, a significant amount of capital moved from Ethereum to other L1 chains as DeFi participants sought to invest in early protocols emerging on other chains, as well as to take advantage of attractive yields that could be found throughout the broader DeFi landscape.

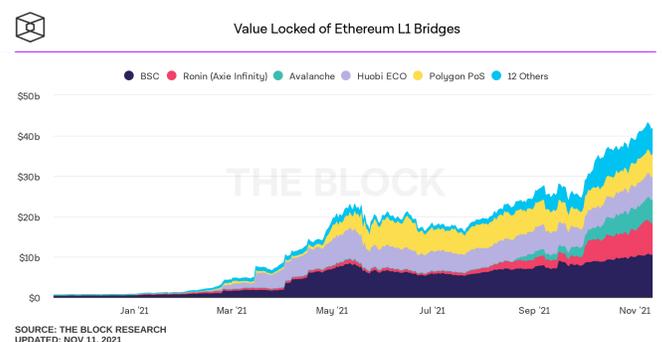


Figure 84: Total value locked in Ethereum to layer-1 by bridges in 2021  
Source: DefiLlama, The Block Data Dashboard

TVL in cross-chain bridges as measured by their smart contracts on Ethereum increased dramatically this year, from about \$667 million at the beginning of year to over \$32 billion as of November 30. Of the various bridges from Ethereum to other L1s, the Binance Bridge has grown to become the largest with a TVL of about \$10.4 billion as of November 30, reflecting the rise of BSC to become the second-largest smart contract platform.

Cross-chain bridges took on many forms this year, with varying implementations and levels of decentralization. For instance, the Binance Bridge is one of the most centralized as it is managed entirely by Binance. When users send assets through the Binance Bridge, the assets are in fact sent directly to the Binance exchange, where they remain [custodied](#) as BSC-compatible wrapped assets are minted. While already having a central point of failure with regards to its custody of assets, the Binance Bridge is also not entirely permissionless, banning users with a US IP address and underscoring some of the main problems with centralized bridges for DeFi.

Other bridges like the Avalanche Bridge have implemented additional security measures in an attempt to better safeguard the assets that can now easily be worth several billions of dollars. In August, the Avalanche Bridge was upgraded to implement [Intel SGX secure enclave](#) technology, wherein the bridge contract that mints or burns assets is controlled by a group of trusted wardens, of which three of four must track and process transactions in order for assets to be transferred. The Avalanche Bridge also [reduced the number](#) of smart contract interactions on-chain from five to one, moving some of the typical bridge processes like relayer voting and execution calls off-chain in order to significantly reduce the cost of using the bridge. It was these technical improvements

that ultimately allowed the Avalanche Bridge to support the relatively cheap (and fast) transfer of significant capital to and from the Avalanche ecosystem, which likely played a role in the ecosystem's significant growth this year.

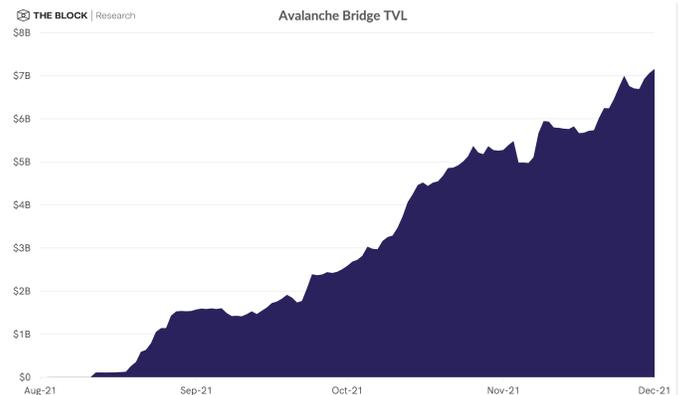


Figure 85: Total value locked in Avalanche bridge  
August - November 2021  
Source: The Block Research

While TVL in the Avalanche ecosystem increased from about \$2.3 billion at the beginning of September to about \$13.4 billion as of November 30 for a gain of about 483%, so did the TVL in the Avalanche Bridge, increasing from \$1.5 billion to \$7.1 billion in the same period for a gain of 373%.

This year, analyzing the flow of capital to and from bridges has been an especially telling indicator of capital flow to particular ecosystems. For instance, another bridge that has reflected the growth of its destination chain this year is the Ronin Bridge, through which players of the popular Axie Infinity game must pass in order to access the Ronin sidechain and interact with the game.

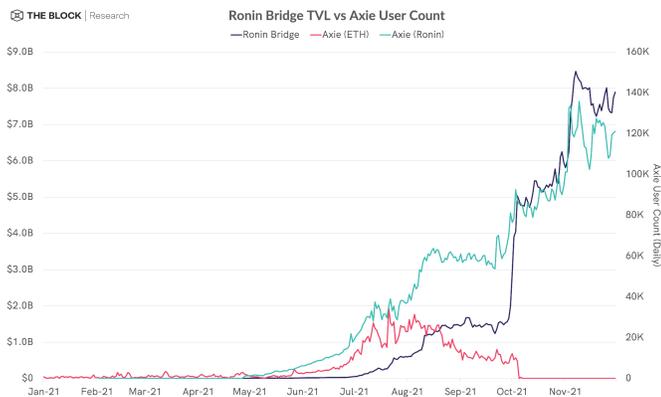


Figure 86: Total value locked in Ronin bridge vs. Axie User count in 2021

Source: DappRadar, The Block Research

Throughout 2021, Axie Infinity, the leading play-to-earn blockchain gaming, saw some of the most explosive growth among DeFi protocols, jumping from an average of 581 daily users in January to an average 121,700 daily users in November. This growth could be seen in the TVL growth of the Ronin sidechain as well, starting from about \$31 million at the start of the year to \$7.9 billion as of November 30. As Axie grew in popularity throughout the year and especially after it migrated its game fully to Ronin, users flocked to the Ronin Bridge, which is now the second-largest cross-chain bridge by TVL only behind the Binance Bridge. More data and insight about blockchain gaming, including Axie Infinity, can be found on the [NFT and Blockchain-based gaming section](#) of this report.

Most bridges deployed today are built with specifications similar to the [ChainBridge protocol](#) by ChainSafe, which uses a “lock and mint, burn and release” mechanism; in this [model](#), tokens being transferred through a bridge are locked in a bridge contract, and equivalent tokens are minted on the destination chain. When wrapped tokens are sent back across the bridge, they are burned on the destination chain and released from the bridge contract on the

source chain. This method works well in most cases, as it provides a simple way to mint assets during transfer without changing the circulating token supply. However, the main flaw with this mechanism is that it requires bridge custody of transferred assets, which can create a vulnerable single point of failure. If the bridge contract is compromised, it could result in stolen funds and render wrapped tokens from the bridge essentially worthless.

One bridge that uses a non-custodial mechanism for bridge transfers is the AnySwap protocol, which gained popularity this year primarily as the main bridge between Ethereum and Fantom. AnySwap uses a [combination](#) of a liquidity swap and a normal mint/burn mechanism, where an intermediary token like anyUSDC is used to remove the need for bridge custody. In an example swap, a user bridging USDC would deposit it in AnySwap, which would mint anyUSDC on Ethereum 1:1, followed by an immediate burn that triggers a mint of anyUSDC on Fantom. It then uses an anyUSDC:USDC liquidity pool on Fantom to exchange for wrapped USDC on Fantom. In this mechanism, bridge custody is not required for transferring assets, only sufficient liquidity.

Taking a look at the AnySwap: Fantom Bridge, it is possible to identify specific events in the timeline of Fantom activity this year. One notable example is the launch of Geist Finance on Fantom on October 6 along with abnormally high liquidity incentives, which resulted in a massive influx of capital into the Fantom ecosystem through the AnySwap: Fantom bridge. Over the course of just four days, the bridge gained over \$3 billion in deposited liquidity, most of which went to the Geist Finance protocol.

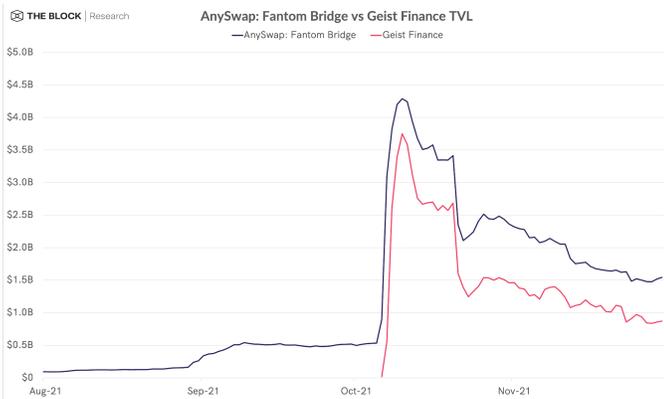


Figure 87: Total value locked in AnySwap by Fantom bridge and Geist Finance August - November 2021  
Source: Dune (@eliasimos), DefiLlama

As reward rates quickly died down for the new lending protocol, capital quickly flooded back out of the Fantom ecosystem, with the bridge losing about \$1.8 billion in TVL just two weeks after TVL peaked on Geist. This incident specifically demonstrates the way in which bridges can provide a window into activity happening between chains, though context is important to have as well.

As cross-chain bridges become increasingly important sources of value and activity in a growing multi-chain world, users will likely begin to look for bridges that can provide the ideal combination of speed, security, and decentralization. These may look similar to AnySwap's protocol, which recently [announced](#) support for NFT bridging as well. Another bridge that also offers NFT bridging and is beginning to gain traction among a number of chains. For example, Wormhole V2 bridge, which uses a unique generic cross-chain messaging protocol that can theoretically allow for the transfer of any asset between chains.

In the future, such generic messaging formats could technically allow assets residing on one chain to be used in a DeFi protocol on another chain, without ever leaving the source chain. In a way, cross-chain bridges

essentially represent a subset of the oracle problem, in which providers are constantly looking to find the ideal tradeoff between speed, accuracy, and security. As such, it might be no surprise that in August, oracle provider Chainlink announced its entry into the bridge game with its new cross-chain interoperability protocol (CCIP). With a greater demand each day to transfer assets permissionlessly between a growing number of L1 ecosystems, cross-chain bridges are positioned right in the middle of the future of cross-chain DeFi. In the future, it is unclear whether one bridge will ultimately rise to service the majority of cross-chain transfers. One thing is certain: the road to ultimate cross-chain interoperability will be filled with the emergence of many potential solutions taking on many different forms. In the end, the only way to come to a conclusion on the best cross-chain solution is to let the market decide for itself.

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## Ethereum Layer-2 scaling solutions developments

As layer-1 chains continue to threaten Ethereum's dominance as a smart contract platform, Ethereum has pushed forward in advancing its infrastructure by leveraging layer-2 technologies: rollups.

There are two classes of rollups, zero-knowledge and optimistic, both of which are currently live on Ethereum main net. Even without a token distribution, layer-2s have seen significant growth in TVL and this will likely continue into 2022.

With Ethereum 2.0 shard chains scheduled for 2022, coupled with the possibility of token distribution to

decentralize L2 sequencer nodes, rollups are poised for even greater adoption in 2022.

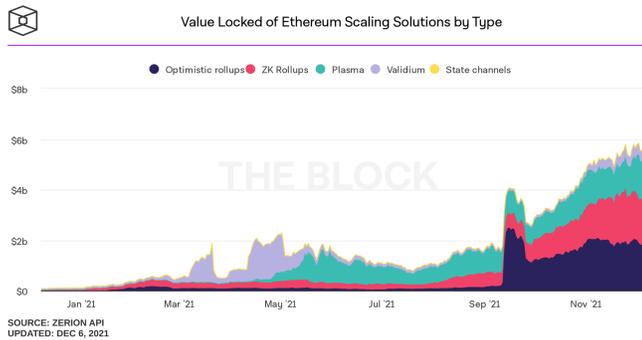


Figure 88: Total value locked in Ethereum scaling solution by type in 2021  
Source: The Block Data Dashboard

### Optimistic rollups

Optimistic rollups (ORUs) have seen significant growth in 2021. Since the launch of Arbitrum and Optimism mainnet on May 28 and June 22, respectively, both ORUs have been increasing in TVLs and user metrics. As of this writing, the TVLs of Arbitrum and Optimism are \$2.6 billion and \$0.4 billion, respectively.

The user metrics for both Arbitrum and Optimism are only on the rise. Although Optimism did launch earlier with Synthetix staking, its mainnet went live after Arbitrum's. That said, both Optimism and Arbitrum have roughly the same growth in terms of unique addresses, but Arbitrum's peak transaction throughput is significantly higher than Optimism's. However, both Arbitrum and Optimism are fundamentally capable of having similar transaction throughput, which suggests that Optimism is primed for growth once it starts to allow decentralized applications (dapps) to deploy permissionlessly.

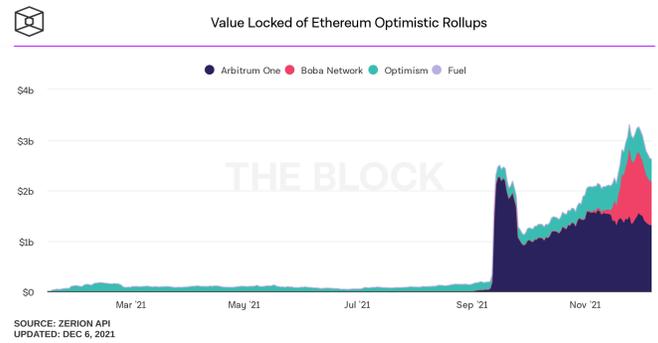


Figure 89: Total value locked in Ethereum optimistic rollups (ORUs) in 2021  
Source: The Block Data Dashboard

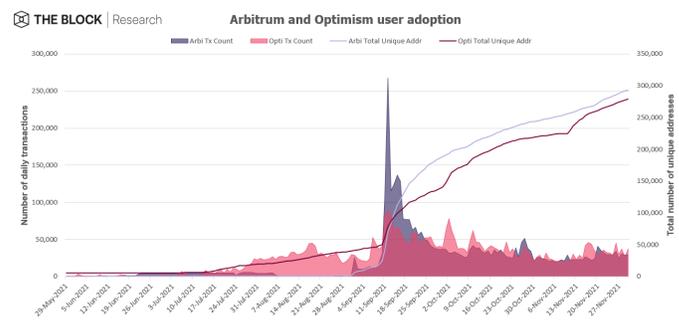


Figure 90: Arbitrum vs. Optimism in transaction count and unique address  
May - November 2021  
Source: Arbiscan and Optimism Scan

Arbitrum and Optimism took very different stances in onboarding dapps: while Arbitrum aggressively sought to onboard as many dapps as possible, Optimism kept a strict whitelist-only requirement for dapps deployment. Needless to say, this has resulted in a significantly larger ecosystem for Arbitrum as opposed to Optimism. As Arbitrum has significantly more dapps than Optimism (58 as opposed to 6), the dapp dominance chart below will only list notable protocols for Arbitrum.

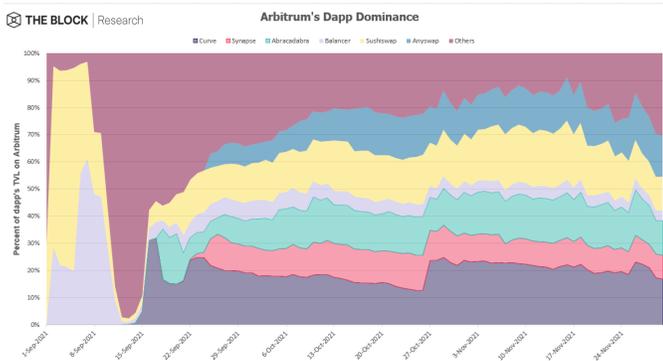


Figure 91: Total value locked dominance in Arbitrum by protocols September - November 2021  
Source: DefiLlama

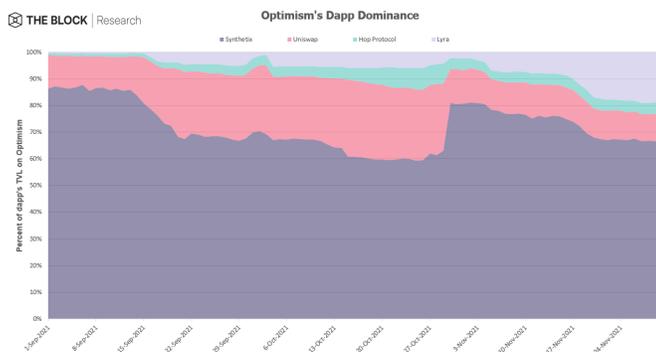


Figure 92: Total value locked dominance in Optimism by protocols September - November 2021  
Source: DefiLlama

Arbitrum has seen significant growth from Curve, Balancer and SushiSwap. More notably, Abracadabra money has also seen rapid growth in TVL, partly due to the rapid rise in its native token SPELL's price. These dapps have been dominating Arbitrum's TVL and are likely to continue doing so in 2022. Optimism, on the other hand, is mainly dominated by Synthetix staking. This is due in part to the fact that there are only 6 dapps on Optimism as of this writing. When more dapps deploy on Optimism, there is a strong possibility that Synthetix dominance will eventually fall off.

Apart from that, there are two other notable ORUs that have gained significant traction in the last quarter of

2021, namely Boba and Metis. Both Boba and Metis are Optimism forks. As of this writing, Metis only has a testnet DEX, whereas Boba is already production-ready with a functioning bridge and a native dex called OolongSwap. The Boba network had an airdrop of their native BOBA tokens to OMG token holders on November 12. This caused significant speculation in the OMG token's price prior to the airdrop. More notably, the funding rate for OMG perpetuals reached -2.4% every two hours on Binance, and right after the airdrop snapshot, OMG's price plummeted. There is unlikely to be another airdrop that adopts this model.



Figure 93: OMG Network native token price vs. funding rates October - November 2021  
Source: Binance Funding History

That said, after the BOBA token was airdropped, it saw a sharp increase in TVL, mostly due to the increase in TVL of BOBA's native dex, OolongSwap. OolongSwap had a liquidity mining incentive which quickly attracted significant volumes of capital to provide liquidity. That said, it is likely that a significant portion of the capital on OolongSwap are mercenary and will likely leave the ecosystem once the yield is no longer attractive.

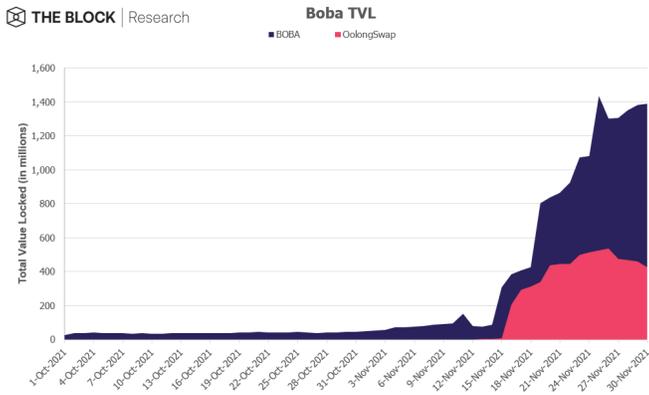


Figure 94: Total value locked in Boba network ecosystem  
October - November 2021  
Source: L2Beat

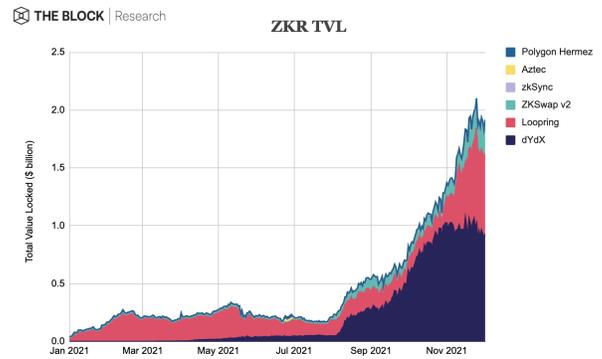


Figure 95: Total value locked in zero-knowledge rollups by solutions in 2021  
Source: Zerion API

Another mention-worthy competitor would be Metis DAO, whose native token, METIS, gained price momentum following the BOBA airdrop. Moving forward, it is unlikely that any L2s will repeat the airdrop for tokens in the same manner that BOBA did, considering the extent in which it distorted the market prices. That said, it remains likely that the two largest ORUs will eventually have to distribute some form of tokens in order to decentralize the sequencer nodes. The mechanism for the tokens’ distribution, if any at all, remains unknown.

### Zero-Knowledge rollups

2021 showed incredible growth for zero-knowledge rollups (ZKRs), increasing from a TVL of \$43.5 million on January 1 of the year, to now having \$1.9 billion locked in ZKR solutions. Validium, a scaling solution utilizing validity proofs but storing data off-chain, has also seen TVL growth throughout the year, although not as drastic as ZKR.

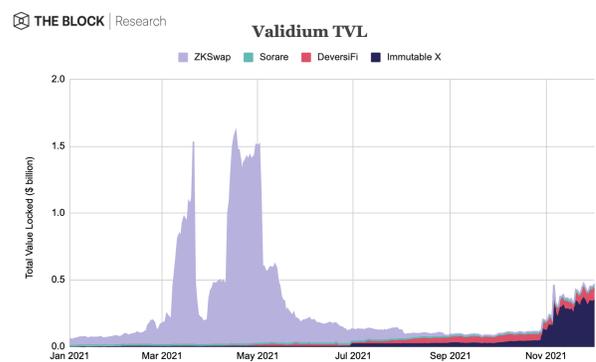


Figure 96: Total value locked in Validium by solutions in 2021  
Source: Zerion API

In the ZKR space, one of the most notable highlights was the launch of dYdX using StarkEx to scale their transaction throughput. The perpetuals exchange also launched a governance token in early September along with new yield generating staking pools, causing the increase in dYdX TVL by over 860% from \$96.5 million on September 8th to \$930 million by the end of November, causing it to be the primary driver of the increase in TVL for ZKRs.

Other ZKR projects include Loopring, ZKSwap V2, zkSync, Aztec, and Polygon Hermez, all of which saw increased value locked since the start of the year with a cumulative TVL going from \$40 million on the first of the year to \$943 million by the end of November.

While Validium value locked did not grow as drastically as its ZKR counterpart, notable NFT projects Sorare and ImmutableX deployed with Validium, both using StarkEx. Similar to dYdX, Immutable X announced their utility token on July 22, which could be used for governance or staked for rewards. This has resulted in Immutable X being the Validium project with the highest TVL at the end of the year at almost \$350 million. During the year, ZKSwap V1 actually had the highest TVL, but is now out of use due to the launch and success of V2.

Aside from the growing TVL of ZKR and Validium, we can see their adoption increase through the deposit calls to the smart contract of validity proof-based scaling projects on a given day. While the days of high deposits vary from project to project depending on their own developments, most projects have seen sustained interest gauged by calls to deposit functions.

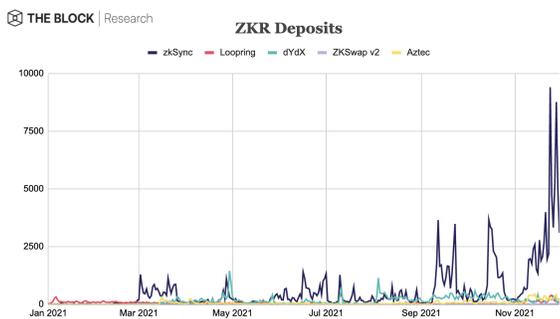


Figure 97: Calls to zero-knowledge rollups deposit functions in 2021  
Source: Dune Analytics (@Brecht)

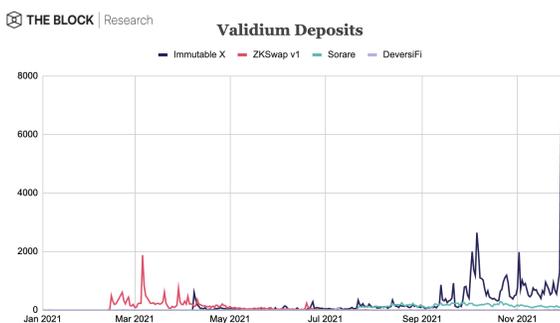


Figure 98: Calls to Validium deposit functions in 2021  
Source: Dune Analytics (@danyanev)

Both StarkWare and Matter Labs have been pioneers in the validity proof space. This year, StarkWare has pushed StarkNet Alpha to mainnet on November 29, which aims to build a complete layer-2 for users and developers to interact with that connects back to the mainnet via ZK-STARKs. Matter Labs announced their development of zkSync 2.0, which would feature zkEVM, an EVM compatible compiler. Similarly, both companies have been looking into creating a hybrid of data availability where the user can pick whether data is stored on- or off-chain, developing Volition and zkPorter as their solutions to merging the two forms of data storage.

## Competitive outlook for Layer-1 platforms and scaling solutions in 2022

Much of the discussion surrounding L1 and L2 platforms this year has focused on scaling, particularly as transaction fees and usage of Ethereum reached record highs amidst a new mainstream focus on crypto and NFTs. In theory, L1s and L2s feature different technical limitations and security guarantees. In practice, they currently function similarly from a user experience perspective. In order to take advantage of the speed and cost improvements of both L1 and L2 chains, users must first bridge their funds from a L1 chain such as Ethereum.

Therefore as with the bridges from L1 to L1, the bridges to L2s serve as valuable indicators of the amount of capital moving from L1 to a particular L2. For instance, TVL in the Optimism bridge has grown from about \$47M at the start of Q3 to about \$517M as of November 30. While experiencing more than a 10X increase in TVL

over the past few months, Optimism’s bridge TVL still pales in comparison to that of other major L1 bridges like the Binance Bridge, which has a TVL of about \$31B as of November 30.

At the moment, L1s have the advantage of playing host to a larger ecosystem of protocols overall, along with key infrastructure features such as oracles, bridges, centralized exchange support, application support, etc. This fact is evident when comparing the TVL in L1 vs L2 protocols, which demonstrates the current dominance of DeFi activity on L1s over L2s.

At the same time, L2s are showing signs of increasing traction in their growth. As is often the case, this growth can be partially explained by the introduction of liquidity incentives that are starting to emerge on L2s. For example, ArbiNyan on Arbitrum launched in early September with extraordinarily high token inflation and APYs, which caused a significant amount of mercenary capital to enter the Arbitrum ecosystem for quick yield, only to leave shortly after.



Figure 99: Total value locked in Optimism bridge

May - November 2021

Source: Dune Analytics (@eliasimos)

Layer-1 vs. Layer-2 Monthly Average TVL

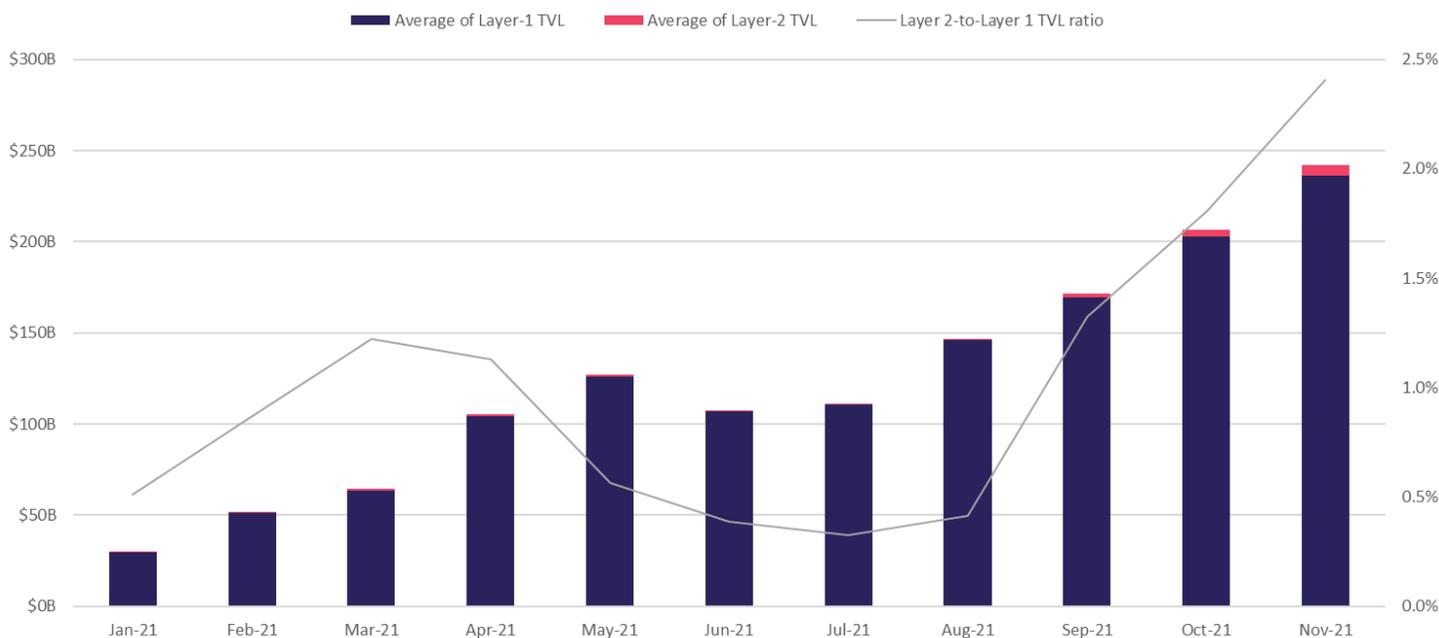


Figure 100: Monthly average total value locked layer-1 vs. layer-2 platforms in 2021

Source: DefiLlama

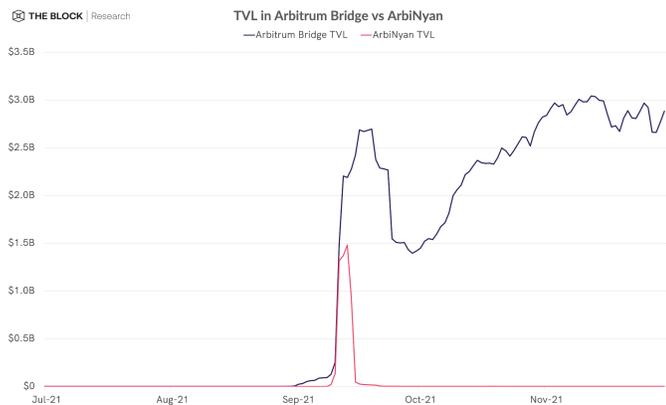


Figure 101: Total value locked in Arbitrum Bridge vs. ArbiNyan  
Source: Dune Analytics (@eliasimos), DefiLlama

That said, Arbitrum and Optimism are still seeing significant growth in their TVLs. Despite the rapid inflow of capital into Arbitrum from ArbiNyan and subsequent outflow, TVL in Arbitrum has nonetheless continued to grow since the beginning of September. Only a few apps currently exist on Optimism, but it is very likely that Optimism will begin onboarding many more dapps in 2022, which could give Optimism the same growth trajectory as Arbitrum. Another material factor to consider is the possibility of a native token for L2s, since there is a need to decentralize the sequencer nodes.

Fundamentally, L2s are not ready to compete with L1s just yet, but there is strong reason to believe they will in 2022. The combined effects of onboarding dapps, greater opportunities for yield generation, low fees, fast transactions, Ethereum-level security and the possibility of a native token is more than sufficient to catapult L2s over L1s if they are well-executed.

# 5 Decentralized Finance: 2021 Overview, 2022 Outlook

Eden Au and Igor Igamberdiev

# Decentralized Finance: 2021 Overview, 2022 Outlook

*Eden Au and Igor Igamberdiev*

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

## Quick Take

- The total value locked in DeFi exceeded \$100 billion. The majority was allocated to lending platforms and decentralized exchanges. However, most DeFi tokens underperformed Ethereum.
- The number of stolen funds has increased eightfold compared to the previous year and, as a result of 50 exploits, totalling at \$610 million.
- Regulatory pressure will bifurcate and reshape DeFi. An increasing number of applications will impose KYC requirements and require trust in product facilitators.

## Current state of DeFi in 2021

Decentralized finance (DeFi) is an open and multi-faceted financial system facilitated by smart contracts and blockchain oracles, acting as an alternative to the traditional opaque system run by decades-old infrastructure and processes. It provides users permissionless and borderless access to various financial instruments without relinquishing control over assets to intermediaries such as brokerages or banks.

The craze of liquidity mining (LM) initiated in 2020’s “DeFi summer” kickstarted the endless opportunities in DeFi, which continued to attract liquidity throughout 2021. The net value locked in DeFi protocols skyrocketed from \$16.1 billion to \$101.4 billion this year, with the majority of crypto assets allocated to lending protocols and DEXs.

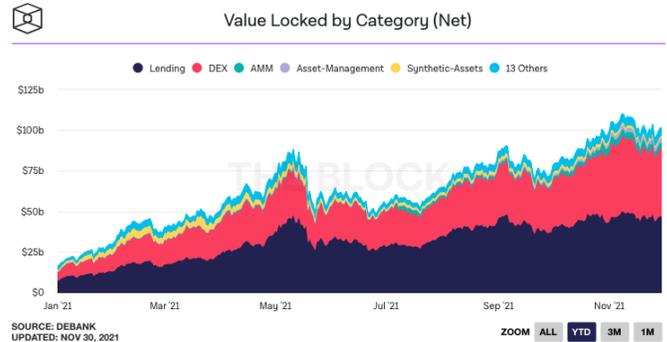


Figure 102: Net value locked in DeFi by category in 2021  
Source: The Block Data Dashboard

The dominance of DeFi tokens as an asset class, however, bled after demonstrating strength in Q1. The “DeFi dominance” index was at 1.0% in January, topped out at 3.2% in April and now sits at 1.5%.

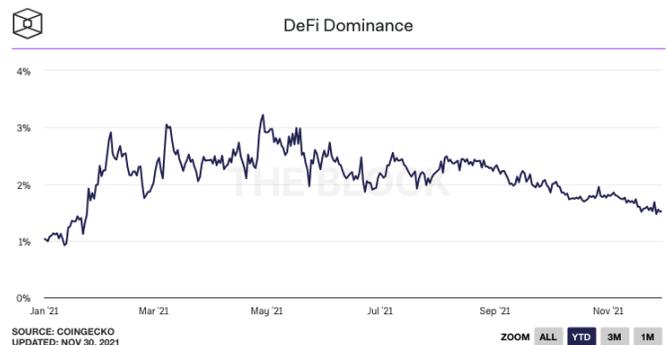


Figure 103: DeFi dominance in 2021

Return of BTC, ETH & DeFi "blue chips" in 2021

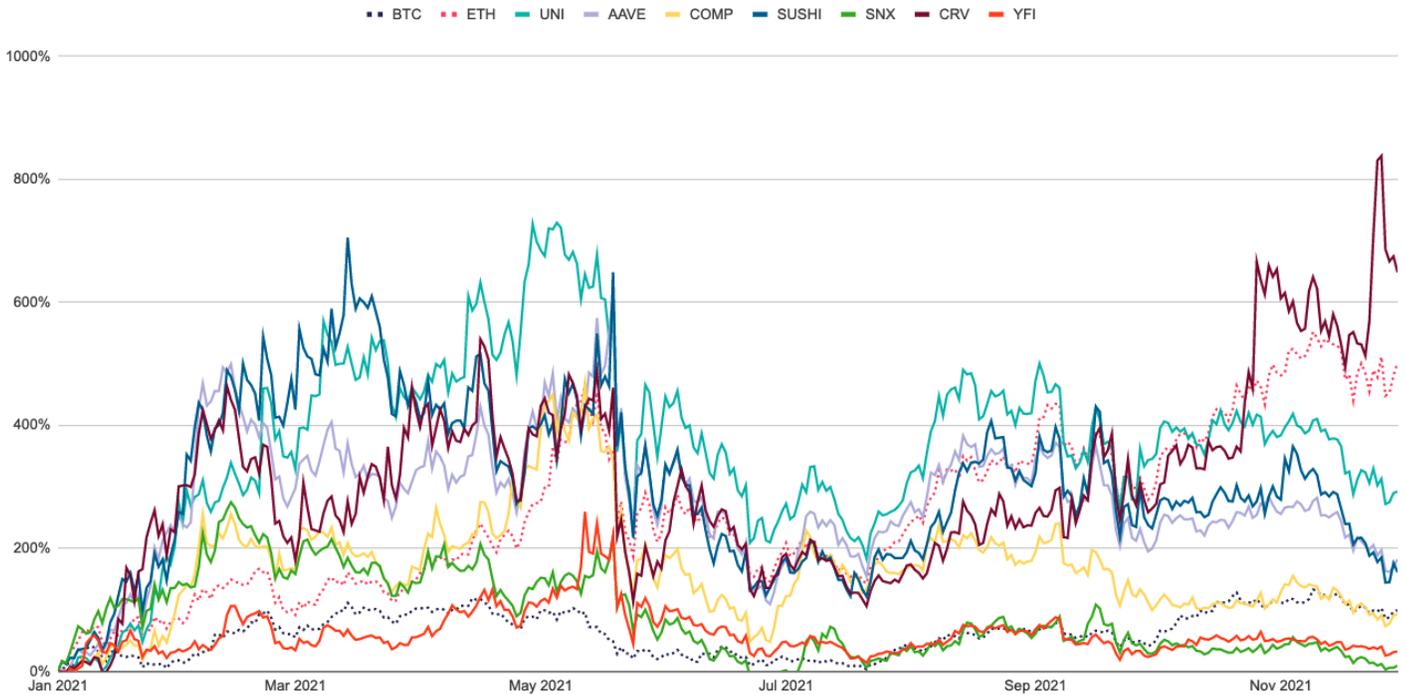


Figure 104: Return of BTC, ETH, UNI, AAVE, COMP, SUSHI, SNX, CRV, YFI in 2021

Source: CoinGecko, The Block Research

Taking DeFi “blue chips” (UNI, AAVE, COMP, SUSHI, SNX, CRV, and YFI) as proxy indicators of the year-to-date performance of DeFi tokens, the majority of them outperformed BTC but underperformed ETH despite having a solid start in Q1. CRV was the only one that surpassed ETH in year-to-date performance after its explosive growth in Q4, whereas SNX, YFI, and lately COMP performed the worst. The strength of ETH could partially be attributed to the growth of DeFi given the concentration of DeFi activities on Ethereum.

Uniswap was the most used DeFi protocol with over a million active users in May. On average, 45.7% of Uniswap’s monthly active users were new.

Uniswap monthly active users

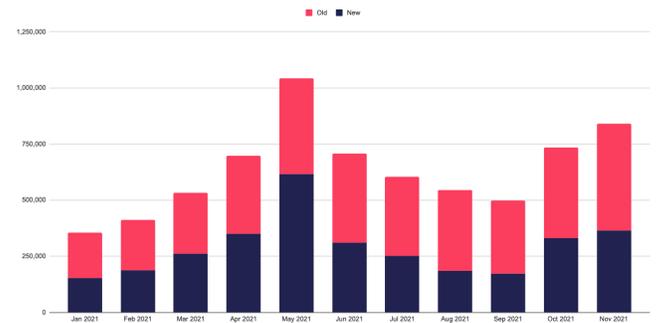


Figure 106: Uniswap MAU in 2021

Source: Dune Analytics (@jefftshaw)

Uniswap also captured most of the DeFi revenue among major lending, exchange, and derivatives protocols, having \$2.2 billion in revenue in 30 days. However, most recorded DeFi revenue was supply-side, i.e., fees belonging to protocol users such as liquidity providers and lenders. Only 8.1% of the revenue

generated amongst major DeFi protocols went to protocols and their governance token holders.

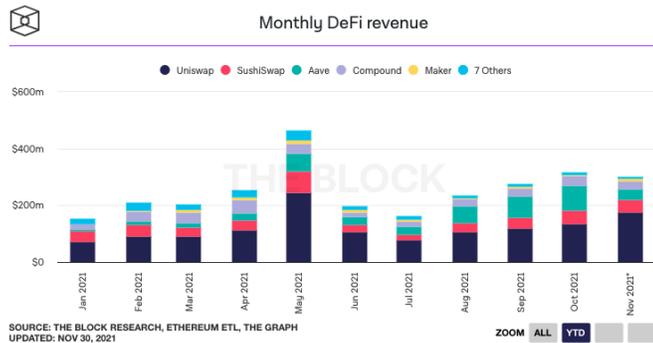


Figure 107: Monthly DeFi revenue in 2021  
Source: The Block Data Dashboard

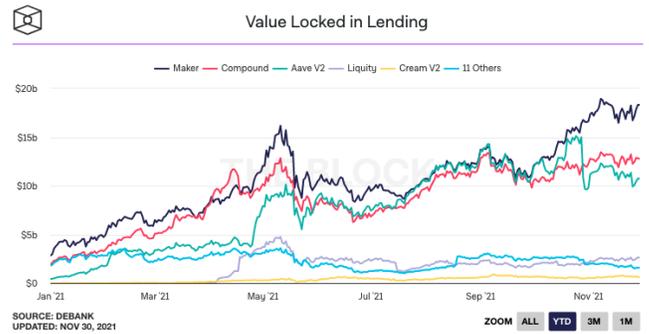


Figure 109: Value locked in lending in 2021  
Source: The Block Data Dashboard

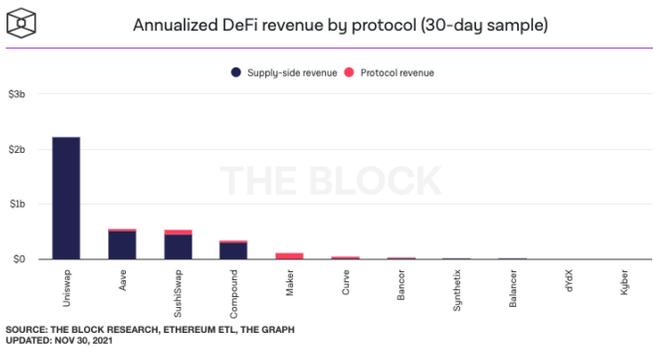


Figure 108: Annualized DeFi revenue by protocol (30-day sample)  
Source: The Block Data Dashboard

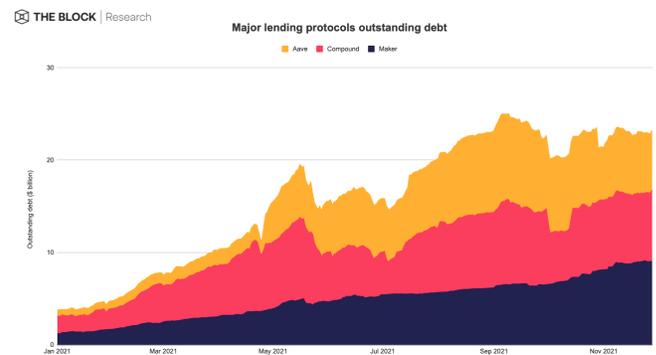


Figure 110: Major lending protocols outstanding debt in 2021  
Source: Alchemy, Compound, CoinGecko

## Lending

Lending is one of the main pillars in DeFi, as the market witnessed an unstoppable growth of lending protocols in TVL from \$7.1 billion to \$46.8 billion in 2021, which translated to a 559.2% increase. The top 3 lending protocols by value locked were Maker, Compound, and Aave with TVL at \$18.3 billion, \$12.8 billion, \$10.8 billion, and total outstanding debt of \$9.1 billion, \$7.7 billion, and \$6.5 billion, respectively.

Maker powers the largest decentralized stablecoin DAI, whereas Compound and Aave are money markets with algorithmically adjusted interest rates dictated by the utilization rates of lending pools. The borrow rates on Compound were more volatile and relatively higher during the bull market early this year before it calmed down after the May crash. The rates for stablecoins were constantly higher than major cryptocurrencies, which reinforced the belief of a long-biased market.

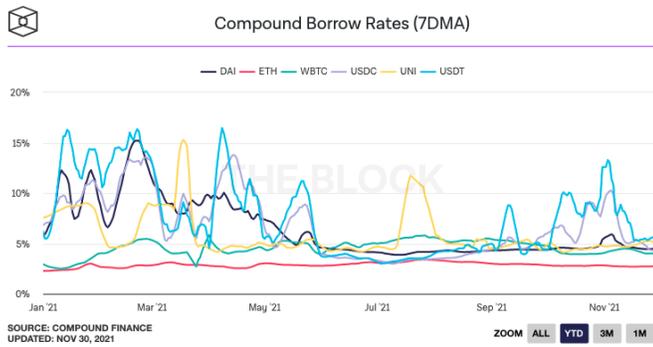


Figure 111: Compound borrow rates (7DMA) in 2021  
Source: The Block Data Dashboard

One common feature among these widely-adopted lending protocols is that all issued loans have to be over-collateralized. Collaterals can be forcefully liquidated by keepers to cover the outstanding debt should a position be deemed at risk, which is usually when the position falls below a certain minimum collateralization ratio. That way, loans can be taken out anonymously and trustlessly while mitigating the risks of protocol insolvency should delinquent borrowers default.

Despite the heavy dominance of long-established lending protocols, the lending landscape is becoming more diverse as new lending platforms implement slight tweaks and target different niche audiences. Cream attempted to onboard long-tail assets onto its money market but introduced significant risks to the integrity of the protocol, as stated in the [Appendix of DeFi Exploits](#). SushiSwap’s Kashi and Rari’s Fuse introduced isolated lending pairs that insulate said risks at the cost of capital inefficiency.

On the other hand, Alchemix and Abracadabra took on yield-generating positions as collateral to mitigate capital inefficiency to a certain extent while bringing in composability risks. Furthermore, TrueFi was the first

on-chain uncollateralized lending platform that maximized capital efficiency for creditworthy borrowers.

Interestingly, despite numerous attempts, fixed-term fixed-rate lending remained unappealing to DeFi power users due to fragmented liquidity. While LM helped temporarily bootstrap liquidity, it distorted the bond price when the organic demand was absent.

### Decentralized exchanges

Besides lending protocols, automated market makers (AMMs) were able to bootstrap passive liquidity from market participants eager to deploy their idle assets for yields.

Overall, monthly DEX volume peaked in May 2021 at \$162.8 billion, and the most considerable month-over-month growth was in January, with a 137.3% gain. However, the volume has not fully recovered from the May crash, and the DEX-to-centralized exchange spot volume ratio remained under 10% throughout the year.

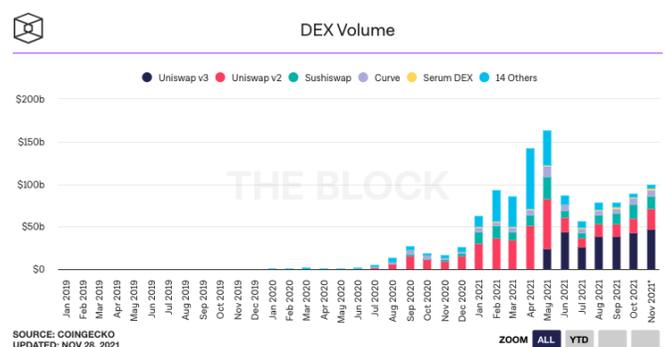


Figure 112: DEX volume in 2019-2021  
Source: The Block Data Dashboard

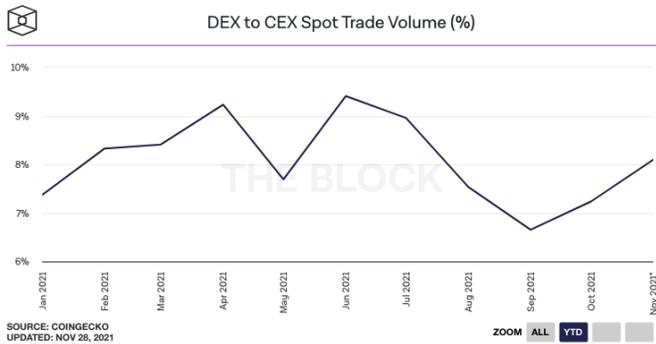


Figure 113: DEX to CEX spot trade volume in 2021  
Source: The Block Data Dashboard

Curve became the largest DEX by value locked at \$16.8 billion and constituted 6.8% of the DEX volume. Curve is an AMM optimized for trading between like-kind assets, as liquidity is algorithmically concentrated around the peg. It generated low-risk and sustainable yields due to its ongoing competitive LM and the lack of impermanent loss.

On the other hand, Uniswap continued to lead in volume as Uniswap v2 was the largest DEX by volume before being overtaken by Uniswap v3 in June. At peak, Uniswap v2 registered a monthly volume of \$59.2 billion in May before getting dwarfed by its successor due to v3’s concentrated liquidity design that dramatically reduces slippage. Uniswap v3 was launched in May under a GNU license that would ward off would-be copycats, as mentioned in the [State of the Market Section](#).

SushiSwap failed to keep up with the growth of its competitors, with TVL of \$5.0 billion and a volume share of 15.0%. While most of the volume was routed via AMMs, the largest order book-based DEX by volume was Serum on Solana with a 2.6% volume share.



### Value Locked in DEXs

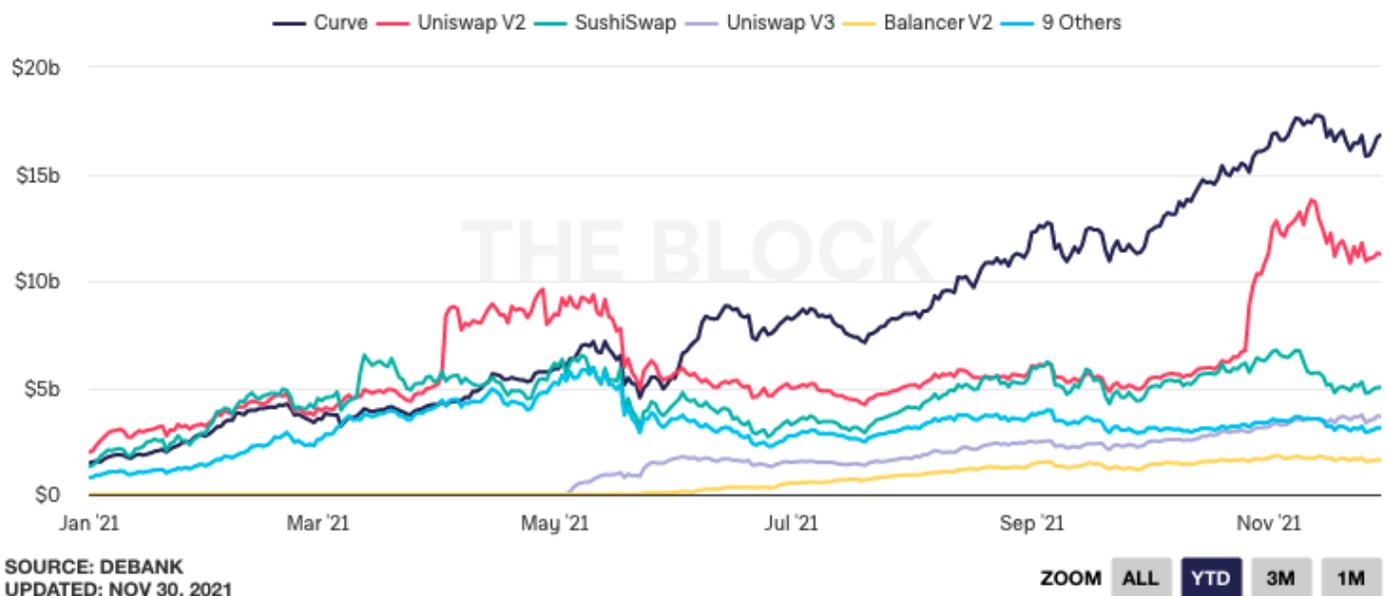


Figure 114: Value locked in DEXs in 2021  
Source: The Block Data Dashboard

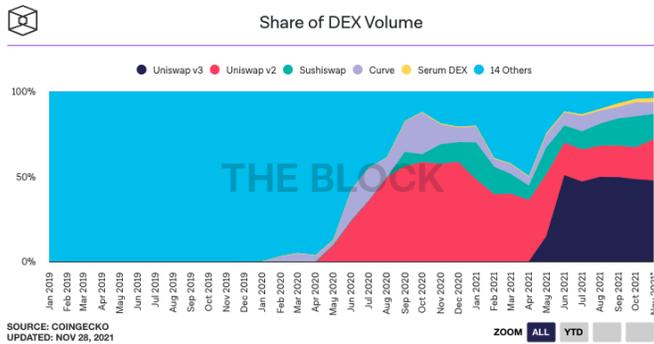


Figure 115: Share of DEX volume in 2019-2021  
Source: The Block Data Dashboard

As liquidity gets fragmented, users might prefer trading via DEX aggregators that provide better execution by optimizing swap routes. Surprisingly, on average, only 13.9% of the DEX volume originated from aggregators. A huge amount of volume was derived from DEX native routers or trading bots.

1inch was the leading DEX aggregator throughout the year with a market share of 64.9%, followed by 0x API (Matcha) at 16.8%.

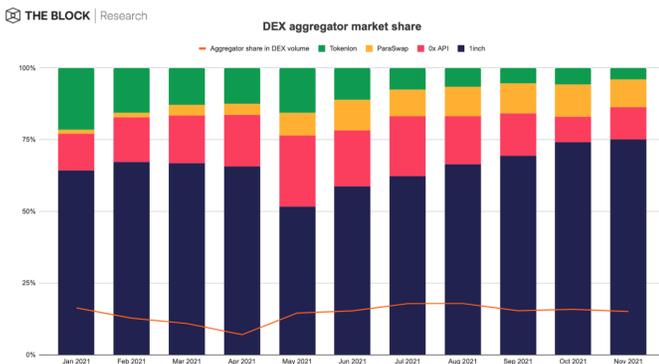


Figure 116: DEX aggregator market share in 2021  
Source: CoinGecko, DeBank, Dune Analytics (@k06a), The Block Research

## Derivatives

The biggest crypto market by volume comes from perpetual futures contracts, which have no expiry or settlement but trade close to the underlying reference index price using a funding mechanism. While DEXs

have become competitive over the years, it is reasonable that the next natural step for growth would be to extend that success to the derivatives market.

Perpetual Protocol led the derivatives sector in trade volume in the first half of 2021, with a record-breaking weekly volume of \$551.1 million during the week of the May crash. Perpetual runs on the xDai sidechain and is built atop a virtual AMM (vAMM) that parameterizes market depth and thus slippage. With this model, the protocol can provide immediate liquidity without the need for a counterparty.

Another way to visualize its growth is the evolution of its insurance fund, which receives 50% of the trading fees. The fund is in place to backstop the protocol by covering under-collateralized positions in a volatile market and funding payments as vAMMs act as the counterparty for each trade. Perpetual’s insurance fund now possesses \$8.2 million of funds.

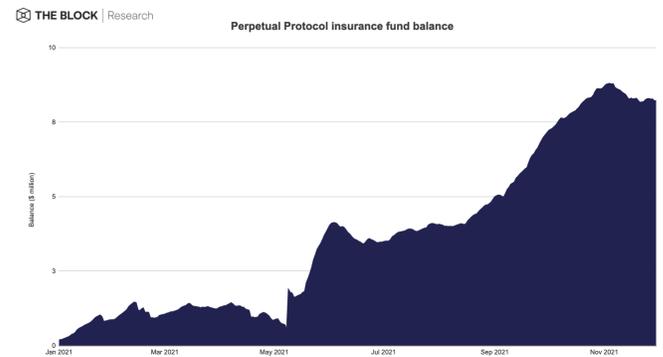


Figure 117: Perpetual Protocol insurance fund balance in 2021  
Source: Dune Analytics (@yenwen)

dYdX has made a comeback since August after initiating its LM program with DYDX, the protocol’s native token. dYdX lives on StarkEx, a zk-rollup layer-2 scaling solution, as discussed in the [Layer-2 Section](#). It leverages a hybrid infrastructure model utilizing non-custodial, on-chain settlement, and an off-chain low-latency matching engine with order books.



## Perpetual Swaps Trade Volume

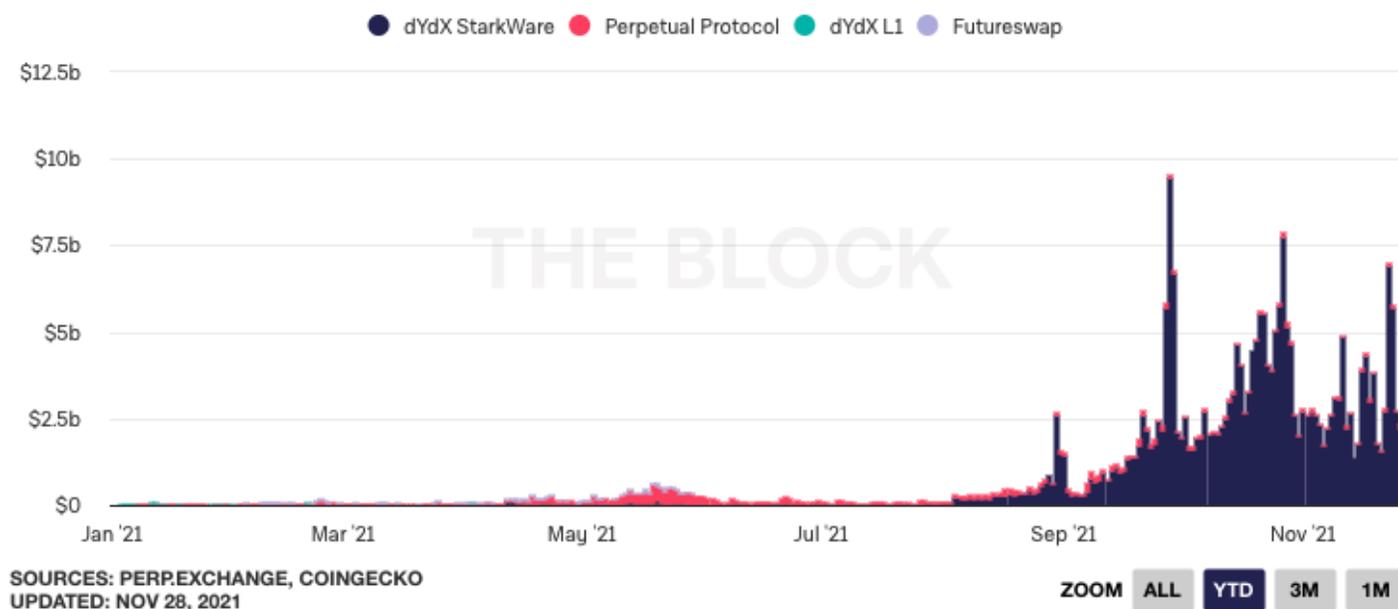


Figure 118: Perpetual swaps trade volume in 2021  
Source: The Block Data Dashboard

Liquidity on dYdX comes primarily from algorithm-focused market makers who operate in the DeFi space (e.g., GSR and Wintermute). Its weekly volume peaked in September at \$9.5 billion, which overshadowed Perpetual's accomplishment.

Perpetual futures typically operate in isolation from other DeFi protocols, sacrificing composability in favor of capital efficiency via leveraging. Synthetic assets, also known as synths, are tokenized derivatives that offer reverse trade-offs via tokenization with over-collateralization.

Synthetix is by far the oldest and largest synth issuance protocol. SNX stakers can mint synths by over-collateralization and trade them for other synths on the Synthetix platform, which offers slippage-free execution at oracle price. However, skewed open interest, which is usually long-biased, as stated in the

[lending section](#), could increase the protocol debt as SNX stakers collectively and passively underwrite all positions.

Trading volume on Synthetix was mainly derived from forex (52.2%) and crypto (47.1%) synths, and July was the month with the highest volume at \$1.6 billion. Since then, its volume shrank, and it was dwarfed by decentralized spot and perpetual futures exchanges. The average number of daily traders on Synthetix plunged from 167.5 in January to 13.8 in November, signifying its failure to capture retail interest. Whether it could regain traction after its recent migration to Optimism remains to be seen.

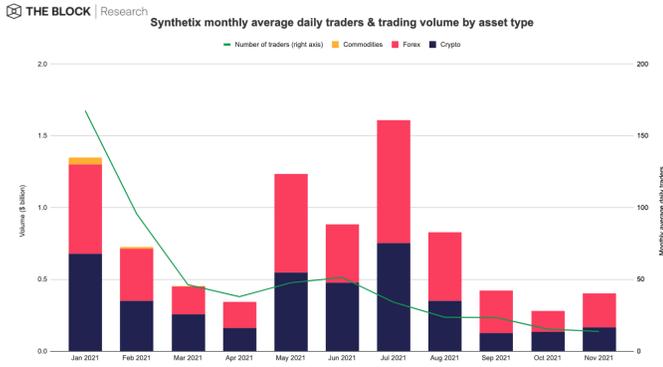


Figure 119: Synthetix monthly average daily traders & trading volume by asset type in 2021  
Source: Dune Analytics (@drethereum)

On the other hand, synthetic stock-focused Terra-based Mirror Protocol mimicked Synthetix’s over-collateralization approach but removed the slippage-free trade offerings such that synths can only be traded on the secondary market. This shifted the burden of skewed open interest to the open market, resulting in Mirror-issued synths constantly trading at a premium.

TVL in both platforms remained steady over the last few months, with Synthetix at \$1.7 billion and Mirror catching up at \$1.3 billion. Their growth might be hampered due to mounting regulatory pressure, as Uniswap Labs [removed](#) their synth tokens from Uniswap’s official frontend, and SEC [recently filed](#) an enforcement action against Mirror.

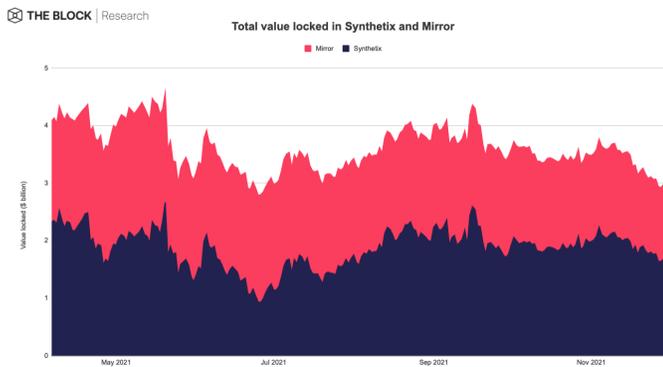


Figure 120: Total value locked in Synthetix and Mirror in 2021  
Source: DefiLlama

Not all types of derivatives blossomed in 2021. Due to a lack of liquidity and mechanism intricacy, the decentralized options market had yet to mature into an effective speculating or hedging tool.

### Structured products

The growth of DeFi in recent times has been accompanied by increasing levels of sophistication in terms of portfolio management. It has given birth to numerous pre-packaged structured products that abstract the complexity of different financial instruments to save investors’ time and cost.

The first iteration of structured products was yield optimizers, which source and optimize yields for fund depositors. Convex was the largest yield optimizer by TVL. It was launched in May 2021 and specialized in boosting rewards for stakers and liquidity providers on Curve, the largest DEX by TVL, as mentioned in the decentralized exchanges section.

With TVL of \$16.0 billion, Convex had already overtaken Yearn, one of the first protocol-agnostic yield aggregators with TVL at \$5.9 billion.

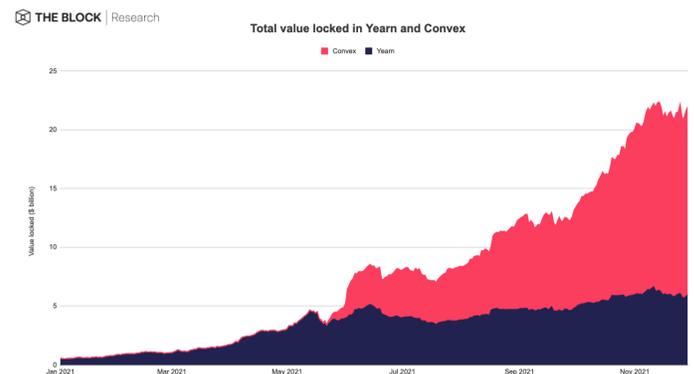


Figure 121: Total value locked in Yearn and Convex in 2021  
Source: DefiLlama

Other types of structured products have begun to evolve this year. For instance, yield-tranching protocols like BarnBridge split yields into tranches for investors with various risk appetites, whereas indices like DeFi Pulse Index provide holders passive exposure to a basket of curated tokens.

On the other hand, automated liquidity provision (LP) managers such as Charm and Gelato auto-rebalance LP positions on Uniswap v3, whereas automated trading strategy managers like Ribbon combine various derivatives with improved risk-adjusted returns. These products are nascent and whether they can gain adoption remains to be seen.

### Liquid staking

The roll-out of the beacon chain in December 2020 initiated Ethereum’s gradual transition to a Proof-of-Stake (PoS) consensus mechanism under

Ethereum 2.0, as discussed in the [Layer-by-layer Section](#). Users can stake Ether to become validators of the network and get rewarded with more Ether. However, being a validator requires sufficient technical knowledge and upfront capital.

Liquid staking solutions democratize, tokenize, and “liquitize” staked Ether such that retail participants can gain exposure to PoS staking and utilize their stake in other DeFi applications, such as collateral in lending platforms.

Lido became the top Ethereum 2.0 liquid staking platform within a year with a market share of 86.6% and a TVL of 1.5 million ETH (\$6.6 billion), which corresponds to 1.3% of the current ether supply. TVL in ETH will continue to rise as withdrawal is unavailable before the Ethereum mainnet merge with the beacon chain scheduled some time in the first half of 2022.

#### Ethereum liquid staking solution by total ETH staked

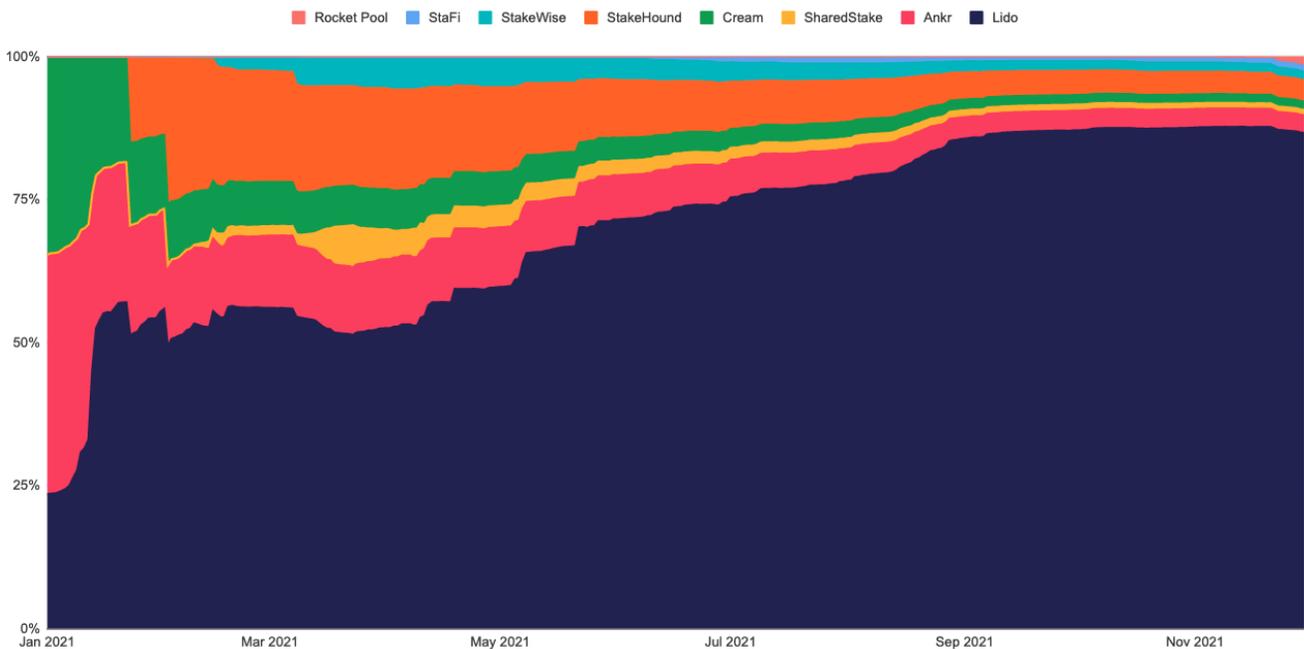


Figure 122: Ethereum liquid staking solution by total ETH staked in 2021  
Source: Dune Analytics (@LidoAnalytical)

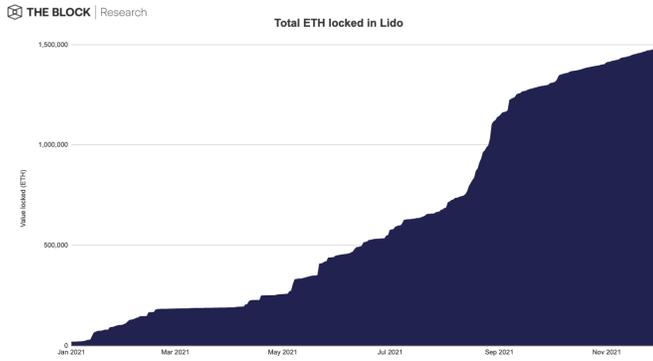


Figure 123: Total ETH locked in Lido in 2021  
Source: Dune Analytics (@LidoAnalytical)

Similar services are also available on other PoS blockchains. For instance, Lido is live on Terra and Solana with TVL of 68.1 million LUNA (\$3.5 billion) and 1.0 million SOL (\$208.1 million), respectively.

### Decentralized stablecoins

Decentralized stablecoins facilitate permissionless payment and leveraging. Maker’s DAI is the largest decentralized stablecoin, and its share of the total

stablecoin supply rose from 4.1% to 6.3% in 2021. The amount of DAI outstanding soared from 1.2 billion to 9.0 billion this year. The introduction of the peg stability module (PSM) stabilized the price of DAI close to the dollar peg, as it intermittently traded at a premium in 2020. PSM allows users to swap given collateral directly for DAI at a fixed rate rather than borrowing. 14.9% of DAI in circulation is backed by USDC or USDP originated from PSM.

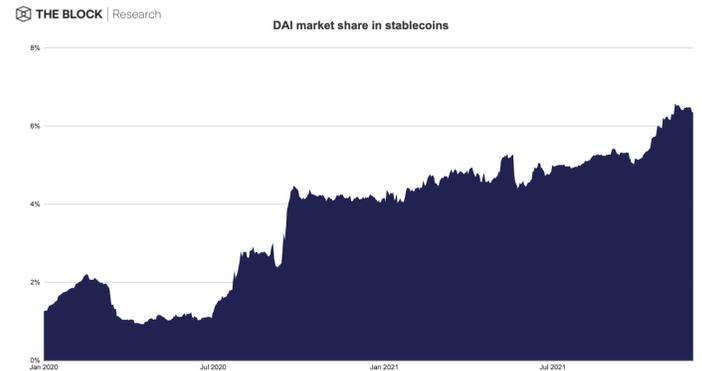


Figure 125: DAI market share in stablecoins in 2020-2021  
Source: Coin Metrics, The Block Research

### DAI collateral by vault type

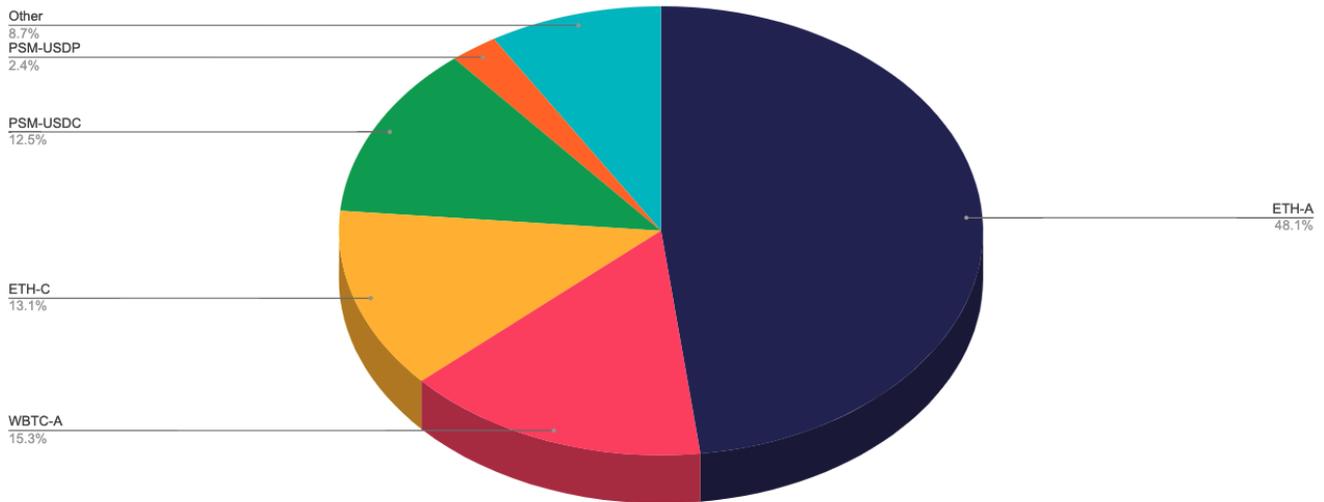


Figure 124: DAI collateral by vault type as of November 2021  
Source: Dai Stats

## Market cap of major collateralized decentralized stablecoins

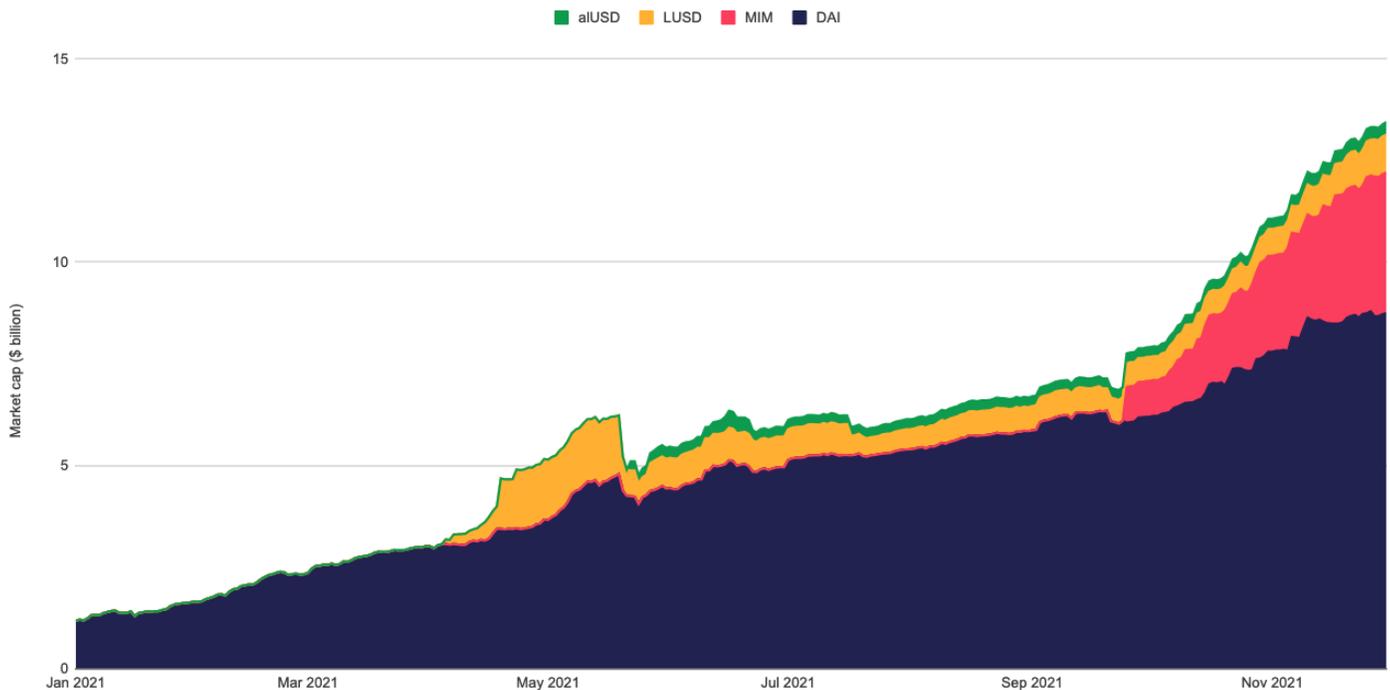


Figure 126: Market capitalization of major collateralized decentralized stablecoins in 2021

Source: CoinGecko

Similar to other DeFi sectors, the landscape of decentralized stablecoins has become more diverse. There are 4 collateralized decentralized stablecoins with a market cap of over \$300 million. Abracadabra's MIM is a stablecoin primarily backed by yield-generating positions, and is by far the second-largest collateralized decentralized stablecoin with a market capitalization of \$3.5 billion. MIM borrowers earn yields on their collateral assets which enhances capital efficiency.

It has been known throughout the years that the "stablecoin trilemma" is notoriously difficult to solve. The trilemma refers to stablecoins' predicament in possessing these three properties: decentralization, capital efficiency, and price stability. Numerous experiments on algorithmic stablecoins were

conducted with the aim to solve the trilemma mentioned above with mixed success.

In early 2021, we saw the collapse of uncollateralized algorithmic stablecoins such as Empty Set Dollar due to the lack of risk-free arbitrage opportunities when they traded below the intended peg. However, other forms of algorithmic stablecoins that rely on fractional reserves or endogenous collateral started to flourish, with 4 of them having a market cap of over \$300 million.

Terra-based UST is the largest algorithmic stablecoin with a market cap of \$7.6 billion backed by endogenous collateral LUNA as seigniorage shares, where LUNA is the native asset of the Terra blockchain. \$1 worth of seigniorage shares can be burnt to create 1 UST, and vice versa. UST greatly benefited from the explosive

Market cap of major algorithmic stablecoins

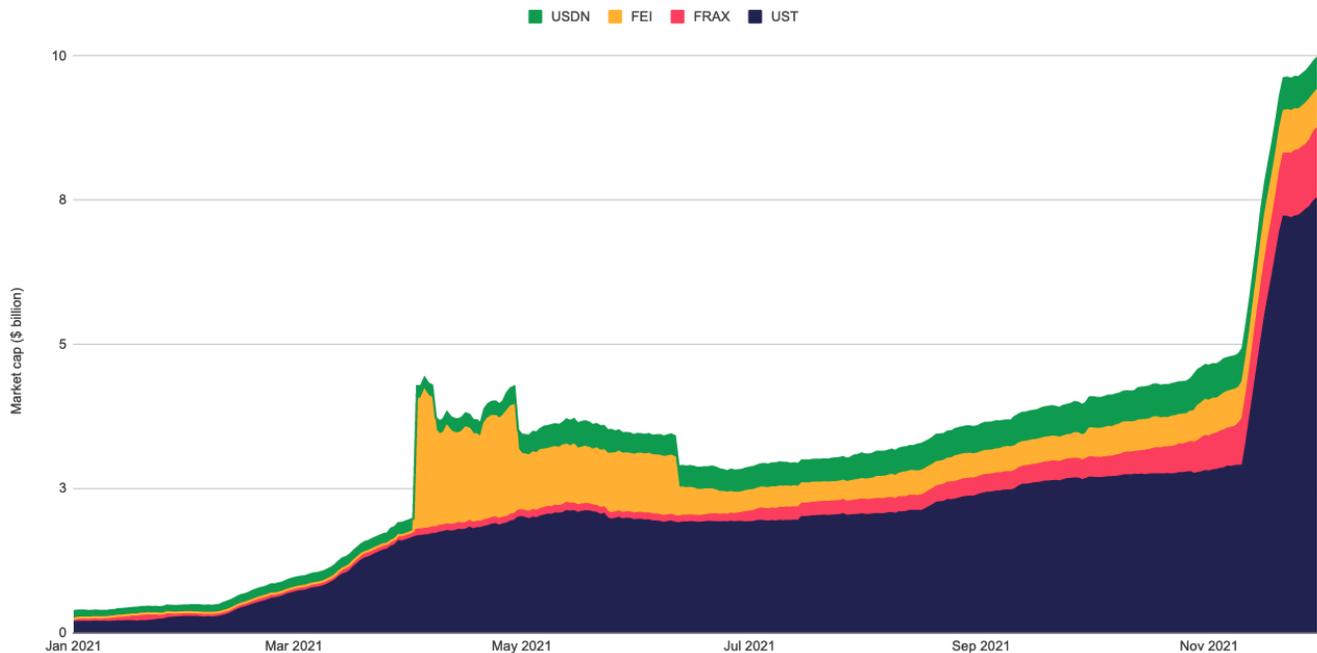


Figure 127: Market capitalization of major algorithmic stablecoins in 2021  
Source: CoinGecko

growth of the Terra DeFi ecosystem, as UST was heavily utilized in Anchor Protocol, a lending platform, and Mirror Protocol, a synthetic asset issuance platform.

Depending on algorithmic designs, algorithmic stablecoins could lose peg momentarily. UST traded 3.8% below peg during the May crash when the price of its seigniorage token, LUNA, plummeted. The peg was restored after a few days.

**Low-volatility tokens**

Commonly known as “non-pegged stablecoins,” algorithmic low-volatility tokens are an emerging asset class that gained market attention this year. They aim to become decentralized reserve currencies that are less volatile than most crypto-assets and less prone to long-term changes in the dollar’s purchasing power caused by unforeseen monetary policies or economic landscape.

These tokens have feedback mechanisms in place that dampen volatility by regulating token supply when demand fluctuates. Launched in March 2021, Olympus DAO’s OHM is the biggest low-volatility token with a market cap of \$4.1 billion.

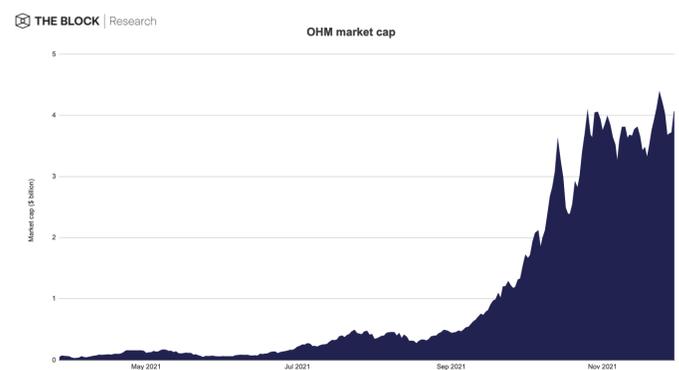


Figure 128: Market capitalization of OHM since inception  
Source: CoinGecko

OHM tokens are backed by collateral but trade at a premium. It is because artificial demand is generated that incentivizes speculators to stake OHM to earn more OHM tokens. The DAO accrues more collateral by selling OHM under vesting at a below-market price, allowing the protocol to issue more OHM tokens supported by the extra collateral. This creates a circular economy driven by speculative demand. Whether these tokens can generate demand beyond pure speculation remains to be seen.

### Bitcoin in DeFi

In some way, Bitcoin was the first DeFi application that allows holders to store and transfer financial value permissionlessly. Despite the lack of quasi-Turing complete virtual machines on the Bitcoin network, BTC is heavily utilized in DeFi applications on other blockchains. This is unsurprising considering BTC has a market dominance of 39.1% in crypto. The number of BTC wrapped on Ethereum rose steadily from 140.0

thousand to 316.6 thousand this year, corresponding to 1.7% of the entire BTC supply.

Centralized custodians play a pivotal role in porting Bitcoin’s value into DeFi, possibly due to capital efficiency and user-friendliness. Wrapped Bitcoin (WBTC) is the most popular wrapped version of Bitcoin that constituted 80.0% of the market share on Ethereum, followed by Huobi BTC (HBTC) at 12.6%, which overtook renBTC in January 2021. The top 3 holders of WBTC were all lending protocols, namely Maker (20.8%), Compound (13.1%), and Aave (10.1%).

On BSC, the circulating supply of Binance-pegged BTC (BTCB) exploded from 5.3 thousand to 105.0 thousand over the same period, which signified a healthy growth in the BSC DeFi ecosystem. The top 2 holders were Tranchess at 19.8%, a BTC-focused structured product; and Venus at 11.0%, the largest lending protocol on BSC by TVL.



### BTC on Ethereum

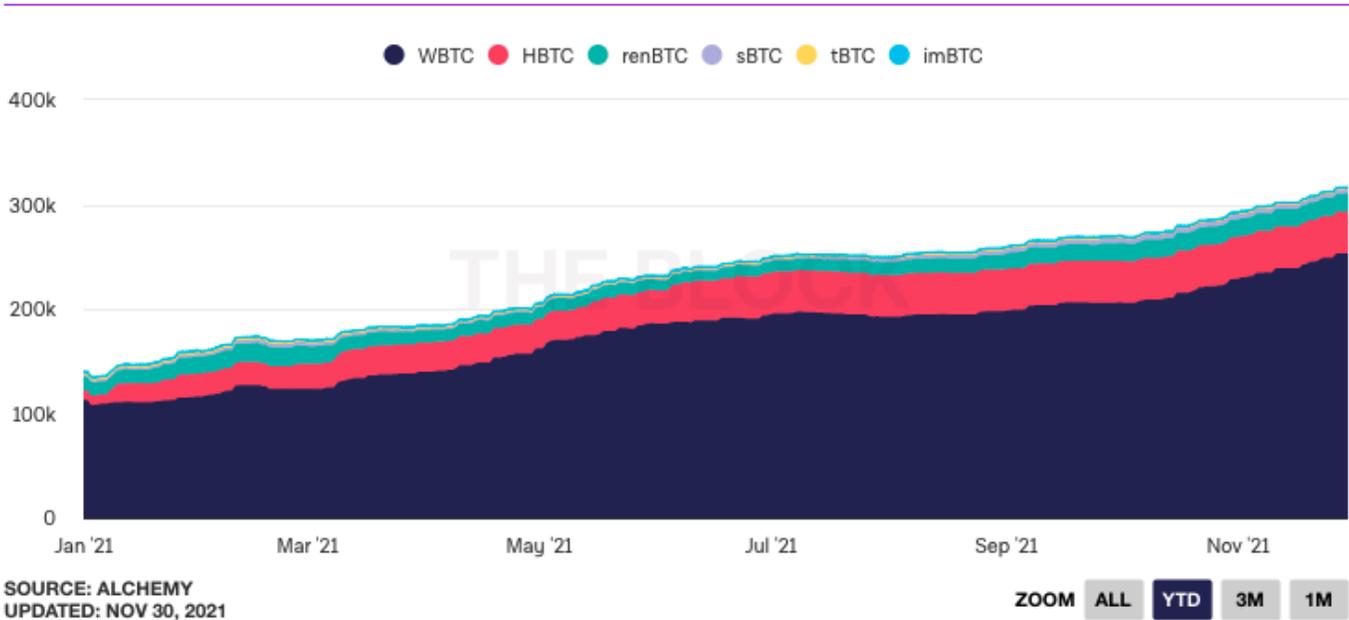


Figure 129: BTC on Ethereum in 2021  
 Source: The Block Data Dashboard

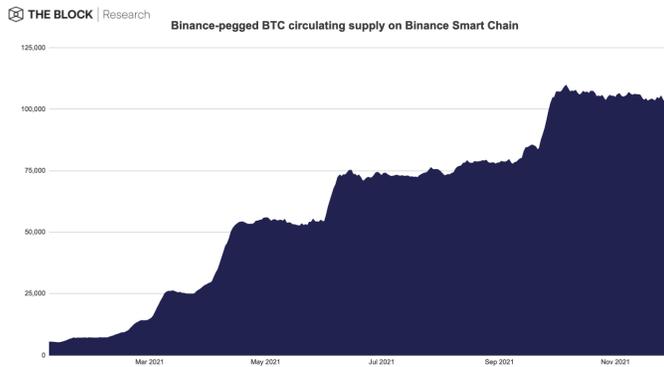


Figure 130: Binance-pegged BTC circulating supply on BSC in 2021  
Source: CoinMarketCap, The Block Research

### Miner extractable value

Miner extractable value (MEV) refers to profit extracted by leveraging and sometimes abusing miners’ or validators’ ability to (re-)order or censor transactions on the blockchain. The conservative estimate of cumulative extracted MEV over a two-year period exceeded \$762.8 million, 78.4% of which were extracted in 2021.

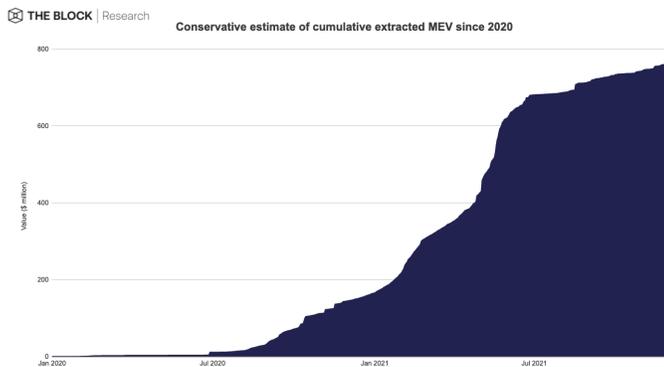


Figure 131: Conservative estimate of cumulative extracted MEV since 2020  
Source: Flashbots

96% of the MEV extracted was related to arbitrage due to the omnipresence of arbitrage opportunities amongst a sea of liquidity pools on DEXs. The rest was related to liquidation or a mixture of both, as such opportunities primarily occurred during periods of sharp price declines or short squeezes. On average, 88% of the profit went to arbitrageurs who initiated the

transactions, whereas miners pocketed the rest via gas fees and “tips” from transaction senders.

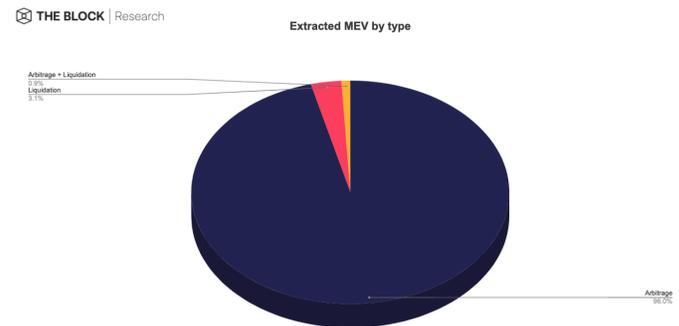


Figure 132: Extracted MEV by type cumulative 2020-2021  
Source: Flashbots

Tools such as Eden Network, Flashbots, and KeeperDAO protect transaction senders from predatory MEV bots extracting MEV by frontrunning and backrunning. Transactions submitted via these tools would be relayed to collaborative and economically aligned miners but not broadcast to the public mempool.

### Smart wallets

There are two fundamentally different types of accounts on Ethereum: externally owned accounts controlled by private keys and contracts dictated by code. Contracts enable the creation of “smart wallets” that offer greater flexibility.

One of the notable use cases is multisig wallets which have been adopted to guard nascent DeFi protocols that have yet to achieve full decentralization. It could mitigate single points of failure as multiple signatures are required to sign off transactions. Launched in 2017, Gnosis Safe has become the de facto standard for multisig wallets. It has shown exponential growth in adoption, with 37.8 thousand Gnosis safes created and 323.9 thousand transactions originating from these safes.

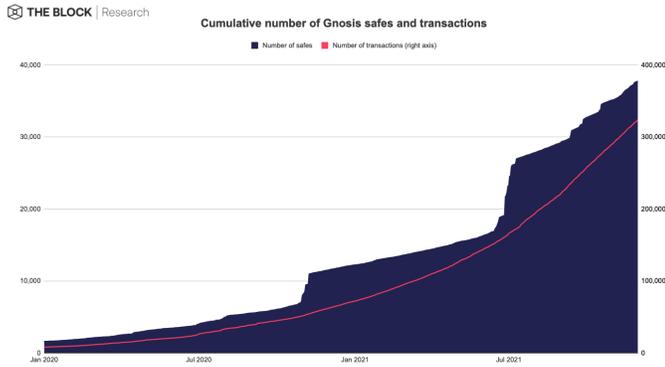


Figure 133: Cumulative number of Gnosis safes and transactions in 2020-2021

Source: Dune Analytics (@tschubotz)

Smart wallets can also bring user-friendly features to wallet management. For example, Argent and Dharma allow user-selected “guardians” to restore or restrict access to their smart wallets. The cumulative number of Argent and Dharma wallets increased slowly from 38.4 thousand and 10.4 thousand, to 59.4 thousand and 16.4 thousand, respectively, in 2021. However, the aggregated ETH balance in these wallets has declined by 20.6% since January.

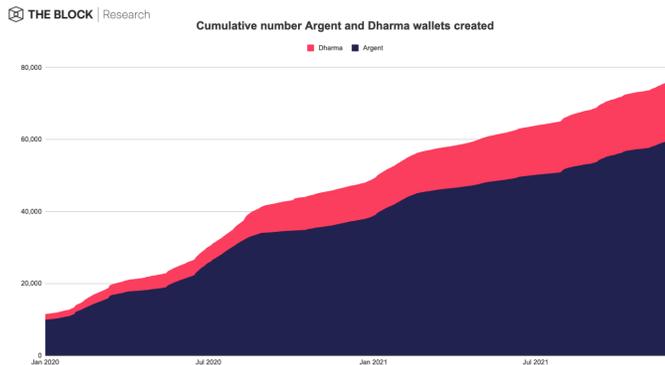


Figure 134: Cumulative number of Argent and Dharma wallets created in 2020-2021

Source: Dune Analytics (@tschubotz)

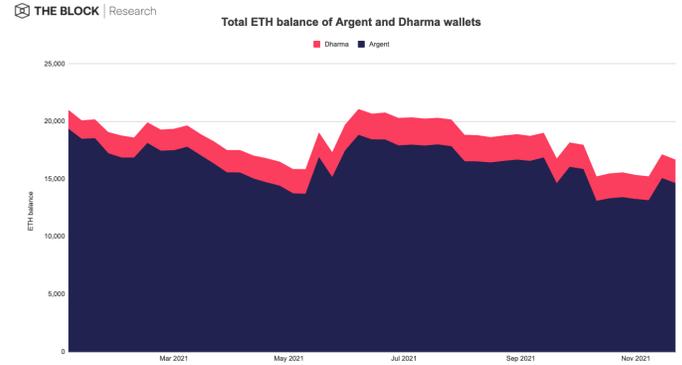


Figure 135: total ETH balance of Argent and Dharma wallets in 2021  
Source: Dune Analytics (@tschubotz)

For advanced individuals, smart wallets such as Instadapp and DeFi Saver provide a one-stop-shop for managing DeFi positions on major protocols with customized automation such as loan refinancing. Instadapp’s TVL skyrocketed this year, reaching \$12.1 billion in TVL, which in part was fueled by LM.

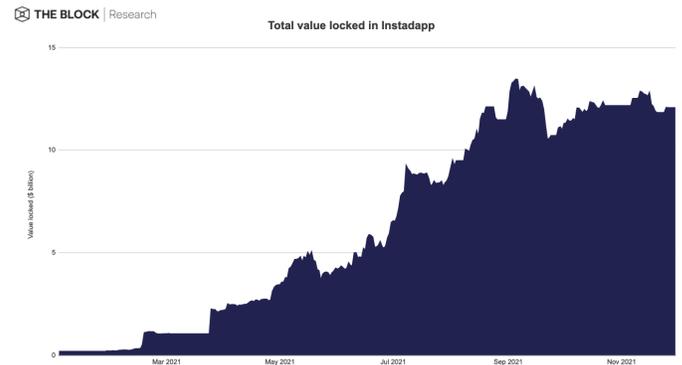


Figure 136: Total value locked in Instadapp in 2021  
Source: DefiLlama

### Privacy

Tornado Cash remained as the go-to privacy mixer on Ethereum. Its TVL grew from \$55.1 million to \$695.9 million in 2021, handling on average \$87.4 million weekly deposits and \$86.4 million weekly withdrawals this year.

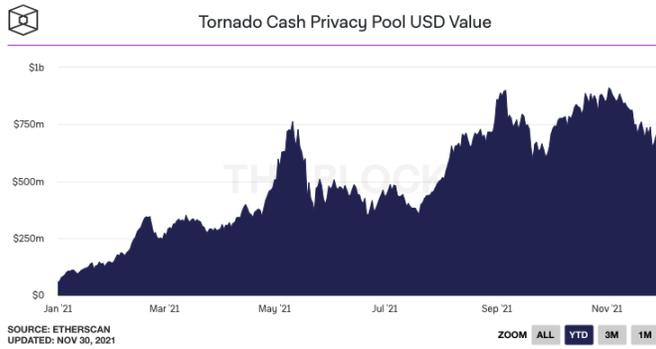


Figure 137: Tornado Cash Privacy Pool USD Value in 2021  
Source: The Block Data Dashboard

35.3% of ETH transactions through Tornado Cash this year had a batch size of 1 ETH, whereas transactions with a batch size of 0.1 ETH became increasingly unpopular in the high gas fee environment.

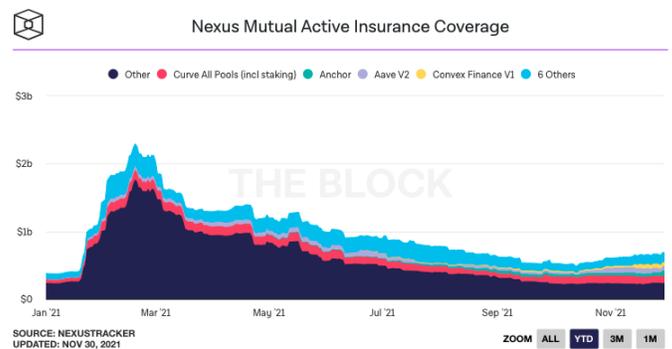


Figure 139: Nexus Mutual active insurance coverage in 2021  
Source: The Block Data Dashboard

### Token offerings

Initial DEX offering (IDO) refers to token offerings via DEXs, and it was one of the most popular token offering methods. However, naïve IDOs conducted by seeding liquidity pools on DEXs attracted frontrunning bots to scoop up a considerable portion of the tokens and significantly pushed up the market price. They would then sell it afterward for a profit.

Liquidity bootstrapping pool (LBP) pioneered by Balancer has become a more favorable approach for token offerings this year. The initial listing price would start high to disincentivize frontrunning. The price would be adjusted algorithmically over time based on instantaneous buying demand. It is analogous to Dutch auction but is more reactive to demand spikes.

On the other hand, initial bonding curve offering (IBCO), popularized by Hegic Protocol, has become the go-to token offering method for most Solana-based projects. Investors can deposit and withdraw funds during the sale, and they can redeem tokens afterward on a pro-rata basis. The more funds raised, the higher the implied token valuation would be. Unlike LBP, IBCO provides the same settlement price for all participants of any size.

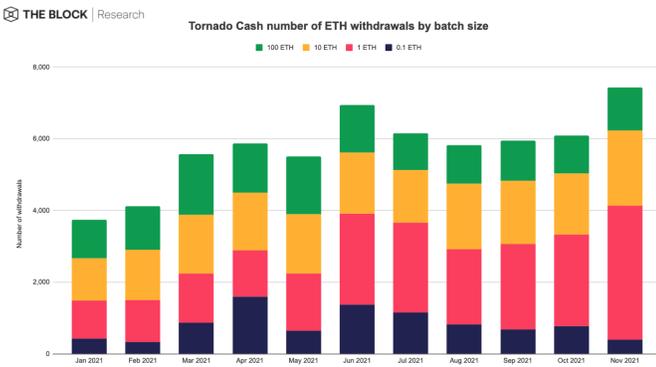


Figure 138: Tornado Cash number of ETH withdrawals by batch size in 2021  
Source: Dune Analytics (@poma)

### Insurance coverage

While most DeFi sectors flourished in 2021, DeFi insurance coverage was probably one of the very few categories that dwindled. Nexus Mutual, the leading insurance coverage solution, saw the amount of active coverage peaked at \$2.3 billion in February before descending to \$688.2 million, which was a 70.0% decrease.

Some projects avoid IDOs and prefer distributing tokens to protocol users, likely due to regulatory concerns regarding token sales. Some speculators have taken advantage of this pattern and attempted to interact with protocols that have yet to issue tokens using multiple wallets, in the hope of getting sizable rewards in the future. This is known as “airdrop farming” and whether it is ethical for different parties to conduct such activities remains controversial.

### Summary of largest DeFi exploits in 2021

In 2020, the rise in popularity of DeFi protocols led to an increase in the user base and TVL of projects. In turn, large TVL attracted the attention of not only keepers but also attackers, who stole over \$77 million through exploits in 2020.

Most of the exploits occurred in the fall due to The Summer of DeFi. During this event, many forks were launched with minimal changes, which were enough for the appearance of vulnerabilities. It seemed that the developers had to learn a lesson and be more responsible for user funds.

However, due to the lack of a sufficient number of security experts, less competition on other

EVM-compatible chains, and the inability to quickly upgrade a vulnerable smart contract, history repeated itself. During the current year, the number of stolen funds increased by eight times and, as a result of fifty exploits, reached \$610 million.

The very first known DeFi exploit (02/15/2020) involving bZx used a flash loan. There are still discussions about whether this primitive is harmful to the ecosystem or not. In any case, about 60% (\$355 million) of all funds were stolen using flash loans.



Figure 141: Stolen funds by using flashloans in 2021  
Source: The Block Data Dashboard

Another important point is that attackers can return part of the stolen funds to projects. This situation usually happens due to the attacker agreeing to a bug bounty or their identity becoming known. Overall, 53% (\$704 million) of total stolen funds in 2021 were returned to projects, most of which were due to the Poly Network exploit.

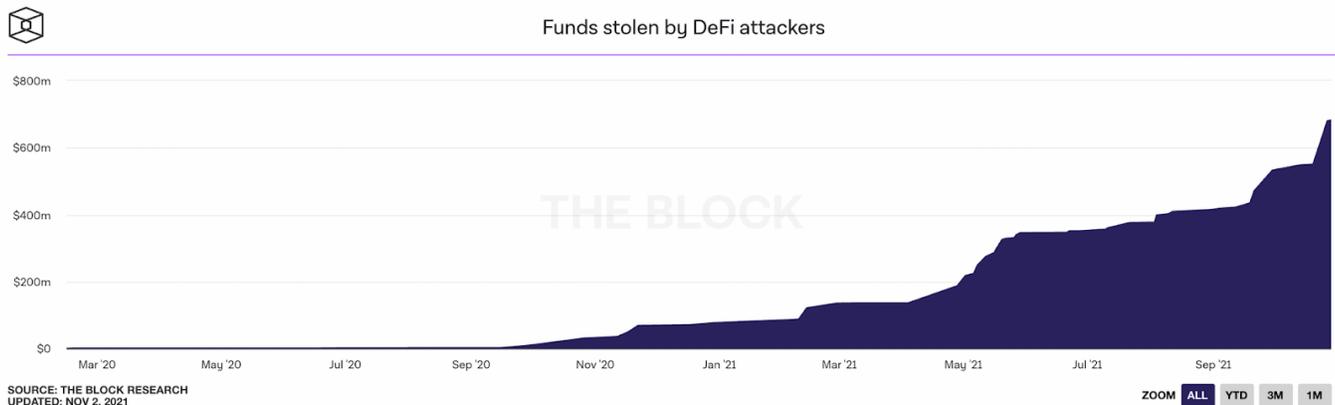


Figure 140: Fund stolens by DeFi attackers in 2021  
Source: The Block Data Dashboard

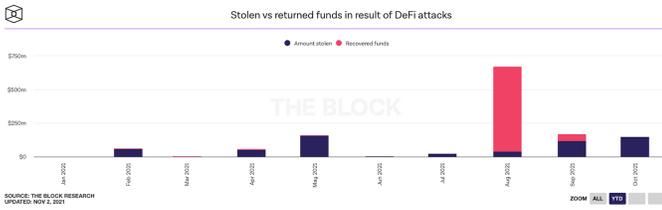


Figure 142: Stolen vs. returned fund in results of DeFi attacks in 2021  
Source: The Block Data Dashboard

The latest insight is confirmation that we live in a multi-chain world. While most exploits still occur on Ethereum, they have also been consistently seen since April on BSC and Polygon, and Avalanche. About a third

of all stolen funds (\$200 million) belonged to projects on BSC, which suffered the most in May this year.



Figure 144: Monthly stolen funds by blockchain in 2021  
Source: The Block Data Dashboard

You may find the timeline of all the major hacks that happened in 2021 at [the appendix of the DeFi section](#).



Amount of stolen funds by blockchain

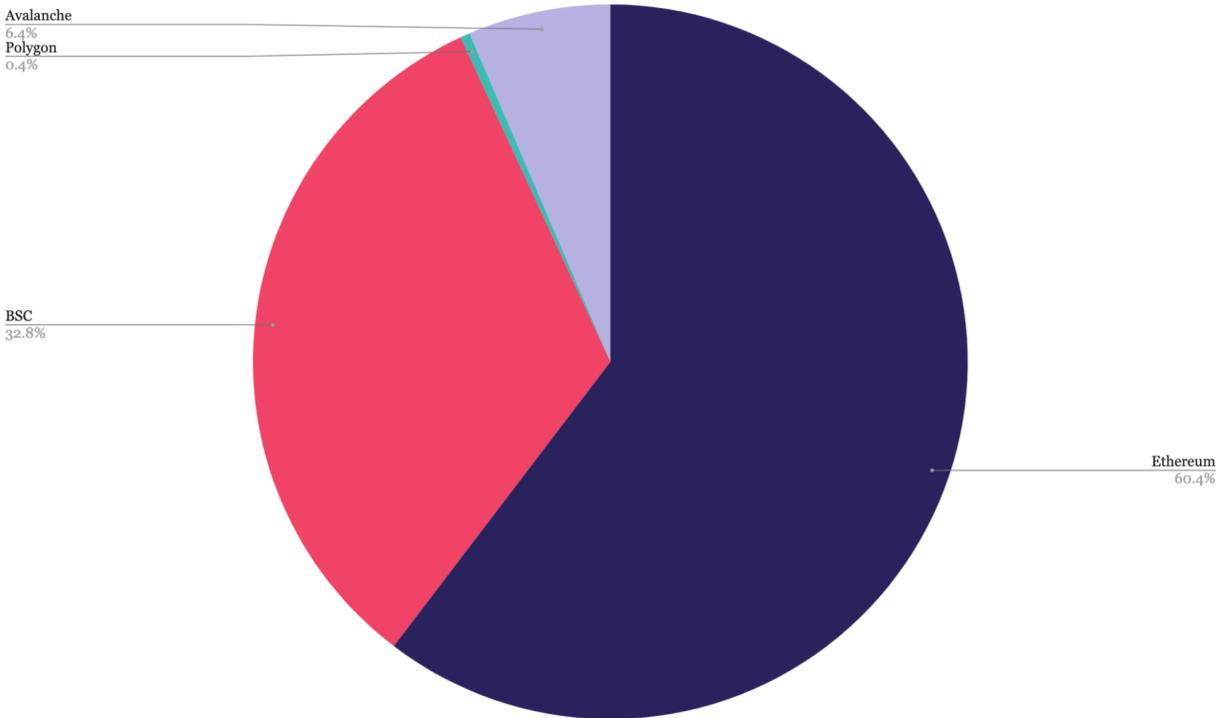


Figure 143: Amount of stolen funds by blockchain in 2021  
Source: The Block Research

## Competitive outlook for DeFi in 2022

### Prediction markets

Prediction markets are where speculators wager on the occurrences of real-world events. It was one of the first concepts of decentralized applications being implemented on the blockchain, like Augur.

Despite its early kickoff, it failed to generate meaningful volume compared to other categories of DeFi protocols. Polymarket on Polygon was the leading prediction market in 2021, and popular markets featured major global affairs (e.g., US presidential election and COVID-19) and crypto trends (e.g., BTC price, Ethereum upgrades). Surprisingly, sports events were unappealing, as gamblers favor traditional regional bookies instead for better liquidity.

frictionless fiat on-/off-ramps could have a head start in capturing market share.

Polymarket currently relies on centralized event oracles for settlement purposes. Moving forward, when prediction markets pick up traction over time, the market resolution process should utilize decentralized event oracles that are economically sound and corruption-resistant. Whether this can be delivered swiftly is doubtful, but one thing certain is that prediction market platforms are not prioritizing complete decentralization as of now.

### Non-dollar stablecoins

Most stablecoins are dollar-pegged, as stablecoins are primarily used for trading cryptocurrencies on USD pairs. While there is a sea of stablecoins pegged to various fiat currencies, most have non-existent demand and liquidity.

Nonetheless, Euro stablecoins will likely gain adoption in the coming years. First, Euro is the second-largest group of stablecoins. There already exist two liquid Euro-pegged stablecoins in the DeFi space. sEUR is the synthetic Euro from Synthetix with a market cap of \$118.7 million, whereas STATIS EURO (EURS) is the largest custodial Euro-pegged stablecoin issued by Stasis with a market cap of \$102.2 million. Their demand is primarily driven by Curve’s incentivized sEUR-EURS pool with TVL of \$109.8 million.

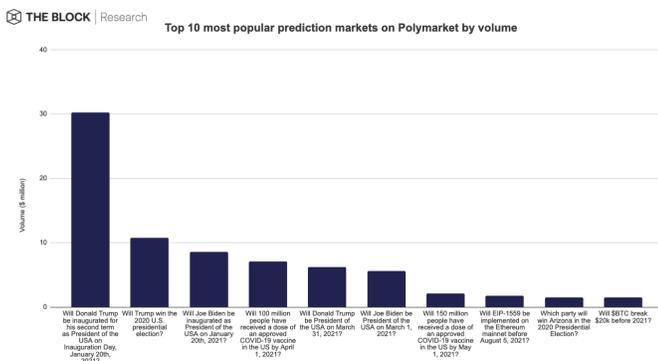


Figure 145: Top-10 most popular prediction markets in Polymarket by volume in 2021  
Source: Polymarket

As DeFi becomes more user-friendly, decentralized prediction markets have the advantage of reaching more gamblers globally and thus providing more competitive rates and deeper liquidity. Retail bettors would likely prioritize user experience over decentralization, and the one that could offer

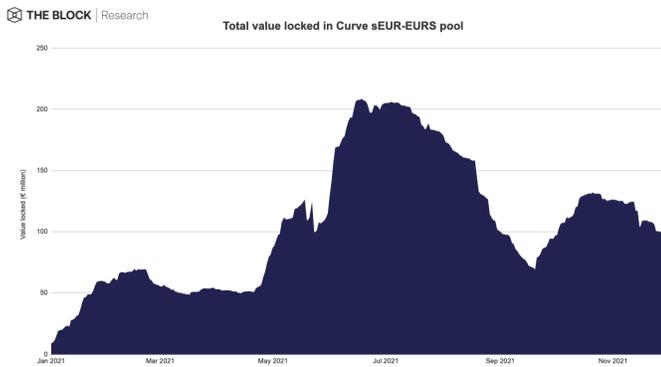


Figure 146: Total value locked in Curve sEUR-EURS pool in 2021  
Source: The Block Research

Second, the European Union’s proactive approach and relatively more welcoming attitude in addressing legal concerns surrounding stablecoins and other crypto assets could bring greater DeFi adoption in Europe. “[Markets in Crypto-Assets](#)” is a proposed regulation that would create a union-level licensing framework to provide regulatory clarity for a wide range of crypto service providers, including stablecoin issuers. Euro stablecoins will play a significant role in facilitating such adoption.

### Tokenization of real-world assets

While crypto as an asset class has matured into a two-trillion-dollar market, it remains comparatively siloed and disconnected from other economies. As the token-based economy advances, everything that carries value, financial or cultural, will somehow be tokenized. Bridging the gap between real-world assets (RWAs) and DeFi could bring a vast pool of “old wealth” into the new digital economy and augment the nascent DeFi ecosystem.

Tokenized RWAs benefit from the existing blockchain and DeFi infrastructure. For example, Centrifuge is a blockchain that facilitates such RWA tokenization as NFTs and enables financing for different types of tokenized assets through DeFi. Tinklake, Centrifuge’s

investment portal to RWA pools, holds over \$44.4 million in TVL amongst 10 RWA pools. New Silver, a pool financing real estate bridge loan on Tinklake, financed its first loan using Maker as a credit facility with an initial \$5 million credit line, making it the first to back Maker’s DAI stablecoin with RWAs. Soon, tokenized RWA loans can be used as collateral on Aave.

### Innovation in derivatives

DeFi has nurtured countless experiments throughout the years, and this is unlikely to stop anytime soon. Just like centralized crypto exchanges revived perpetual futures to enable futures markets for then-illiquid crypto assets, DeFi is primed for revolutionizing the derivatives landscape with creative and novel designs.

Perpetual futures never expire and do not require delivery. In addition to significant simplification for the user, it also affords greater capital efficiency to liquidity providers by consolidating liquidity from many expiry dates into a single market. The same framework could be applied to the crypto options market, which suffers from liquidity fragmentation and high rollover cost across expiries.

Funding payments on “everlasting options” would be a function of the difference between the mark price and its intrinsic value (i.e., the volatility premium). The novelty and complexity of such instruments might cause mispricing at first, but the market would become more efficient as it matures.

Besides perpetualizing options, other potential derivatives include power perpetuals that aim at preserving the convexity of options while consolidating the liquidity of futures, and floor perpetuals that track the floor price of a specific collection of non-fungible

assets. Albeit promising, most of them would have limited success without incentives.

### Bootstrapping liquidity

Liquidity begets volume. Most DeFi projects failed to harness the network effect and create self-sustaining momentum as they cannot attract short-term and retain long-term liquidity. The ubiquity of LM might have proven its short-term effectiveness, but its efficiency and sustainability remain questionable.

Regarding efficiency, existing LM incentivizes liquidity across the full price range from zero to infinity. This is a misplacement of resources as most liquidity would never be utilized. Only a few projects, such as Instadapp, focus on incentivizing liquidity in narrow ranges on Uniswap v3, possibly due to the unfamiliarity of the implementation on concentrated LM.

We would witness an emergence of LM variants that reward loyal liquidity providers who supply meaningful liquidity. Rewards given out could be weighted by a basket of liquidity-related parameters, including concentration, proximity to the market price, loyalty, etc.

As to sustainability, LM provides diminishing marginal utilities. Mercenary liquidity providers offload their rewards, creating immense selling pressure and devaluing reward tokens such that yields diminish over time, causing liquidity providers to remove their liquidity. Ultimately, LM is a recurring expense for protocols with the hope of reaching escape velocity one day. It equates to renting liquidity from mercenary capital, where the objectives between protocols and liquidity miners are misaligned.

Lately, Olympus DAO brought up the idea of protocol-owned liquidity (POL), which is self-explanatory. Since decentralized protocols cannot remove liquidity, at least not without the approval of governance via thorough procedures, liquidity owned by the protocol itself is essentially permanent. Instead of renting liquidity from mercenary capital, protocols purchase them outright by offering bonds, a mechanism by which protocols trade tokens in exchange for the liquidity of said tokens.

Whether POL and bond sales can revolutionize the art of bootstrapping liquidity remains to be seen. It would not be shocking to see other innovative ways to tackle this billion-dollar question that affects all DeFi protocols.

### Governance revamp

The interest of governance token holders and protocol users is misaligned. Only [7% of users belong to both groups](#), and users from these groups have vastly different time horizons. Token holders usually prefer maximizing the extraction of short-term value even at the expense of the long-term sustainability of the protocol. In contrast, protocol users favor the longevity and neutrality of the protocol.

Maker is a classic example of this governance dilemma. MKR holders benefit from raising the interest rate of DAI borrows, whereas borrowers would prefer the opposite for obvious reasons. If users cannot rely on voters to make appropriate decisions in their best interest, that would drive away users.

Curve's vote locking resolves the dilemma. Curve's native token CRV does not directly provide voting rights. However, CRV holders can lock the tokens to receive veCRV, which grants holders voting rights. The

longer the tokens are locked for, the more veCRV (and vote) they would receive. That way, Curve voters have a vested interest in the endurance of the DEX.

Furthermore, liquidity providers on Curve get boosted rewards if they acquire and lock CRV, incentivizing users to participate in governance actively.

Different implementations of vote locking will likely spread throughout the landscape of DeFi governance to realign interests amongst stakeholders.

### **Bifurcation of DeFi**

Institutions are eager to deploy capital into the DeFi space but face countless obstacles due to regulatory uncertainties, from KYC/AML practices to concerns related to securities laws. Some protocols cultivate the notion of “permissioned DeFi,” pardon the oxymoron, which could satisfy existing compliance requirements.

Some believe that such development defeats the purpose of DeFi. Be that as it may, trustlessness is not the solution to everything. Some applications require trust in certain parties, such as borrowers and facilitators of uncollateralized lending, custodians of RWA tokenization, etc. Open finance should not be just about decentralizing every aspect of finance but about bringing options and transparency to users.

These projects will be able to access war chests from institutional giants that have never got in touch with DeFi. Some existing decentralized protocols are also developing a separate arm catered towards institutional customers, like Aave Arc and Compound Treasury.

Still, most protocols will remain permissionless, and an increasing number of developers of such protocols will stay anonymous. They will expedite the process of full

decentralization and avoid censorship at all costs. The threat of restricted access would also accelerate the development and adoption of a privacy-enhanced DeFi ecosystem powered by zero-knowledge technology.

Many “decentralized applications” nowadays rely on centralized components, such as centrally hosted user interfaces, proprietary route optimizing algorithms, etc. They will be forced to choose sides as regulatory pressure mounts up. Some would comply and enforce KYC processes or restrict users from certain jurisdictions; others would stay anonymous and relinquish control of frontends and smart contracts.

Regardless, the bifurcation of DeFi seems inevitable.

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## Appendix:

### Summary of largest DeFi exploits in 2021

#### [Yearn v1 yDAI vault \(02/05/21\)](#)

As a result of disabling the withdrawal fee and the high value of the slippage parameter, the attacker manipulated the exchange rate between stablecoins in the 3crv Curve pool. The vault lost \$11 million, but this value could have been higher if it hadn't been for the lightning-fast reaction of the Yearn team. The exploiter stole about \$1 million, while the rest of the funds were returned to the protocol or remained as fees in other DeFi projects.

#### [BT Finance \(02/09/21\)](#)

This exploit was a copycat of the previous attack, and even additional security measures could not protect the protocol from losing \$1.3 million.

#### [Alpha Homora v2 \(02/13/21\)](#)

The attacker was the only borrower in the non-launched sUSD pool, which allowed them to exploit a calculation bug and generate a large amount of cySUSD. Then using cySUSD, they borrow \$37.5 million in various tokens from Iron Bank.

#### [Furucombo \(02/28/21\)](#)

The exploiter tricked Furucombo into thinking that their fake contract belonged to Aave v2. Because of this, all approvals issued to the Furucombo proxy contract became available to the attacker, making it possible to withdraw more than \$14 million from the protocol users' addresses.

#### [DODO v2 \(03/09/21\)](#)

As a result of the vulnerability, under certain conditions, anyone could reinitialize some DODO pools to become their owner and then withdraw all assets. However, the attacker was unlucky, and two generalized bots frontrun their transactions and returned almost all stolen funds to the protocol.

#### [ForceDAO \(04/04/21\)](#)

The use of tokens that did not comply with the ERC-20 specification led anyone to mint xFORCE without locking FORCE tokens. The simplicity of the exploit attracted a large number of people. However, due to the work of a white-hat hacker, the protocol losses amounted to about \$0.6 million.

#### [Uranium Finance \(04/28/21\)](#)

The presence of a bug in the implementation of the formula  $x*y \geq k$  allowed the attacker to execute swaps, which gave them 100 times more assets than usual. The attacker who stole \$51 million remains unknown, although it is hypothesized that this is an insider job.

#### [Spartan Protocol \(05/02/21\)](#)

Spartan protocol was built from scratch, and developers made a mistake in oracle implementation. Using the current pool balances instead of the cached ones when calculating the LP tokens price resulted in a loss of \$30.5 million.

#### [Value Defi #2 \(05/06/21\)](#)

The second time around, the protocol suffered from the ability to reinitialize the pool, resulting in a loss of \$6 million.

#### [Value Defi #3 \(05/08/21\)](#)

In a few days, liquidity providers of Value DeFi non 50/50 pools lost another \$11 million. The issue was a misuse of one of Bancor's formulas, which bypassed the AMM formula check.

#### [Value Defi #4 & Rari Capital \(05/08/21\)](#)

These two attacks were almost identical and were related to a bug in integrating leveraged yield farming protocols into aggregator strategies. So far, these attacks are the only example of a situation where the attacker was one person who managed to steal \$15 million.

#### [xToken \(05/12/21\)](#)

As a result of two different vulnerabilities and using Flashbots, an exploiter could steal \$25 million. One of the vulnerabilities was to use Kyber as an oracle, while the other allowed wrapped BNT to be minted using any token on Bancor at a 1:1 ratio.

#### [Bearn Finance \(05/16/21\)](#)

A bug in the code led to the protocol accepting BUSD into one of the strategies but giving ibBUSD (stablecoin with the accumulated interest) when exiting it. Thus, with the help of several flash loans, the attacker removed \$11 million from the protocol.

#### [Bunny Finance \(05/20/21\)](#)

By manipulating the reserves of an AMM pool, an exploiter could change the LP tokens' price, which the protocol used to mint BUNNY tokens. They sold tokens on PancakeSwap with a profit of \$40 million while dropping the price 25 times.

#### [Bogged Finance \(05/22/21\)](#)

The deflationary token became inflationary when performing self-transfers, since fees were not burned during transfers, and a staking pool was growing. Using flash loans in several iterations, the attacker accumulated a decent amount of BOG in a staking pool, which they claimed and sold for \$3.6 million.

#### [Autoshark Finance \(05/24/21\)](#)

This attack was a copy of the Bunny Finance exploit with the difference that the token had much less liquidity. The exploiter received only \$750 thousand after the sale.

#### [MerlinLabs #1 \(05/26/21\)](#)

Another Bunny Finance fork fell victim to a copycat attack, losing \$680 thousand.

#### [MerlinLabs #2 \(05/26/21\)](#)

Within five hours, due to a bug in the number of decimals for BAND token, the attacker was able to mint tokens for another \$550 thousand.

#### [JulSwap \(05/27/21\)](#)

The use of AMM's reserves for the minting price of a native token in the case of JulSwap also resulted in a loss of \$6.5 million.

#### [Wild Credit \(05/27/21\)](#)

The missed initialization of a Wild Credit pool did not turn into an issue, since the withdrawal transaction belonged to the white-hat hacker.

#### [BurgerSwap \(05/27/21\)](#)

Transferring the  $x*y>=k$  formula check to the router contract instead of the pool contract allowed the attacker to interact directly with pools using a fake

token and empty them. The amount of stolen funds was \$7.2 million, which, as in most cases, was hidden in Tornado Cash.

#### [Belt Finance \(05/29/21\)](#)

This exploit is similar to what happened with the Yearn v1 yDai vault, as the attacker created an imbalance to manipulate the price of liquidity shares. In this case, they managed to get \$6.2 million out of the protocol.

#### [PancakeHunny \(06/03/21\)](#)

Another exploit was due to the calculation of the HUNNY price depending on the pool reserves, which resulted in the theft of \$112 thousand.

#### [Impossible Finance \(06/21/21\)](#)

This attack was a copycat of what happened to BurgerSwap a month before and again required a fake token. \$0.5 million was withdrawn from the protocol due to the relative novelty of Impossible Finance.

#### [Eleven Finance \(06/22/21\)](#)

An error in one of the functions made it possible to withdraw funds from the protocol without burning LP tokens, which, using flash loans, led to a loss of \$4.6 million.

#### [SafeDollar \(06/28/21\)](#)

A bug in the deflationary mechanism made it possible to receive many SDO tokens as a reward, which were sold for \$246 thousand.

#### [MerlinLabs #3 \(06/29/21\)](#)

Due to the lack of the necessary sanity check in the new strategy, the exploiter made a pool think that the BNB sent to it should be interpreted as a multiplier for the

amount of rewards. After stealing \$333 thousand from the protocol, its developers announced the ending of the project's support.

#### [Anyswap \(07/10/21\)](#)

Due to reusing one of the cryptographic variables in two transactions, the attacker recovered the private key. With its help, they generated new transactions to withdraw \$8 million from Anyswap.

#### [ChainSwap \(07/11/21\)](#)

A bug in the authentication system allowed minting tokens of various BSC projects on Ethereum using new addresses. The exploiter sold the received tokens for over \$4.4 million.

#### [THORChain \(07/15/21\)](#)

Using a fake contract, the attacker tricked the THORChain validator network into thinking that they were making deposits. After completing many transactions, they were able to withdraw \$5 million of assets from the protocol.

#### [Bunny Finance #2 \(07/19/21\)](#)

Even on Polygon, this protocol lost \$2.4 million in an attack that inflated the number of tokens minted as a reward even on Polygon. However, in this case, inflation appeared not because of the manipulation of reserves but because of a bug in a staking contract.

#### [THORChain #2 \(07/22/21\)](#)

Using a fake router, the exploiter managed to issue fake deposit events, bypassing sanity checks, which is why validators processed them. Later, this manipulation made it possible to withdraw \$8 million worth of assets from THORChain.

[Popsicle Finance \(08/03/21\)](#)

A logic bug in the protocol contract made it possible to collect fees for a specific user even if they did not have LP tokens. Using flash loans, the attacker significantly increased the number of rewards they could claim, which allowed them to steal \$20.5 million.

[Vault Finance \(08/03/21\)](#)

By minting WUSD in large quantities, the exploiter also leveraged the protocol's internal mechanism to perform swaps with WEX tokens, which increased their price. As a result of this arbitrage opportunity, \$0.8 million was removed from Vault Finance.

[Poly Network \(08/10/21\)](#)

Using several non-trivial vulnerabilities, the attacker could change the set of validators and single-handedly sign transactions. The stolen \$611 million from Ethereum, Polygon, and BSC were returned after a while.

[Punk Protocol \(08/10/21\)](#)

An access control vulnerability allowed an attacker to be privileged to withdraw funds from Punk Protocol. However, upon withdrawing funds, a generalized bot was able to front-run a transaction and return \$5 million out of the \$9 million stolen.

[DAO Maker \(08/12/21\)](#)

Probably as a result of an insider job, USDC deposits were stolen from more than 5,000 DAO Maker users. This happened as a result of a private key compromise or a bug in the access control is still unknown due to the closed source code.

[xToken #2 \(08/29/21\)](#)

The previous exploit didn't teach the protocol anything, so using AMMs as an oracle ended up losing another \$4.5 million.

[Cream Finance \(08/31/21\)](#)

The lack of proper asset due diligence work prior to listing has led to the addition of AMP (ERC-777 token), which has an opportunity for reentrancy. Using reentrancy, the attacker was able to borrow the same asset twice, and after other manipulations, they were able to steal \$18 million, which they later returned.

[DAO Maker #2 \(09/04/21\)](#)

Reinitialization of the four pools made it possible to withdraw \$4 million from the protocol, which was already the case with DODO and Value DeFi.

[Zabu Finance \(09/12/21\)](#)

Due to the incompatibility of Zabu Finance and deflationary tokens, the exploiter, using a loop of deposit and withdrawals, could empty a staking pool, which provided it with a large number of ZABU tokens. Selling them on DEXs earned him \$3.2 million.

[pNetwork \(09/19/21\)](#)

The attacker was able to forge an event log for the BTC withdrawal operation due to a bug in the implementation of the protocol node, which allowed them to steal \$12.7 million.

[Vee Finance \(09/21/21\)](#)

Due to oracle misuse and calculation bug, the exploiter could bypass slippage checks and withdraw \$36 million from Vee Finance.

[Compound \(09/30/21\)](#)

As a result of one of the Compound upgrades, COMP rewards for participants of some pools have significantly increased. In total, users claimed tokens for \$114 million, of which they returned at least \$52 million.

#### [Indexed Finance \(10/14/21\)](#)

An attacker manipulating the UNI price was able to mint a large number of indexed tokens. After redeeming these tokens for underlying assets, they stole \$16 million from Indexed Finance.

#### [PancakeHunny #2 \(10/20/21\)](#)

The HUNNY TUSD vault became the target of the attack in this case because of a bug that inflated HUNNY rewards for TUSD staking. Ultimately, this earned the exploiter about \$2 million.

#### [Cream Finance #2 \(10/27/21\)](#)

Another oracle misuse led to the fact that the price of yUSD, was seriously overestimated, which made it possible to borrow all the assets on Cream Finance. This exploit is currently the largest in terms of stolen funds (\$130 million).

#### [Autoshark Finance #2 \(10/29/21\)](#)

Again, due to a bug in the reward mechanism, the attacker could mint a large number of governance tokens of Autoshark Finance. The damage they caused is approximately \$2 million.

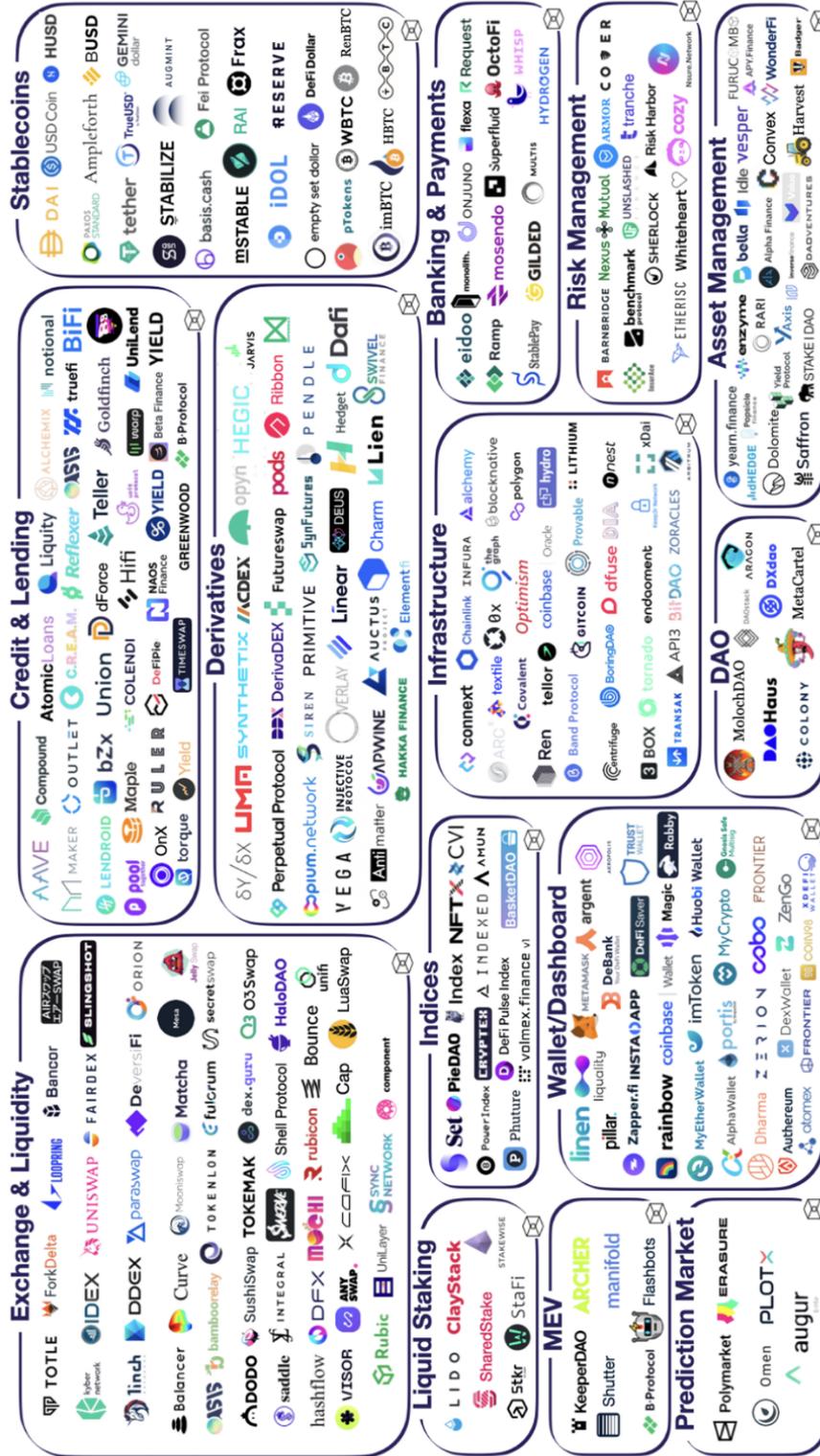
#### [Rari Capital #2 \(11/02/21\)](#)

Using Uniswap v3 as an oracle for the VUSD-USDC pair resulted in emptying Fuse Pool #23 (\$3 million) after injecting a small amount of liquidity into the Uniswap pool.

# DeFi Ecosystem on Ethereum

## DeFi ecosystem on Ethereum

THE BLOCK | Research



# 6

# Web3: 2021 Overview

Hiroki Kotabe

# Web3: 2021 Overview

*Hiroki Kotabe*

A look at Web3, the tech driving an inflection point in the web's evolution and explore the latest data to see where we might be headed

## Quick Take

- As Web3 matures, it's important to have frameworks for understanding its technical organization and interactions, and how they give rise to new user experiences
- To this end, we developed an integrative model of Web3 which depicts Web3 as a “horizontal” evolution of Web2 technologies
- Here, we explain this new framework and dive into related aspects ranging from the technicalities of streamlining blockchain data access to numbers and figures behind the recent flurry in activity in the Web3 economy

## 2021: Buzzed on Web3

In 2021, there has been a lot of buzz about “Web3”. A quick search of news about Web3 over just the past couple of months brings up a wealth of major events ranging from tech developments to massive funding opportunities to increased adoption of Web3 tech by traditional firms.

For example, in October, [Stripe](#) announced that they are creating a crypto-focused engineering team to “build the future of Web3 payments.” Blockchain infrastructure provider [Alchemy](#) announced raising \$250 million in a Series C funding round that boosted their valuation to \$3.5 billion. Soon after Facebook rebranded to Meta, they [revealed](#) that their metaverse would support NFTs, so people can securely buy, display, and sell them in their digital spaces.

In November, Solana, Lightspeed ventures, and FTX [announced](#) a \$100 million fund targeting Web3 gaming development, supporting gaming studios and technology that integrate Solana into desktop and mobile games. The popular dating and friend-finding platform [Bumble](#) revealed that they are exploring through “a Web3 lens” how to incorporate blockchain and crypto into the relaunch of their friend-finding platform BFF. Crypto venture firm [Paradigm](#) announced a massive \$2.5 billion fund aimed at developing Web3 applications, and noting that the journey of Web3 and crypto is just beginning with Web3 applications currently reaching a small fraction of the audience that Web2 has reached.

Worldwide interest in the term “Web3” also reached all-time high on Google in November, increasing about 150% since the beginning of October. The y-axis below is a measure of search interest relative to the highest point between January 1 to November 30.

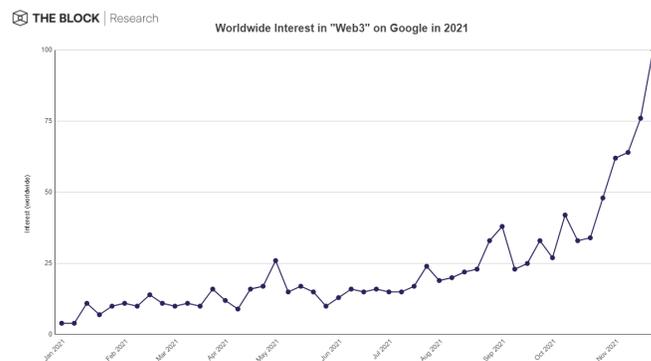


Figure 147: Worldwide interest in “web3” on Google in 2021  
Source: Google Trends

Despite all the buzz, there is still a lot of confusion about what Web3 is. We developed an integrative model of Web3 which focuses on the technological developments happening at the level of web architecture. Next, we discuss this model, its context in the web's history, and how developments happening at

both the backend and frontend of the web can give rise to major changes in how people use and experience the web.

### A simple framework for understanding Web3 technology

In one sense, “Web3” (like “Web2”) is merely a buzzword used to encompass a collection of novel phenomena on the web. These terms can be misleading because the web is constantly evolving and does not “upgrade” all at once from one version to another. However, periods of rapid development do occur during certain evolutionary inflection points.



Figure 148: Web1 vs. Web2 vs. Web3  
Sources: Consensus, The Block Research

In the case of Web2, the developments were mostly related with commercialization and the social experiences possible on the web — some [key differences](#) included the shift toward users as first-class entities with prominent profile pages, the ability to form connections between many users, posting content in many forms, and technical advancements such as internal messaging systems and public Application Programming Interfaces (APIs).

In Web3, major developments are happening at both the backend and frontend, ranging from how data is stored and served to novel user experiences with integrated wallet applications and Web3 gateways. At a social level, there is movement toward a more publicly

built and owned web governed by [community-owned and operated organizations](#) enabled by blockchain technologies.

With that said, Web3 is still in its early stages and any claim of a “revolution” over Web2 or replacement of Web2 technologies is premature. Such claims may come from a lack of clarity about how communication between clients and servers works in Web3. Next, we attempt to address this issue by focusing on specific developments happening at the client-server level of web infrastructure.

### An Integrated model of Web3

The model presented below is “integrative” in the sense that it highlights how Web3 can be construed as a horizontal expansion of Web2 infrastructure that increases users’ capacities for decentralization, ownership, verifiability, and execution.

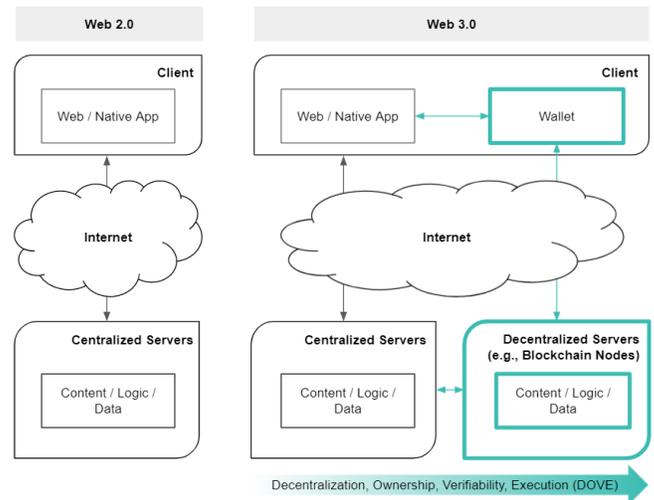


Figure 149: Integrative model of Web3  
Source: The Block Research

On the left, we present a simplified illustration of the technological infrastructure of Web2, the dominant form of the web since roughly 2004. Essentially, Web2, aka the “[participative](#)” and “[social](#) web,” consists of

client and server computers communicating through the Internet protocol [stack](#).

Compared to “Web1,” which refers to the first stage of the web’s evolution from roughly 1991 to 2004, Web2 involves much more bidirectional communication between clients and servers. Increased capacities for client-to-server communication allowed users to write and update data in a secure, reliable, trustworthy, and scalable way not possible before — hence, sometimes Web1 is referred to as the “read-only Web” while Web2 is referred to as the “[read-write Web](#).” These capacities paved the way for novel developments such as user profiles, internal messaging systems, and social networking platforms.

Focusing on the server side, we note that web content (e.g., HTML/CSS, JavaScript, images, videos), app logic (e.g., for serving dynamic content via HTTP), and data (e.g., data stored in database management systems like MySQL) are stored on privatized and centralized servers in Web2. In contrast, Web1 was relatively decentralized, with mostly static informational pages hosted by various Internet service provider (ISP)-run web servers and free web hosting services.

One of the reasons for server-side privatization and centralization is the economic opportunities that came with the social developments of Web2. It was the first time that we could create thriving digital markets. And like in any market, knowing your customer is vital for effective marketing. As such, we witnessed the birth and explosive growth of digital marketing, the commercialization and commoditization of personal data, and the race among tech companies to own it. The tech giants that survived the dot-com crash have kept competing to this day to find ways to capture and control this value. Power became centralized by the few companies that control these valuable resources — for example, the cloud infrastructure market is dominated

by a [handful](#) of tech giants (e.g., Amazon, Microsoft, Google).

Essentially, the line between clients and servers has become blurred in Web2 as clients also “serve” servers with valuable data and resources. In the process, clients lose ownership of these data and resources because they typically do not own or operate the server computers.

### **Web3 technicals, decentralization, and “publicization”**

It is clear by now that the web has lost touch with one of its initial core [tenets](#):

*“No permission is needed from a central authority to post anything on the web, there is no central controlling node, and so no single point of failure ... and no “kill switch”! This also implies freedom from indiscriminate censorship and surveillance.” - The Web Foundation*

The decentralized vision of the web has been replaced by a reality where digital fiefs are controlled by monopolistic technology companies. But, after a long period of ossification, the tech industry’s top-down structure is showing signs of [weakening](#). Critics are voicing their concerns over censorship, surveillance, disinformation, and user exploitation and antitrust watchdogs are clamping down on big tech firms to root out monopolistic practices. In tandem, we have a massive influx of talented developers working on building a new version of the web that respects its original utopian vision that upholds [principles](#) of liberty, inclusion, community, and civility. As web inventor [Tim Berners-Lee](#) puts it — “a web for everyone.”

But the last two decades have proven that building dapps that are also scalable and secure is hard. It seems that combining decentralization with the user experience we have become accustomed to and demand in Web2 is computationally infeasible on Web2 infrastructure. It's possible that server-side centralization also arose as the only feasible computational solution to meet user demands from web applications.

Fortunately, a decentralized solution may exist in blockchain and related technologies. For example, Bitcoin is a blockchain-based application that runs in a distributed manner at scale currently with around 14K reachable full nodes and counting, technological security increasing with network size and value for individual users and intrigue for non-users increasing per network effects. As such, talented developers

worldwide are looking in this direction for a way to build a new web that avoids the missteps of Web2.

To understand the main technical differences of this new web, let's first go over the major server-side developments. In the figure below, we zoom in to the bottom of the Web3 diagram to provide a simplified illustration of how various data structures may be stored and communicated in Web3.

In Web2, we have web content, app logic, and data stored in centralized web servers, application servers, and database servers, respectively. User actions taken on an application frontend start a cascade of informational requests and responses on the backend. For example, an HTTP request sent from a client browser can trigger web servers to communicate with application servers via API calls and application servers

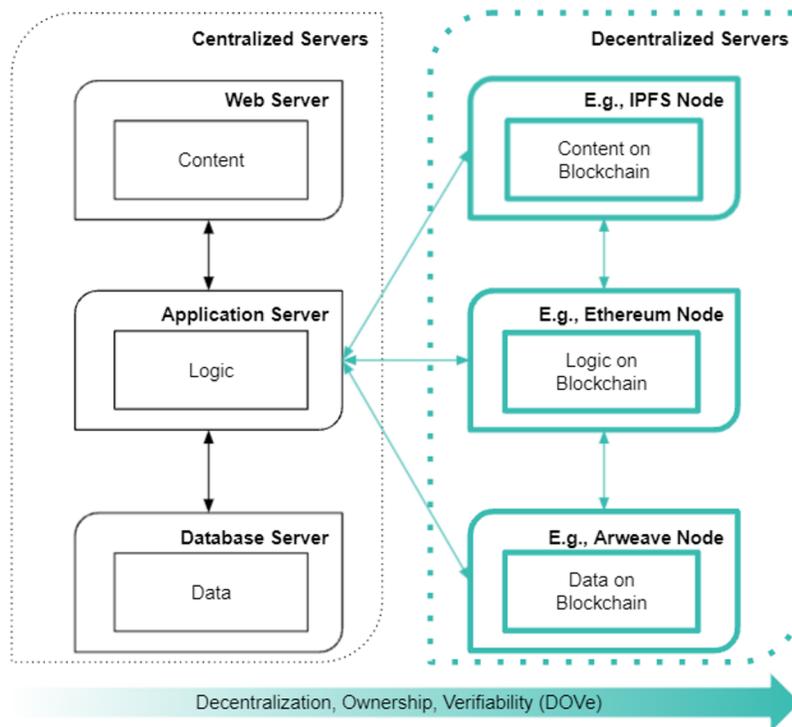


Figure 150: Servers in Web2 vs. Web3  
Source: The Block Research

to communicate with database servers via SQL queries. The HTTP response would then be sent from the web server back to the client containing the relevant information.

In Web3, it is possible for the data structures currently stored in centralized web, application, and database servers to be stored in decentralized [IPFS](#), [Ethereum](#), and [Arweave](#) nodes, respectively. The data stored in these decentralized servers (i.e., blockchain nodes) could be requested by centralized application servers via remote procedure calls (RPCs) to then provide the centralized web server with relevant info. In addition, the blockchain nodes could send the relevant info to a Web3 frontend application such as a wallet (e.g., [MetaMask](#)) or gateway (e.g., [IPFS gateway](#)) via RPCs.

This is only one example and other setups are possible. For example, content such as HTML could be stored on Arweave nodes and datasets could be stored on IPFS nodes; application logic, create-read-update-delete (CRUD) commands, and financial executions could be implemented on [Solana](#) nodes or another decentralized computing platform.

## Decentralization by design

One of the key choices that developers need to make when implementing Web3 technologies is the degree of decentralization to impart into their designs. It is often misconstrued that there are “Web3” versus “Web2” websites and apps, but the reality is less categorical and more continuous with apps now having access to a Web3 backend that opens up more potential for decentralization. Initially, many developers aimed to decentralize their apps to the maximum extent possible, but that has proven idealistic due to the slow and expensive nature of present-day blockchains. It's likely that in the near term that “Web3 apps” will still

utilize Web2 infrastructure to some degree or another (perhaps we should label them Web 2.1, 2.2, ..., 3.0 apps for accuracy). For example, [Uniswap.org](#) and other popular DeFi apps host their frontends on centralized servers and their domains were bought from centralized DNS hosts.

## Wallets

Returning to the overall Web3 diagram, we can see that Web3 also comes with frontend developments enabled by the new backend developments. Perhaps the most prominent development so far is the user wallet, which allows us to securely view blockchain information such as account balances and transaction history. And importantly, we can “own” the wallet in either software or hardware — what is known as “self-custodial,” “non-custodial,” or “user-controlled” wallets. In the ideal case, the owner, and only the owner, has full ownership and control over the private keys to access the wallet. In other words, the wallet software doesn't replicate private key information, preventing third parties from controlling the wallet in any way. Note that what we “own” is actually the private key to access a typically public address linked to public user data such as account balances replicated and stored across many servers in a decentralized way.

Another option is “custodial” or “hot” wallets — these are typically controlled by centralized exchanges such as [Coinbase](#) and [Binance](#) that manage user funds through pooled wallets also controlled by the same entities. As such, they provide the user with less ownership and security but also less responsibility and more convenience.

Software wallets like MetaMask also act as gateways to dapps. To use dapps, users need to know the state of blockchains and be able to interact with them. For example, MetaMask allows users to access Ethereum

blockchain data via Ethereum nodes provided by [Infura](#) by default, opening access to the expanding universe of [Ethereum dapps](#). However, a user can set MetaMask to access the Ethereum blockchain through another node provider or even through their own node. Or, they could access Ethereum dapps through a different wallet or a custom application via RPCs. Again, these features point to a sort of continuum of user control that wasn't possible on a Web2 infrastructure. If Web2 was about a shift toward user prominence and sociality, Web3 seems to be about a shift toward user control and empowerment.

### **Decentralization, Ownership, Verifiability, Execution (DOVE)**

On the bottom of the figure above, a gradient illustrates how shifting to Web3 infrastructure lends itself to four key *changes* to the user's experience — from Decentralization to Ownership to Verifiability to Execution (DOVE). We use the word "changes" rather than "benefits" as each change certainly comes with both [costs and benefits](#).

**Decentralization** is an effect of the way servers are connected in Web3 vs. Web2 infrastructure. A simple way to think about it is that data structures in Web2 are primarily managed by large servers controlled by a small number of entities, whereas, in Web3, they are managed by smaller servers controlled by a large number of entities. Furthermore, in Web2, access to the server side is exclusive to those who own the server farms, whereas in Web3, access to the server side is inclusive to the extent that a single person can realistically own the client and server computers.

The former system provides the user with a data network that is easier to deploy, develop, and maintain but more prone to single points of failure, security risks,

and privacy intrusions. The latter system promises an open and trustless infrastructure, censorship resistance, and no single point of failure but tends to have lower throughput, require more computational resources, and be more complex to implement and coordinate.

**Ownership** is an effect of the native [statefulness](#) of the blockchain layer of Web3 — the way that we publicly keep state or history by running nodes, which is guaranteed by consensus rules instead of relying on private information brokers (tech giants) who act as both creators of and gatekeepers to our own user states and history. In other words, due to the [lack of native statefulness in Web2](#), the user has no history — no data, identity, security, or transactions — without requesting these from trusted intermediaries. In this way, the statefulness property of Web3 infrastructure sets the foundations for a [trustless](#) infrastructure in which intermediaries can be removed without loss of functionality. However, with ownership comes responsibility. Without intermediaries, we gain user control at the expense of service by intermediaries.

**Verifiability** is an effect of the public availability of blockchain data that has passed a fault-tolerant group consensus mechanism. In the case of a truly decentralized blockchain, anyone can download and verify the entire history of the validated blockchain data. There is no intermediary entity standing between the user and their state, and the blockchain “belongs” to everyone equally and fairly. In this way, decentralization and ownership enable an unprecedented level of verifiability. They enable *direct* verification of selective and copy-protected information about what we own and what others own, opening the possibility for multiple parties who don't know each other to settle agreements about value over the web for the first time. The downside here is that to achieve

verifiability; the fault-tolerant consensus mechanism requires an extreme form of data replication and processing across nodes that can quickly become computationally intensive.

**Execution** is an effect of smart contracts being executed exactly as they are written, without intermediaries or closed protocols and opaque code. In other words, smart contracts are self-executing, with the terms of the agreement among parties interacting with it written into lines of open source code. Furthermore, there are many open source smart contract libraries available that provide reusable building blocks for Web3 projects. It is in such ways that Web3 returns to the open and inclusive spirit of Web1. The modular and open design allows for a greater degree of networked and community collaboration that isn't possible within a Web2 framework. The challenge in this case is about how networked collaborations can develop and deploy apps at a pace that is competitive with centralized Web2 operations.

## Discussion

All in all, then, Web3 is opening the potential to publicly own a larger part of the web (again). It's doing this by building a foundation of linked data on the backend that we call blockchains — data that is decentralized, censorship-resistant, verifiable, and publicly available. These technological developments and the trustless system they give rise to form what some consider a new [value settlement layer](#) of the internet — a way to securely exchange value at a global scale without borders.

The future will tell how much the new web qualities brought about by Web3 infrastructure will accrue value. Now that the infrastructure is starting to cement itself next to time-tested Web2 infrastructure, we can expect developers to horizontally integrate their platforms

more and more with Web3 technologies to meet user demands for decentralization, ownership, verifiability, and execution — demands that will naturally take into account both the benefits and costs involved.

In moving to a web based in distributed data, one of the key challenges will be about how users and developers can efficiently and cost-effectively bring blockchain data to applications. If Web3 is to be decentralized, a robust, secure, and economical node network infrastructure is essential. Next, we focus on Web3 infrastructure that is enabling efficient, secure, and cost-effective ways to utilize blockchain data..

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## Centralized vs. decentralized Web3 infrastructure

Currently, there are centralized and decentralized operations that streamline blockchain data access. For example, blockchain infrastructure providers like [Infura](#) and [Alchemy](#) provide portals to blockchain data, but they are developed, owned, and operated by centralized entities. On the other hand, projects like [The Graph](#) and [Pocket Network](#) already offer decentralized solutions to accessing blockchain data.

## Decentralized access to decentralized data

It seems that the future of Web3 will rely on a base layer of distributed, secure, and immutable ledger data across multiple blockchains. Then, Web3 faces three key challenges:

- How to efficiently bring data from a blockchain to an application
- How to conveniently access data across multiple blockchains

- How to do A and B in a decentralized way

In a decentralized web architecture, a reliable node infrastructure is essential for decentralized computing.

A decentralized compute network can be broken down into three general components:

1. **Applications.** These are any software that submits API requests (e.g., queries, relays) meant to be routed to any public or encrypted database node.
2. **Nodes.** These are decentralized servers that provide functions such as storing database indices, sending session information to an application, servicing API requests submitted by applications, and storing network states such as account balances and work reports.
3. **Network Layer.** The ecosystem that maintains the operation of the decentralized protocol, including governance, protocol rules, the actors involved, and the economic games they participate in.

As shown in the diagram below, the relay or indexing nodes sit “between” applications and the blockchain nodes (or other decentralized server networks) that they retrieve data from. After processing data from blockchain nodes, they send relevant information to either centralized or decentralized application servers.

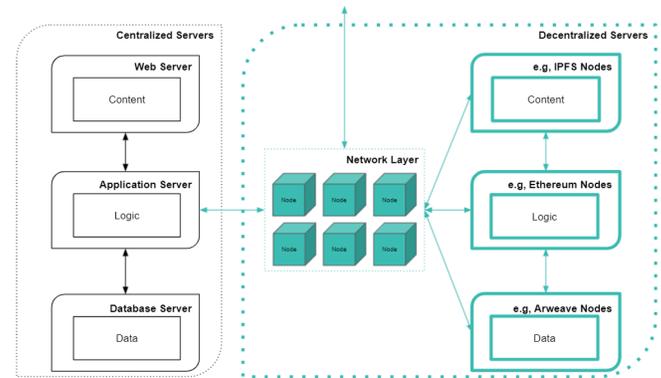


Figure 151: Decentralized blockchain infrastructure in Web3

Source: The Block Research

Next, we explain how decentralized computing infrastructure works with two example cases: The Graph and Project Network.

### The Graph: Decentralizing indexing and queries in one package

Web3 applications may benefit from querying data from a blockchain by filtering or searching. This process can be slow and computationally intensive because blockchains store data and handle state transitions, but they don't index the data. Indexing makes locating relevant data quicker and less computationally demanding.

Before The Graph, dapp developers would set up their own database indices for their users and clients. But, this practice keeps indexed data in centralized databases (not decentralized nodes), reducing the trustlessness of the dapp. It's also redundant for many teams to set up their own indexing servers.

In The Graph, [subgraph manifests](#) define which data to store and how to store it. Although the subgraphs for a project are usually defined by that project's developers, anyone is free to define these subgraphs.

Next, [Graph nodes](#) store that data in a database index (creating a served subgraph), continually scan the relevant blockchain (e.g., Ethereum blockchain) for event changes, and update the data accordingly. The resulting endpoint can then be queried by applications via [GraphQL](#), opening up the possibility of a cross-chain data index accessible via a unified query language.

The indexing nodes were originally owned and operated by The Graph, but earlier this year, [ten projects](#) started migrating from the hosting service to The Graph's decentralized mainnet. Eventually, The Graph aims to realize its vision of a fully decentralized data economy. In this economy, the Graph protocol will define the rules by which a Graph node can be run or queried by anyone.

How can The Graph decentralize its pseudonymous suppliers while providing service guarantees? It all comes down to the network layer. The Graph shares a network structure like other decentralized compute solutions, with the following four properties:

1. Supply (data providers) and demand (apps, users) meet in an open marketplace.
2. Suppliers engage in an economic game (staking tokens) that aims to ensure service guarantees.
3. The performance of suppliers is checked by some mechanism (via cryptographic proofs or “fisherman” who check their work quality and are rewarded for correctly reporting misbehavior).
4. If the supplier is caught failing at their job, they are penalized in some way (losing a portion of their staked tokens or not being selected to participate in the revenue-generating service).

The Graph utilizes a [work token](#) model in which Graph node providers stake GRT to receive work indexing data defined by Graph subgraph manifests. This model introduces economic incentives for service quality as indexers can lose work opportunities or be slashed (lose tokens) for serving incorrect data.

The network layer or “query market” of The Graph involves four primary actors. The token incentives for each of these actors are designed to ensure high-quality service and give the token utility.

**Developers.** These entities define subgraphs. Currently, they are usually developers from a given protocol creating subgraphs for that protocol's data. However, in theory, a subgraph of data from a public blockchain could be created by anyone. Currently, developers are expected to pay for requests on behalf of their users. Eventually, The Graph envisions that [end users](#) will pay for their own queries when Layer 2 solutions are widely implemented across Web3 wallets.

**Indexers.** These entities stake GRT to receive work from The Graph network. Their work involves indexing blockchain data on Graph Nodes per subgraph manifests. Indexer revenue (and by extension delegator revenue) comes from rewards collected for indexing work. The collective query fees from the protocol are distributed to indexers (and delegators) proportionally to the GRT staked and they also receive indexing rewards from the 3% yearly inflation of GRT.

**Curators.** These entities signal which subgraph manifests are better quality so that indexers know which ones to index in Graph nodes. Any developer could launch a subgraph with decentralized blockchain data, so The Graph network needs these actors to identify useful ones.

Curators signal to indexers by staking GRT behind specific subgraphs. For their service, they receive a share of the query fees generated by the subgraph they signaled. That share is determined by a [bonding curve](#) that pays out rewards based on how early a curator signaled for it, creating a prediction market in which curators speculate on the future popularity of subgraphs.

**Delegators.** These entities stake GRT to indexers and receive a share of the indexing reward and query fees that the indexer earns, set by the indexer. The amount that a delegator can stake with an indexer is limited by how much GRT the Indexer stakes.

It creates incentives on both sides. Delegators earn more by delegating to the “best” indexers — those who index the most important subgraphs as determined by curators. Indexers earn more by “winning” delegators’ capital, incentivizing indexers to offer a fair share of their earnings with delegators.

[Currently](#), there are 7,306 delegators, 2,266 curators, and 160 indexers in The Graph network.

The Graph is an exemplary case of how the network layer can successfully operate a decentralized compute network without a centralized entity in charge. It demonstrates a working decentralized solution for bringing data from a blockchain to an application and a way to conveniently access data across multiple blockchains through a unified query language.

### **Pocket: solving the node incentivization problem**

Like The Graph, Pocket has applications, nodes, and a network layer. Perhaps the main difference is that Pocket focuses on solving a particular problem limiting the growth potential of Web3: the [node incentivization problem](#). On the other hand, The Graph likens itself to a

sort of “Google of Web3,” aiming to organize the world’s blockchain information and make it universally accessible and useful.

For a decentralized web to flourish, it is necessary to develop a reliable node infrastructure. But, it’s not practical for developers to both host their own full nodes and provide back-end support for their applications. Therefore, Web3 developers have heavily relied on centralized solutions entailing centralization risks such as single points of failure, security risks, and privacy intrusions. There is currently a lack of a reliable node infrastructure run by third parties.

One of the reasons for a lack of full nodes being run by individuals and companies is the absence of native relay node incentivization (other reasons include the complexity to set it up and inconvenience). To solve this problem, Pocket Network financially incentivizes individuals and companies to deploy and operate full nodes for any blockchain that has application demand.

Through a combination of token incentives, cryptographic proofs, and pseudo-random selection algorithms, Pocket can create a reliable decentralized relay network where developers can access cross-chain data with more security and less cost than centralized providers.

Again, the question arises about how Pocket provides service guarantees through a decentralized network of service providers we don’t know? Trustlessness is again established through a decentralized network layer, although with different rules and incentivization schemes from The Graph.

A major difference is that Pocket uses a session model, which doesn’t rely on nodes storing indexed data like nodes in The Graph network. Pocket nodes have three functions: serving session information to the

application that contacts it, servicing relay requests sent by applications, and storing information about the state of the Pocket network to assign work and validate work reports.

Sessions are the mechanism the network uses to regulate interactions between applications and nodes. They are data structures that use data about the state of the Pocket network stored in nodes to pseudo-randomly pair an application with a set of up to five nodes per chain to provide the service that apps have paid for.

Then, the two key players in the Pocket network are applications and relay nodes which also act as validators and block producers for the Pocket blockchain — a [Tendermint](#)-based database to secure consensus among applications and nodes about infrastructure provisioning.

Nodes are rewarded based on how many requests they service during the session. For each relay (e.g., MetaMask call to fetch balances, fetch transaction history, send a transaction, query a smart contract) served by nodes and validated by the protocol, 0.01 POKT is minted. The reward for each validated relay is then split as follows:

- 89% to the Service Nodes
- 10% to the Pocket DAO
- 1% to the Block Producer

Ultimately, Pocket Network is addressing the same core issues as The Graph — namely, how to efficiently bring blockchain data to an app, conveniently access cross-chain data, and decentralize these processes. However, the scope differs with Pocket focusing more on being a unified cross-blockchain API via node

incentivization, whereas The Graph focuses more on being a unified search engine for blockchain data.

## Centralized blockchain infrastructure

Technically, all we need to access blockchain data is to connect with a blockchain node. Those nodes can be distributed in a decentralized network of individuals and companies like in The Graph and Pocket network, or they can be owned and operated by centralized entities like Infura and Alchemy.

To illustrate the difference, see the diagram below.

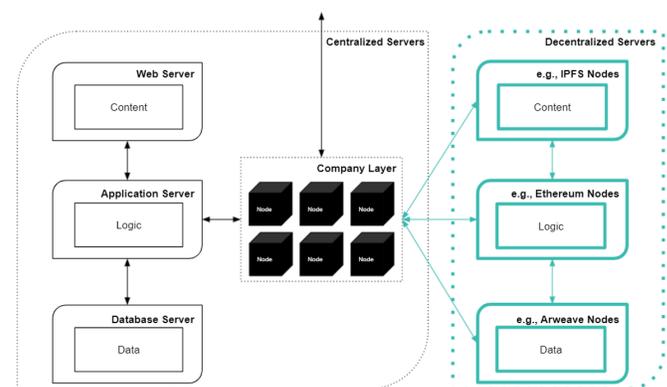


Figure 152: Centralized blockchain infrastructure in Web3  
Source: The Block Research

The main difference between centralized versus decentralized portals to blockchain data is that companies are in charge of maintaining the operations of the nodes — all of their operations can be grouped into a “company layer.” In addition to providing access to full archival node data, actors in the company layer can decide to set up database indices to facilitate queries involving filtering or searching.

Like any centralized compute network, this setup comes with certain benefits and costs. On the benefit side, a centralized solution can make the data network easier to implement, develop, and maintain. For example, within a few years, Alchemy and Infura were

able to develop and release a wide range of tools for facilitating prototyping and development.

But, there comes a cost in various forms of security risks and single points of failure. For example, Infura's Ethereum infrastructure had a major [outage](#) last year that caused delays in price feeds of ETH and ERC-20 tokens of popular services, including MetaMask. It also led major crypto exchanges, including Binance and Bithumb, to temporarily disable the withdrawal of ETH and ERC-20 tokens.

Infura stated that the root cause was traced to several components within its Ethereum infrastructure, which were locked to an older version of the [Geth](#) client. The postmortem sparked debates about Ethereum's decentralization and questions about overreliance on centralized blockchain infrastructure providers.

With that said, we note that Infura and Alchemy do not own or control the base blockchain data but rather act as centralized portals to that decentralized data. If Infura or Alchemy goes down, we do not lose access to the blockchain data. We could use another centralized or decentralized infrastructure provider to access that same data if needed. Or, we could set up our own full node and serve ourselves. One could draw some comparisons to an ISP — if Comcast goes down, we can switch to another ISP to access the internet.

## Discussion

Centralized and decentralized infrastructure solutions will likely have different roles in the next iterations of Web3 depending on the pros and cons involved. For example, if advanced prototyping and development tools are sought after for a certain part of a project. In that case, centralized solutions like Alchemy or Infura may be a good fit for those parts. If trustlessness and security are sought after for other parts of the project,

then decentralized solutions like The Graph or Pocket Network may be a good fit for those parts. The prospect is a new web with significant portions based on distributed, secure, and immutable blockchain databases, communicating through both centralized and decentralized infrastructures.

Next, let us examine how some decentralized blockchain infrastructures may gain traction by examining the numbers and drivers behind Pocket Network's recent surge in network activity and revenue. By maintaining virtually 100% uptime, we see how such decentralized data providers could support the growing Web3 economy.

## Case study: Pocket Network

### Network activity

To examine the Pocket's usage and growth through 2021, we first focus on average daily relays. Relays are simply application requests targeting any public database node. The chart below plots average daily relays from January through November 2021 at four-day intervals.

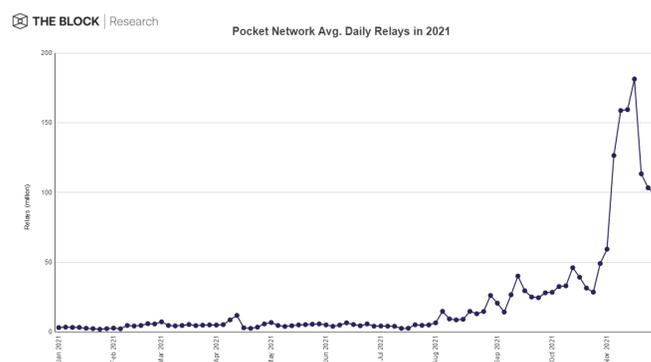


Figure 153: Pocket Network relays in 2021

Source: c0d3r.org

Pocket Network usage has seen tremendous growth this year, particularly with an explosive rise in network activity starting in October. What were the primary drivers?

First, in February, Pocket Network [announced](#) that they would start providing Ethereum infrastructure for [Fuse](#), a platform for building decentralized payment systems. As an Ethereum [sidechain](#), Fuse requires a stable and functioning Fuse-Ethereum bridge. By integrating with Pocket, Fuse can further decentralize their platform and increase user privacy while decreasing costs and inefficiencies associated with running their own Ethereum node.

Later, in August, Pocket [announced](#) support for the [xDai](#) chain, another Ethereum sidechain that supports the xDai stablecoin bridged from [Dai](#) on Ethereum. One of xDai's primary use cases is enabling fast and low-cost transactions in the MMO space-conquest game Dark Forest. Similarly, by integrating with Pocket, xDai can increase decentralization while “outsourcing” their Ethereum infrastructure demands.

Most recently, the surge in network activity starting in October came after an [announcement](#) that Pocket would be handling [Harmony RPC](#) traffic. Harmony is a Layer-1 blockchain that can act as an interoperable [Layer-2](#) scaling solution for Ethereum by utilizing random state sharding, allowing secure block confirmation at high speeds with low fees. With Harmony network surging in the range of 50 to 100 million API calls at that time, they sought a way to reroute traffic through a scalable and decentralized API. Now, developers can mint the Harmony RPC endpoints from Pocket's frontend [API portal](#) to use in their dapps. These Pocket-powered endpoints provide dapps with an additional layer of resilience, reliability, and privacy.

In the Pocket network, an application stake is the entry point to register as an application in the network. Apps lock POKT into a bond within the network to receive an allocation of throughput for relay execution via network nodes. The rules of this bond are determined by the monetary policy and protocol rules as set by the Pocket DAO.

The amount of POKT staked by apps for reserving relay requests has grown more steadily since the beginning of the year, as shown in the chart below.

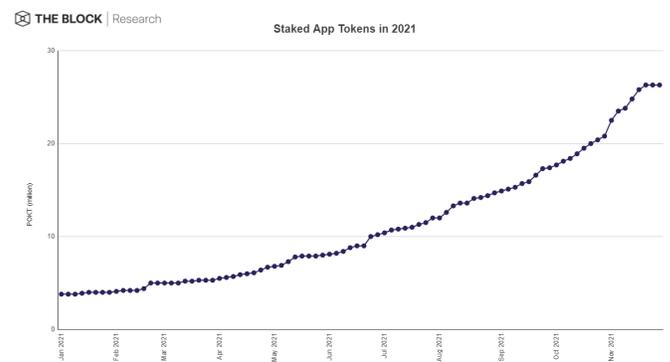


Figure 154: Staked app tokens in Pocket Network in 2021  
Source: c0d3r.org

The daily relay request reserve is equal to the number of POKT staked by apps multiplied by 40. Then, we can see that apps have “paid” (staked enough POKT) to reserve nearly a billion relays per day while using about 160M or 16% of their reserve. It should come as no surprise, however, as apps should have a reserve buffer in case of a surge in network activity. Eventually, assuming that these staked tokens exhaust the relay request reserves, these billion or so relays will be paid out as “revenue” to the relay providers, Pocket DAO, and POKT block producers. Let's now examine these revenues and rewards in more detail.

## Revenue and rewards

To translate relays to revenue, it is simply a matter of multiplying the number of relays by 0.01 (the amount of POKT minted per relay) and POKT price. The chart below shows POKT revenue by month in 2021 based on average daily relays and POKT price per month. Price data were available starting in April through November.

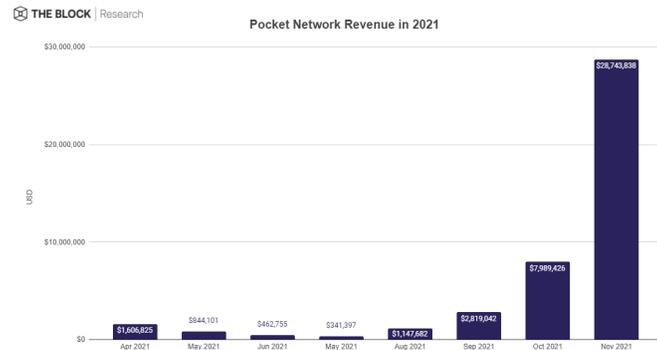


Figure 155: Pocket Network Revenue in 2021

Source: thunderheadotc.com (POKT price) & c0d3r.org (relay count)

There was some decrease in network activity back in May through July, corresponding with a decrease in overall activity on the Ethereum network and the crypto market as a whole. But, it's clear that Pocket revenue surged this quarter after setting up endpoints to connect with the Harmony network.

We can also look at how much POKT is being earned per relay node by dividing relay count by the total number of relay nodes and multiplying it by 0.89 (since 89% of the minted POKT is distributed to service nodes, 10% goes to the Pocket DAO, and 1% to the block producers). The chart below shows the average daily rewards per validator node from January 1, 2021, to November 8, 2021, separated by four-day intervals.

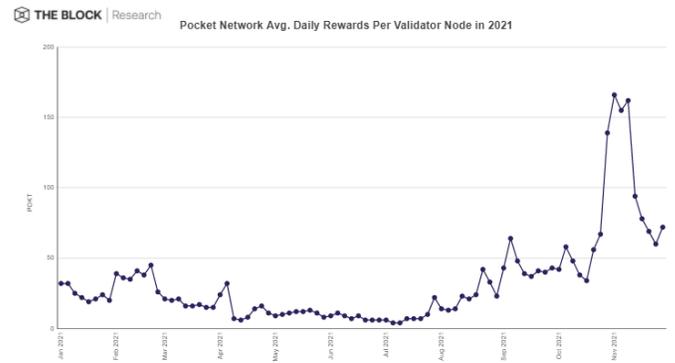


Figure 156: Average daily rewards per Pocket Network relay node in 2021

Source: c0d3r.org

At the beginning of the year, POKT nodes were earning more daily rewards as fewer nodes were in the network. The chart below shows the number of active validator nodes in the network from January 1 to November 8, separated by four-day intervals.

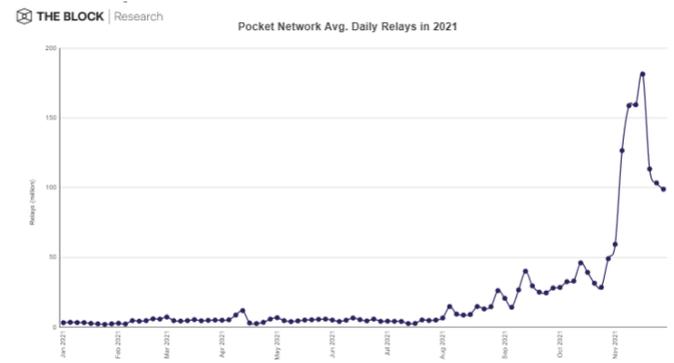


Figure 157: Active validator (relay) nodes in Pocket Network 2021

Source: c0d3r.org

So far, active validator nodes have increased more than 15-fold since the beginning of the year, from slightly over 600 nodes to over 9,000 today. This month, average daily rewards per validator node have shot up to an average of 161 POKT (~\$118 at \$0.73/POKT) per day per node, coming out to well over 300% APY in terms of POKT rewards per node in the network (assuming that each node stakes the minimum amount of 15,150 POKT).

To put this into perspective, that puts Pocket in the top five networks in terms of protocol revenue, between Compound and SushiSwap based on last month's [figures](#), with \$33.22M revenue generated by Compound and \$48.51M generated by SushiSwap.

## Discussion

There's no certainty that these rewards are sustainable in the long run. The attractive returns will likely bring in more node providers, further dividing the total validator rewards and POKT rewards paid out via supply dilution (minting 0.01 POKT per relay). Furthermore, there is the question of whether rewards paid out via supply dilution should be considered revenue in the first place. On the one hand, they do represent real demand for Pocket's service. On the other, both app and node stakes are diluted each time work is performed on the Pocket network.

At the peak rates in November, that would amount to adding ~\$412M in market cap per year. That said, the Pocket DAO could vote to cut issuance of new POKT in the near future. Also, despite these staggering numbers, the Pocket Network is still only handling a small fraction of the traffic of its centralized competitors, with over [~2.4 billion](#) Ethereum relays served by Infura alone on a record day in 2020.

Given the massive total addressable market and the success of the integration of Harmony and other protocols with Pocket, we may see more and more protocols rerouting and decentralizing their traffic with Pocket Network to either prevent or respond to [issues](#) arising from dependencies with centralized blockchain infrastructure.

Whether such decentralized infrastructures can support a flourishing Web3 economy with billions of dapp users

will depend on the resilience and ideally, antifragility, of the node and network technologies.

## The emerging Web3 economy

To conclude this section, we will look at some figures on the emerging Web3 economy to get a sense of where we are now and where we may be headed.

Although there is no single metric to track Web3's development as a whole, we can take a look at several proxy measures that track different aspects of Web3 from DeFi to NFTs to adoption of Web3 frontend applications like wallets.

Below, we plot total unique Ethereum addresses and unique Ethereum addresses interacting with DeFi protocols from January 1, 2016 to November 17, 2021.

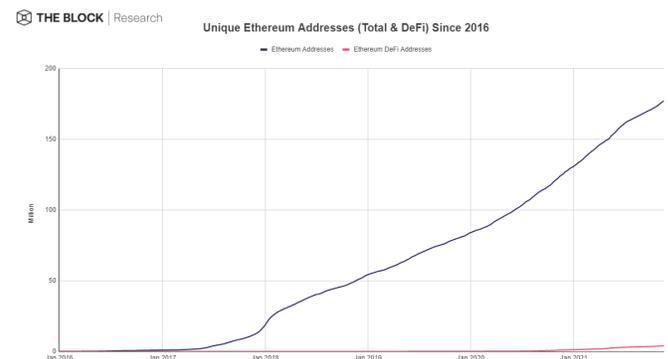


Figure 158: Unique Ethereum Addresses (Total + DeFi) 2016 - 2021  
Source: Etherscan & Dune Analytics (@rchen8)

Since around the beginning of 2018, the total number of unique Ethereum addresses has steadily increased. There has been an average of ~52% year-on-year growth in unique Ethereum addresses since the beginning of 2019 to the present.

Ethereum addresses interacting with DeFi protocols have exploded since 2019 as well, with ~700% year-on-year growth, though slightly slowing down

**Number of Unique Wallets Buy/Sell NFT in 2021**

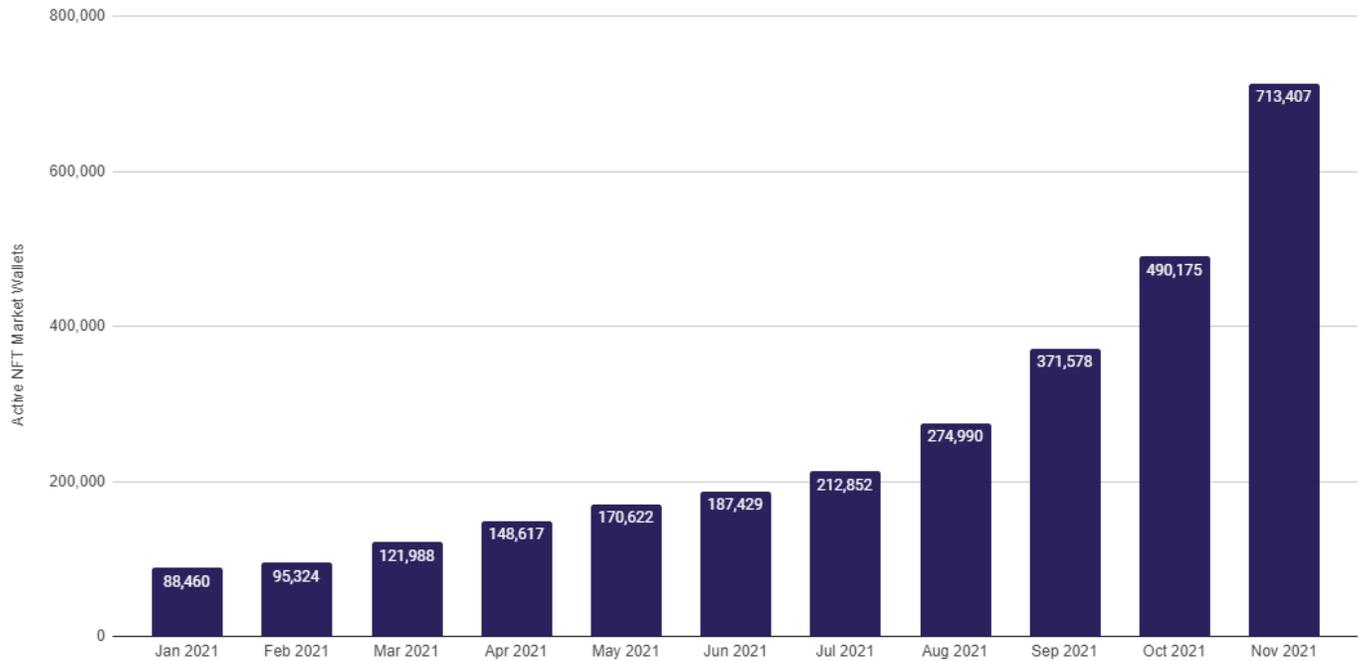


Figure 159: Active NFT Wallets (Buying & Selling) in 2021  
Source: Nonfungible.com

from ~875% year-on-year growth from 2019 to 2020 to ~500% year-on-year growth from 2020 to 2021. Currently, only ~2% of Ethereum addresses have interacted with DeFi protocols, but that is still over twofold the 0.9% figure at the beginning of 2021. There appears to still be a lot of upside potential for DeFi protocols.

Another proxy for tracking the NFT submarket of the Web3 economy is the total number of unique wallets that have bought or sold NFTs. There has been a clear month-on-month increase to varying degrees - for example, 8% growth from January to February, 28% growth from February to March, 10% growth from May to June, and 35% growth from August to September. Overall, the number of active wallets in the NFT marketplace has increased over 600% in this year alone.

We can also look at the number of monthly active MetaMask users as a proxy of activity within the Web3 economy. Below, we plot the monthly active user account provided by [Consensys](#) from the start of Q1 2020 to the end of Q3 2021.

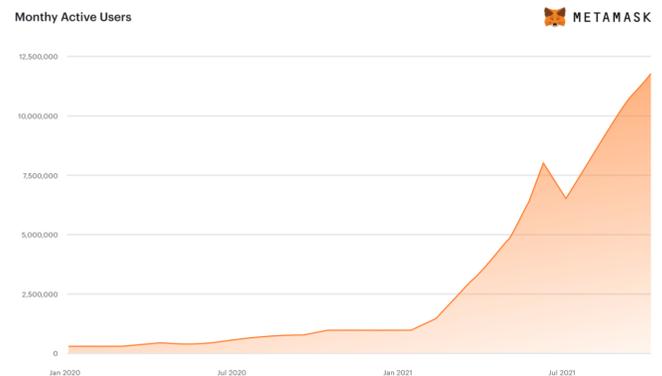


Figure 160: MetaMask MAUs, 2020-2021  
Source: MetaMask

To provide some perspective, in July 2020, Consensys reported 550 thousand active monthly MetaMask users. By August 2021, that number came out to over 10 million users, or a growth of 1,800% in about a year. A brief look at the Web3 economy in these terms does help make sense of the buzz growing behind Web3 and the surge in venture capital interest supporting projects in these spaces ranging from DeFi to NFTs to gaming and beyond. Given the upward trends over reasonably long time frames, we can start to have some confidence that Web3 is indeed starting to cement itself beside Web2 architecture. These new user experiences are made possible by decentralized, secure, and immutable databases like blockchains; new ways to streamline access to data structures utilizing token incentives, economic games, and cryptographic proofs; and a wide range of new tools for Web3 prototyping and development.

# 7

# NFTs & Blockchain-based Gaming: 2021 Overview, 2022 Outlook

Saurabh Deshpande and Thomas Bialek



# NFTs & Blockchain-based Gaming: 2021 Overview, 2022 Outlook

*Saurabh Deshpande and Thomas Bialek*

A data driven overview of the NFTs and blockchain-based games landscape, growth metrics, prominent themes, and more.

## Quick Take

- The total NFT trading volume was \$8.8 billion with Art and Collectibles contributing 59% and gaming NFTs comprising 41% of the volume
- Blockchain-based games found a product-market fit with a new business model where game developers can oversee the entire cycle of in-game assets while earning fees from secondary market transactions and introduces users to the interoperability of their assets as well as potential in-game earnings
- High gas fees forced NFT activity away from Ethereum on to other layer ones, sidechains, and layer two solutions

## 2021: The year of NFT

2021 was a good year for crypto assets, but one could argue that NFTs and NFT-based games went from zero to one this year. From Beeple's NFT selling for \$69 million to celebrities donning CryptoPunks and Bored Apes to PayPal buying a CryptoPunk to large art auction houses like Christie's and Sotheby's embracing NFTs, multitudes of events in 2021 brought NFTs into the zeitgeist. With many themes in the background, two larger themes stood out that propelled the rise of NFTs. Firstly, the market agreed that NFTs are much more than "right-click and save." It started putting a price on

authentic ownership of digital collectibles. Secondly, the gaming business model that allows players to own and freely trade their game assets enables game developers to earn a fee even from secondary market trades. This activity was otherwise a part of an opaque grey market from the developers' perspective.

## Overview of NFT markets

NFT volumes can be broadly divided into two categories - Art and Collectibles, and Gaming. Typically, Art and Collectibles NFTs are not actively used while the gaming NFTs find their utility within games. Although the whole NFT movement was triggered by art and collectibles, gaming NFTs started capturing some share in the market. The total volume traded in both the categories stands at \$8.8 billion, with 60% coming from Art and Collectibles category and the remaining 40% from gaming NFT volume as of November 30. NFT activity hit a peak in the third week of August with just over \$1 billion in traded volume. Since then, the weekly volume has reduced significantly, particularly in the Art and Collectibles category, while activity within gaming NFTs seems more robust at around \$150 million in weekly traded volume.

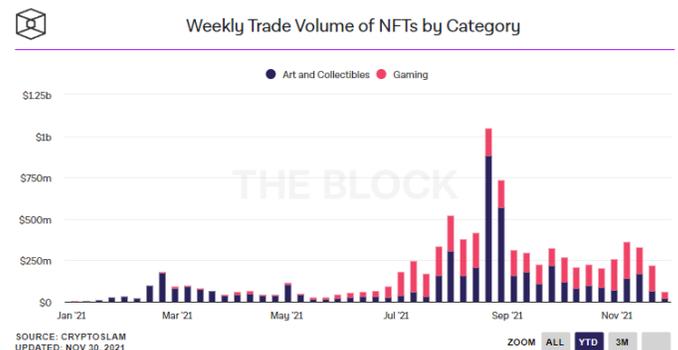


Figure 161: Weekly trade volume of NFTs by category 2020-2021  
Source: The Block Data Dashboard

The average ticket size of art and collectibles NFTs is orders of magnitude higher than that of gaming NFTs.

However, gaming NFTs have a higher velocity and make up for the price with a very high number of transactions than art and collectibles NFTs.

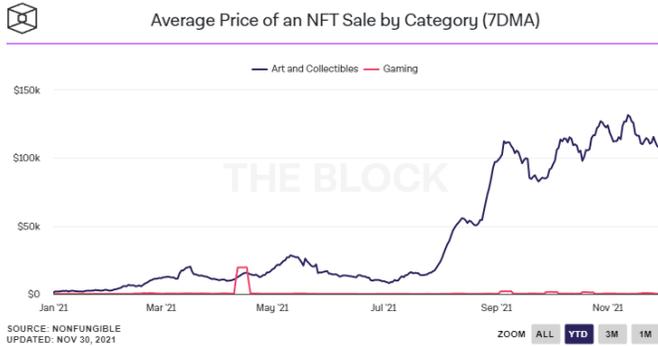


Figure 162: Average price of an NFT sale by Category (7DMA) in 2021  
Source: The Block Data Dashboard

Despite the three dominating in terms of volume, NBA TopShot leads the pack regarding the number of transactions.

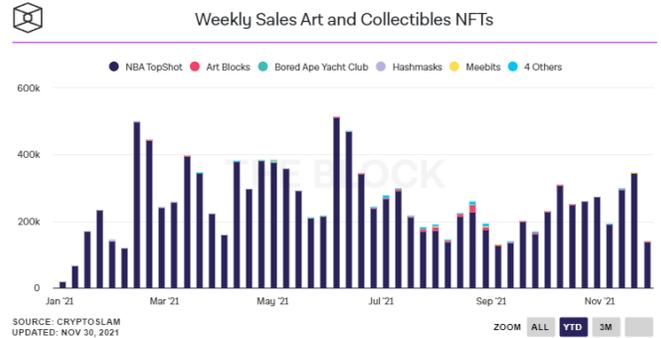


Figure 165: Weekly Art and Collectibles NFT transactions in 2021  
Source: The Block Data Dashboard

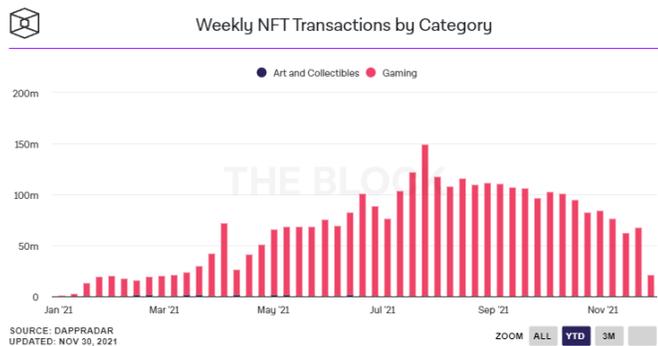


Figure 163: Weekly NFT transactions by category in 2021  
Source: The Block Data Dashboard

In the gaming sector, Axie Infinity is the leader in terms of weekly volumes. An interesting observation here is that Axie Infinity’s activity started picking up in May, after the launch of its sidechain Ronin.



Figure 166: Gaming NFT trade volume in 2021  
Source: The Block Data Dashboard

The volume is unsurprisingly dominated by Bored Ape Yacht Club, CryptoPunks, and Art Blocks within the arts and collectibles category.

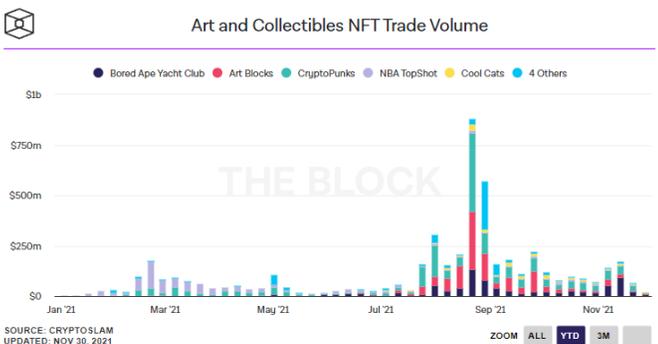


Figure 164: Art and Collectibles NFT trade volume in 2021  
Source: The Block Data Dashboard

### NFT marketplaces

The total monthly NFT marketplace volume increased 133 times from \$17.9 million in January 2021 to \$2.0 billion in November. From nonexistent in January to facilitating \$2.3 billion worth of NFT trades, the rise of OpenSea as a marketplace has been staggering.

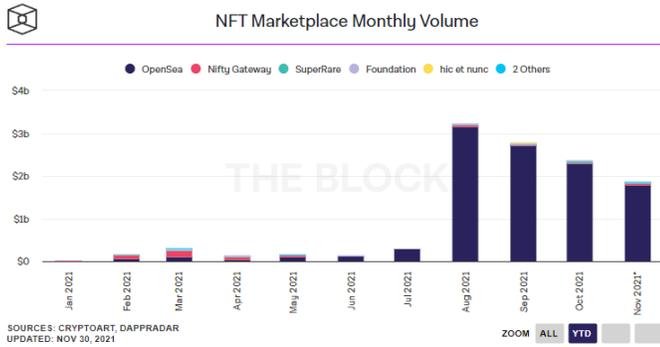


Figure 167: NFT Marketplace Monthly Volume in 2021  
Source: The Block Data Dashboard

With over 9.2 million lifetime transactions, Axie Infinity has almost twice the total secondary sales as the following best NFT collection, CryptoPunks. Ethereum remains the most dominant blockchain as far as secondary sales are considered. At \$9.3 billion, it has almost three times the secondary market sales compared to Ronin’s second best. However, it is essential to note that these are all-time comparisons, and Ethereum has had a head start ahead of sidechains or other layer ones.

The following tables show all-time sales by different collections and blockchains.

All-Time Sales by Collection					
	Collection	Secondary market sales (all time)	Total Transactions	Owners	Buyers
1	Axie Infinity	\$3,191,184,421	9,287,585	2,569,424	1,032,009
2	CryptoPunks	\$1,642,651,822	18,915	3,282	4,701
3	Art Blocks	\$1,064,698,729	115,527	24,448	20,440
4	NBA Top Shot	\$776,942,006	11,542,453	601,274	372,703
	Bored Ape				
5	Yacht Club	\$736,359,390	22,390	5,825	8,171
	Mutant Ape				
6	Yacht Club	\$388,284,409	16,449	10,092	9,806
7	Loot	\$263,921,331	9,950	2,559	3,557
8	Meebits	\$234,485,283	13,433	5,344	5,042
9	Cool Cats	\$182,236,851	22,893	5,003	7,885
10	CrypToadz	\$166,611,520	14,855	3,507	6,184
11	Parallel Alpha	\$160,132,233	65,382	29,400	10,713
12	MekaVerse	\$156,244,117	9,175	5,101	4,600
13	0N1 Force	\$146,695,086	15,897	4,232	6,866
	Pudgy				
14	Penguins	\$134,972,881	26,544	4,739	9,860
15	PUNKS Comic	\$128,333,183	8,685	3,097	3,328

Figure 168: All-time NFT sales by collection  
Source: CryptoSlam, Dune Analytics (@smaroo)

All-Time Sales by Blockchain					
	Blockchain	Secondary market sales (all time)	Total Transactions	Sellers	Buyers
1	Ethereum	\$9,280,212,692	3,960,890	239,220	407,965
2	Ronin	\$3,191,184,421	9,287,585	669,589	1,032,916
3	Flow	\$780,036,779	11,574,382	366,370	374,995
4	Solana	\$710,165,390	514,567	103,387	98,171
5	WAX	\$278,307,252	10,371,342	889,012	460,645
6	Polygon	\$132,656,789	201,443	29,903	50,772
7	Panini	\$18,842,943	204,310	13,148	7,022
8	Theta	\$14,555,271	3,935	537	451
9	BSC	\$5,075,289	19,953	1,856	2,029
10	Zilliqa	\$15,534	7	7	3

Figure 169: All-time NFT sales by blockchain  
Source: Cryptoslam

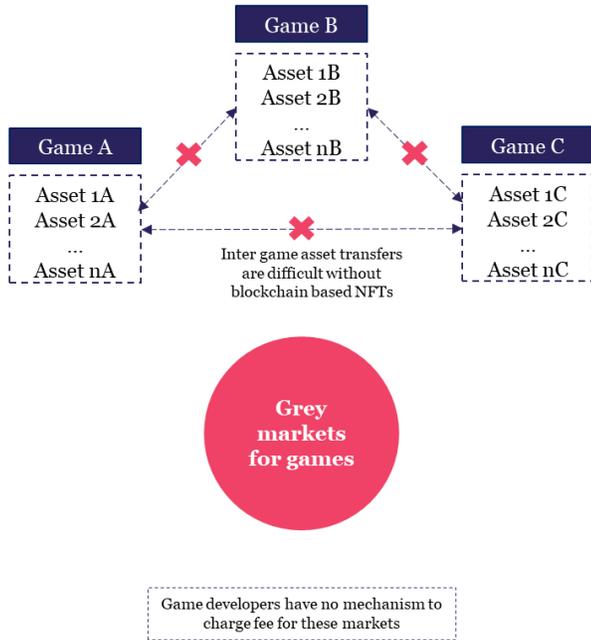
## NFT and Blockchain Gaming Themes of 2021

### The gaming business model saw a major shift in 2021

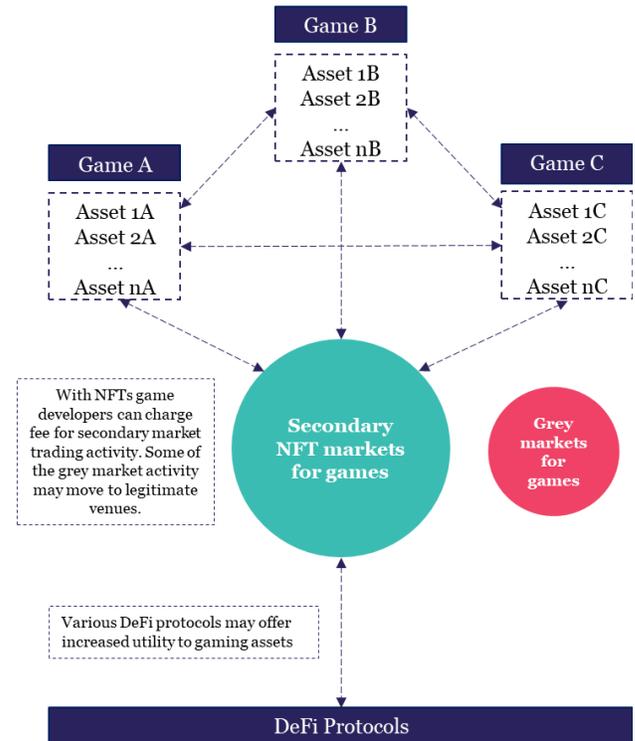
NFTs allowed digital assets to get seamlessly integrated into games and allowed players to own their game assets truly. On the one hand, it lets players earn from playing the game, and on the other hand, it also empowers game developers to track secondary market trades of game assets and earn fees. Essentially, the grey market activity opaque to game developers is now replaced by transparent trade, which enhances developers’ ability to monetize the game. As players are confident of their possession, their willingness to spend upfront has increased. We did a deep dive on the implications of NFTs in games, the state of blockchain based games, and the metaverse in our report [Blockchain-Based Gaming - A Primer](#).

Blockchain is facilitating formal secondary markets for gaming

Inability to take assets out of games has historically resulted in grey markets for in-game items...



... but NFTs and digital assets are bringing grey market activity into formal secondary markets



Source – The Block Research

Figure 170: Difference between gaming business models with and without blockchains / NFTs

Source: The Block Research

Multiple games employ different tokenomics to determine which stakeholder captures value at what point in the game’s lifecycle. Striking a balance between immersive gaming experience and incentivizing participation is a vital consideration for game developers. While the overall blockchain gaming market is nascent and in its experimental phase, the following graphic provides moving parts of the gaming ecosystem today.

General model for Blockchain Gaming Economics

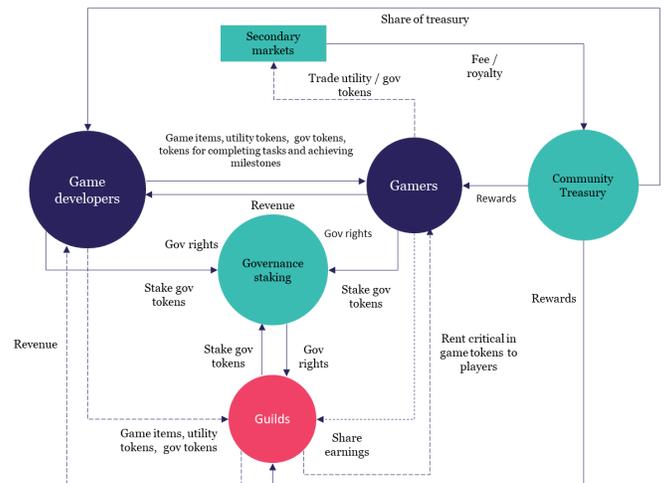


Figure 171: General model for blockchain gaming economics

Source: The Block Research

## The rise of gaming guilds

The ability to earn from games has opened new business models, and gaming guilds are one. Guilds support players from onboarding to lending necessary in-game assets and take some share of players’ game earnings in return. The majority of the guilds are structured as DAOs (Decentralized Autonomous Organizations). One of the reasons guilds are an essential part of the gaming ecosystem is that as the popularity of the game increases, in-game assets necessary for playing the game get more expensive. For example, a player needs three Axies to play Axie Infinity, and the total cost of acquiring them is approximately \$360, which is 3 times [the price of the most expensive game \(\\$119\)](#) on Steam, a major digital gaming service platform. This makes the entry barrier too high for many players. In such cases, guilds buy and breed Axies and rent them to players. And take around 20-30% of the player earnings in return. Some of the prominent guilds in the ecosystem are Yield Guild Games, Merit Circle, Avocado Guild, AAG Ventures, and Blackpool.

## Fundraising activity in the gaming industry has increased exponentially

2021 has been a remarkable year for NFT and Blockchain related fundraises, to say the least. The sector has witnessed nearly \$28 billion in fundraises. And this does not include IDOs from games. The following table shows the top 10 fundraises of the year by companies in the space.

Date	Company	Category	Funding (\$MM)	Valuation (\$MM)	Select Investors
11/12/2021	Forte	Infrastructure	\$725	Undisclosed	Sea Capital, Kora Management, Andreessen Horowitz (a16z), Tiger Global, Solana Ventures
09/22/2021	Dapper Labs	Game Studio, Infrastructure	\$250	\$7,600	Andreessen Horowitz, GV, Version One Ventures, GIC, BOND
05/20/2021	Forte	Infrastructure	\$185	\$1,000	Griffin Gaming Partners, Union Grove Venture Partners, Andreessen Horowitz, Battery Ventures, Canaan
09/21/2021	Sorare	Game Studio	\$680	\$4,300	SoftBank, Atomico, Bessemer Ventures, D1 Capital, Eurazeo, IVP, Liontree
10/06/2021	Sky Mavis	Game Studio	\$152	-\$3,000	Andreessen Horowitz, Paradigm, Accel, FTX, Seven Seven Six, Samsung Next, Fabric Ventures, Standard Crypto, Rainfall, Cultur3 Capital
11/04/2021	Mythical Games	Game Studio	\$150	\$1,250	Andreessen Horowitz, Sequoia Capital, Jump Capital, Solana Ecosystem Fund, Lightspeed Venture Partners, FTX, Pantera Capital
10/21/2021	Candy Digital	eSports/Sports/B	\$100	\$1,500	Insight Partners, SoftBank, Animoca Brands, Connect Ventures, Will Ventures, Gaingels, Com2Us
11/02/2021	The Sandbox	VR/Metaverse	\$93	Undisclosed	Sino Global, GSR, Skyvision Capital, Alameda Research, CMS Holdings, Ok Ventures, Chain Flow Capital
05/13/2021	Animoca Brands	Game Studio	\$89	\$2,200	Liberty City Ventures, Ubisoft Entertainment, Sequoia China, Dragonfly Capital, Com2Us
06/09/2021	Mythical Games	Game Studio	\$75	Undisclosed	Billibili, Gary Vaynerchuk, Moore Capital Management, Proof, RedBird Capital Partners

Figure 172: Funds raised by companies in blockchain gaming sector  
Source: The Block, Pitchbook, Crunchbase

Besides companies building in the space, some of the crypto native projects have raised funds through three different methods - Venture Capital, ICO/IEO (Initial Exchange Offerings — where new projects use existing exchanges as distribution platforms for token sales), and NFT sales. The following table shows funds raised by leading gaming projects in the space.

Project	Chain	Funds raised via VC Rounds (\$ MM)	Funds raised via IDO/IEO/ICO (\$ MM)	Funds raised via NFT sales (\$ MM)	Game Status
Gods Unchained	Ethereum + ImmutableX	N/A	\$10M	N/A	Live
Guild of Guardians	Ethereum + ImmutableX	3	\$5.5	\$17	To be launched
Illuvium	Ethereum	5	\$38	N/A	To be launched
Parallel	Ethereum	50	N/A	\$7	To be launched
Aurory	Solana	3.7	\$109	~\$1.2	To be launched
Blancos block party	EOSIO	N/A	N/A	\$1	Live (Early Access)
Ember Sword	Polygon + ImmutableX	2.7	N/A	\$204	To be launched
Axie Infinity	Ethereum + Ronin	9	\$3	0.8	Live
Star Atlas	Solana	1.1	\$2	\$21	To be launched

Source - The Block, Project comms

Figure 173: Funds raised by companies in blockchain gaming sector  
Source: The Block, Pitchbook, Crunchbase

## Higher gas prices encouraged the development and usage of Ethereum sidechains and other blockchains

Gas prices on Ethereum have been high ever since the rise of DeFi on Ethereum in the summer of 2020. NFT

activity on top of ongoing DeFi rendered the base layer of Ethereum unusable for smaller market participants. We saw developers take different approaches to help scale NFTs beyond the Ethereum base layer.

Concerning NFTs’ traction, we encountered an interesting dichotomy between the public’s interest and actual usage. More precisely, Google searches for “NFT” and “OpenSea”, which are generally good proxies for understanding interest in NFTs, have been on a steep upward trajectory ever since July and even reached all-time highs in September and November, respectively.

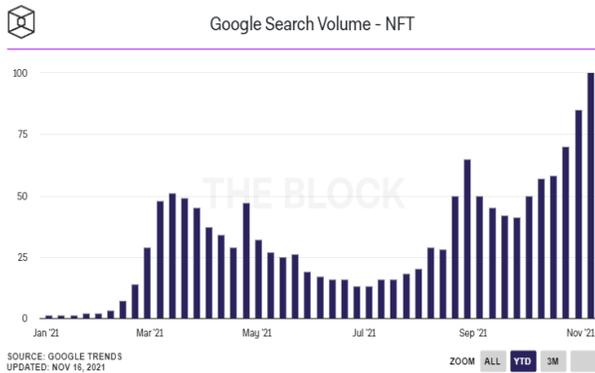


Figure 174: Google search - NFT in 2021  
Source: The Block Data Dashboard

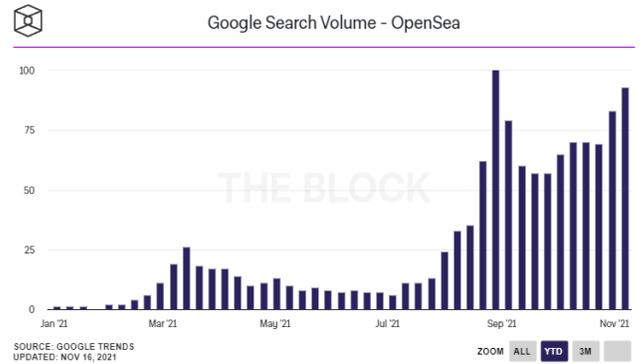


Figure 175: Google Search - OpenSea in 2021  
Source: The Block Data Dashboard

Contrary to this trend, aggregate NFT marketplace volumes have been on a distinct decline since August, which strikes as counterintuitive at first glance.

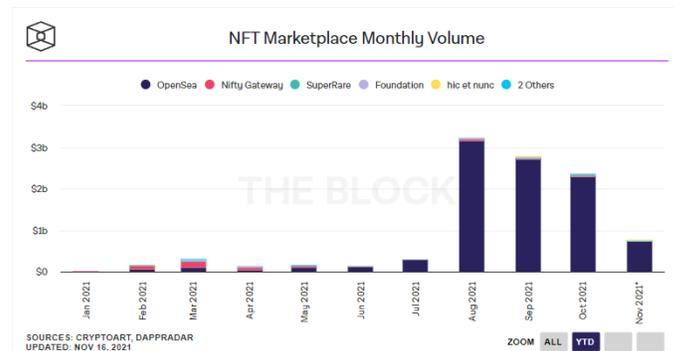


Figure 176: NFT Marketplace Monthly Volume  
Source: The Block Data Dashboard

Digging deeper, though, this comes against the backdrop of skyrocketing gas fees on Ethereum as well as surging prices of the underlying assets, such as ETH or SOL. This trend occurred during the same time period that NFT marketplace volumes faded significantly.

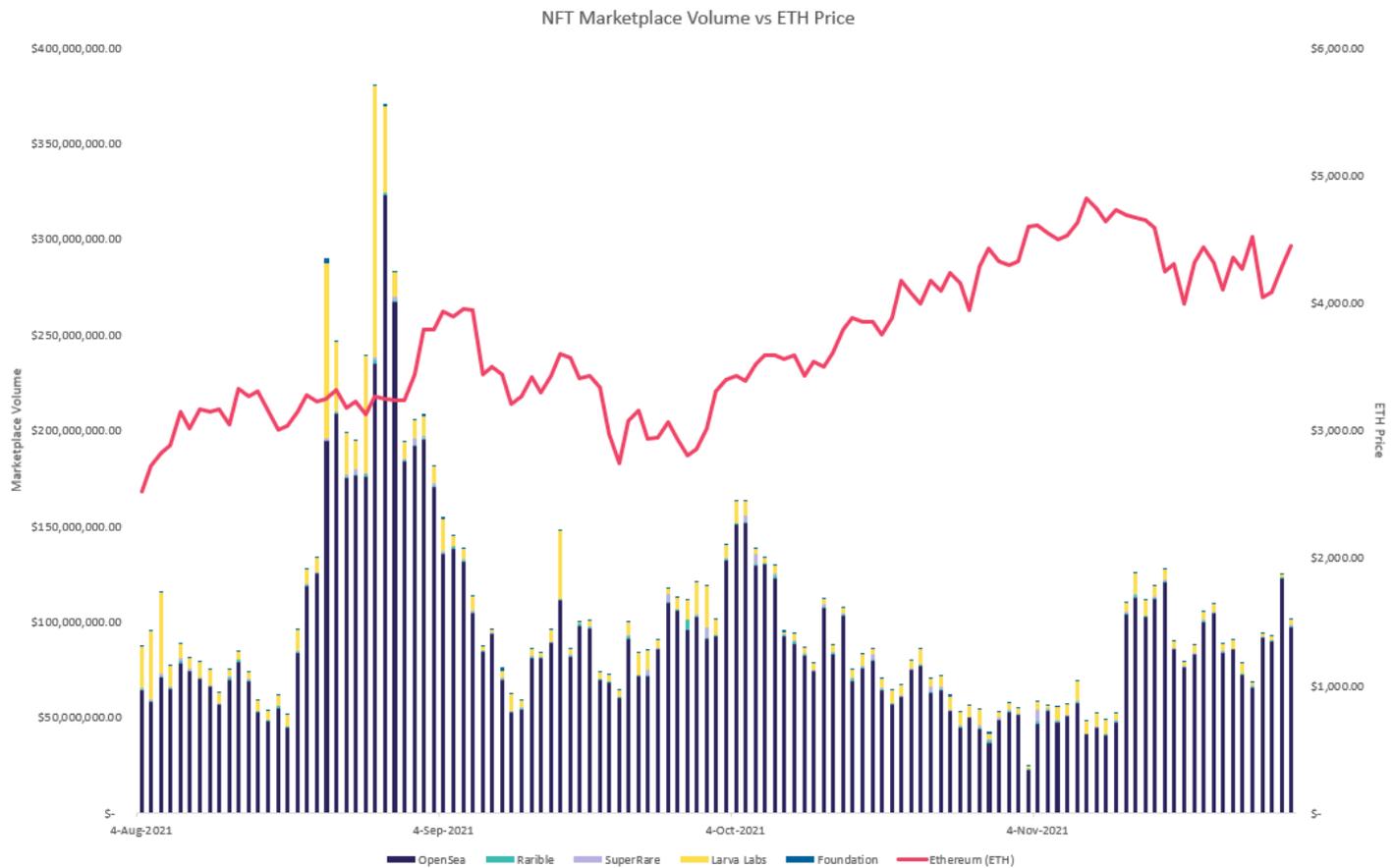


Figure 177: NFT Marketplace Volume vs. ETH Price  
 Source: CoinGecko, Dune Analytics (@hildobby)

Therefore, it stands to reason that two of the main drivers for this diverging trend have been the surging investment and transaction costs, which rendered most individuals, who still primarily denominate their net worth in USD, unable to join in and participate in the NFT market across chains. This once again emphasizes the increasingly critical need for L2 scaling solutions (see our [layer-2 platforms section](#) in this report).

creator of Axie Infinity, launched the sidechain Ronin in April 2021. Ronin had a staggering impact on the growth of Axie Infinity. The total daily active users (DAUs) increased over 16 times in less than four months to cross 1 million DAUs on August 9. In April 2021, Immutable, the company behind Gods Unchained, launched the first Ethereum Layer-2 scaling solution tailored for NFTs, Immutable X.

CryptoKitties creators, Dapper Labs have launched Flow, a new blockchain for NFTs and games. Sky Mavis,

Trading Volumes and Userbases Across Main NFT Marketplaces			
Marketplace	Blockchain	Trading Volume (30D)	Average Weekly Users
OpenSea	Ethereum	\$1.5B	69,500
Rarible	Ethereum	\$15M	9,784
SuperRare	Ethereum	\$18M	1,374
Foundation	Ethereum	\$45.0M	4,090
Hic Et Nunc	Tezos	\$5.0M	17,008
Objkt	Tezos	\$11.3M	2,194
Solanart	Solana	\$75.1M	54,674
Magic Eden	Solana	\$143.1M	71,626
SolSea	Solana	\$3.6M	5,326
Digital Eyes	Solana	\$5.6M	9,639

Source: DappRadar

Figure 178: Trading Volumes and User base Across NFT Marketplaces

Source: DappRadar

A recent event showed plainly that the nascent NFT market still largely resembles the uncharted territory. After having a dispute with another community member, Hic Et Nunc's (HEN) lead developer decided to shut down the website on an alleged whim. This was possible because he was the only community member who owned the key to the project's Github. Once again, this incident stresses the importance of true decentralization. The HEN community decided to build a new community-led Hic Et Nunc in response to this turn of events.

## Metaverse is coming

From Microsoft to Facebook, almost all the tech companies are talking about their visions of the metaverse. The term metaverse dates back to Neal Stephenson's 1992 novel, *Snow Crash*, in which he refers to the metaverse as a persistent virtual world. The idea is that the metaverse is a real-time 3D social medium where people collaborate and participate in an economy.

Although there is no agreed-upon definition yet, there are overlaps among different ideas. One of the common aspects is about how the metaverse will also be integral to digital economies. And if this is the case, asserting ownership, proving digital scarcities will be vital attributes of the metaverse. Imagining a metaverse without blockchains and NFTs is difficult as they already have the characteristics of the metaverse.

## New primitives for games are being experimented

Amidst the speculation of the NFT frenzy, experimentation with unorthodox modalities flourished as well, resulting in the birth of new primitives. Standing testament to the out-of-the-box thinking of such experiments, Loot came to the fore as a prime example for the still untapped long-term potential of NFTs. Loot is randomized adventurer gear generated and stored on-chain. Instead of relying on the conventional top-down approach, i.e., project developers creating the NFT including the front end and embedding it in a context (collections, crypto games, etc.) that minters can then access, Loot pioneered a bottom-up approach. According to this approach, collectors would only mint the base layer of the NFT so that the community could then collectively construct the context and front end around it. To provide an example, shortly after Loot's launch, the community launched a token, Adventure Gold (AGLD), to use as an in-game currency and governance substrate.

In sum, Loot represents a composable "DNA" that can be plugged into different games, where the corresponding visual representation of the adventurer's gear and additional features manifest based on the "DNA" code of the given Loot bag. In this sense, you

peel off the layers of imposed preconception, as would be the case with, say, avatar NFTs for a specific pre-built crypto game, and hand the design freedom back to the community. Given the project's novelty and creator, Dom Hofmann, co-founder of Vine, an old viral 6-second video social app, a Loot frenzy ensued and drove up Loot's floor price to \$53,000 on September 3 before settling around the \$15,000 mark.



Figure 179: Loot Floor

Source: CoinGecko, Dune Analytics (@rantum)

It quickly became apparent that paying a minimum of \$15,000 for entry tickets into Loot-based games was not feasible for most individuals, outside of a few crypto whales, to enter the ecosystem and potentially stymied the ecosystem's proliferation. As a counter, several extensions, such as Synthetic Loot, were created, which grants access to the Loot ecosystem via "synthetic" NFTs without any costs. In this way, the Loot ecosystem could embark on a more sustainable trajectory. Overall, this grassroots movement illustrates a community's potential when given a composable blank canvas to build upon.

### **NFT launches were primarily first-come, first-serve, which ended up being gas wars and left the average user devoid of successful mints**

When Larva Labs launched CryptoPunks in 2017, they were free, and gas was cheap on Ethereum, [averaging](#)

[at \\$5.70](#). And yet, it took a few days for CryptoPunks to be snapped. These days, almost all anticipated NFT launches are riddled with bot activity and fully minted within a few blocks despite exorbitant gas fees rendering the average Ethereum user powerless. Projects like Parallel are trying to find ways to launch NFTs fairly by trying to eliminate gas wars as they allow buyers to complete the transaction within 24 hours of the purchase. In our research piece [A look at current NFT launches](#), we identified that a fair NFT launch should be time agnostic, immutable, and trustless.

## 2022 NFT and Blockchain Gaming Outlook

### **Crypto games' current value proposition rests on the unsound footing**

With interest rates almost everywhere in the developed world at all-time lows, the cost of capital is low as well. With many investors flush with cash, nearly every gaming project is closing seed rounds at valuations of their choice. Although the IDO amounts are in the range of \$1 - \$3 million, projects have been raising capital using other avenues like selling in-game NFTs upfront. In the play-to-earn model, when players are credited with earnings, someone must be getting debited. It can either be market participants with a positive outlook on the game's prospects or protocol token inflation. Other than market participants or protocol token inflation, advertisers can subsidize players as a meaningful way to interact with their end consumers. Although we have not seen this in full force, FTX sponsoring some of the Yield Guild players was an example of companies targeting players in NFT games. Designing simple and effective game loops is going to be crucial. When the market takes a turn for the worse, and there isn't too

much money floating around, it would be difficult for games to keep attracting new players. Therefore, apart from the ‘earn’ aspect, games should have other characteristics that attract players.

Proponents of the play-to-earn model, despite some of P2E games having a monotonous gameplay, often suggest that these games need to be a little more interesting than traditional mundane jobs. This argument misses the point that although this job is mundane, it adds value to others. For example, commuters pay cab drivers because drivers facilitate their commute. If others don’t derive value from someone playing a game, it is difficult to believe someone will perpetually fund players.

### **Overabundant funding hints at a close resemblance to the ICO mania of 2017**

The gaming and NFT funding landscape, albeit, mirrors the ICOs of 2017. Unity packs<sup>2</sup> used to build games are the equivalent of whitepapers. However, a small minority of games will genuinely bring added value to their players by using censorship-resistant blockchains.

The story is the same with NFTs as profile pictures (pfp). Many projects across different chains have launched finite (typically, 10,000 or 8,888) NFTs to induce scarcity. However, scarcity alone does not make things valuable; it needs to be coupled with demand to be valuable. Not every pfp can be a CryptoPunk, just as not every proof of work coin can be bitcoin. Beyond technical capabilities, there is social consensus that lends CryptoPunks and bitcoin value. CryptoPunks and Bored Apes are valuable because they were the

<sup>2</sup> Unity is a game engine that also develops plug and play gaming modules. A lot of blockchain based games use default Unity packs to raise money via NFT sales.

originals; they started the movement. There is little reason for the n<sup>th</sup> derivative of Apes to have any value.

**Beauty lies in the eyes of the beholder.** This couldn’t be more true for NFTs. Evaluating the value of an NFT project is much more subjective than DeFi or infrastructure projects, such as a project’s story, its artist, and whether the NFT brings material utility in the future. When there are so many intangibles to account for, and the value is not obvious, people perhaps turn to public figures or influencers for value signaling. The first-mover NFT projects, like Cryptopunks, didn’t have to fight for their place in the NFT space and had organic emergence mainly due to their historical significance. On the contrary, newer projects have to fight for the prospective buyer’s mind share. With the market being flushed with the abundance of so many pfp projects, influencers have achieved the kingmaker status.

### **Mass adoption of NFTs will most likely be driven by multi-chain scaling solutions**

It wouldn’t be too much to say that interacting with NFTs on Ethereum’s base layer is for the wealthy. And if the aim is to facilitate the broad adoption of web 3, facilitating cheaper transactions on decentralized networks like Ethereum is crucial. As mentioned in [our Layer-2 section](#), the second half of 2021 saw layer-2 scaling solutions such as Optimism, Arbitrum, and ImmutableX launch on top of Ethereum. However, many users have already ported over to other chains like Solana, Avalanche, Binance Smart Chain, Fantom, and Harmony. One of the reasons for the adoption of other layer-1 platforms is that they were ready to onboard projects and users before the Ethereum layer-2 infrastructure could be available for users. Base layers like Solana, Avalanche, Fantom, Algorand, and Harmony launched massive incentive campaigns for

projects to build or port on top. Additionally, as highlighted in [our layer-1 section](#), the cross-chain bridge expedited the adoption of NFTs between layer-1 networks. For instance, AnySwap's protocol recently announced support for NFT bridging between Ethereum and Fantom, as well as the Wormhole V2 bridge between Ethereum and Solana.

User experience journey on Ethereum layer-2 scaling solutions like Optimism and Arbitrum is not the same as other layer-1 networks primarily because it involves an additional step and costs as users must incur to bridge funds to layer-2 from Ethereum's base layer. As of November 30, there are a limited number of bridges to those layer-2 solutions outside of Ethereum. This means users who wish to use either Arbitrum or Optimism must first deposit funds from centralized exchanges to Ethereum and then transfer them to the layer-2 platforms via bridges like Hop Exchange or Celer. As a result, users are subjected to multiple transaction fees as well as exorbitant gas costs. Whereas the majority of centralized exchanges currently provide direct withdrawals to other Layer-1 networks, significantly lowering transaction fees and eliminating the need for interacting with Ethereum.

Although other blockchains have gained some ground on Ethereum, multiple catalysts could propel Ethereum forward. For instance, Immutable X, a layer-2 solution specifically for NFTs and games went live in April 2021 and OpenSea will support trading NFTs directly on Immutable X. Ember Sword, a popular MMORPG game, recently moved from Polygon to Immutable. In 2022, we may see centralized exchanges facilitate direct withdrawals to Ethereum's layer-2 solutions. All the developments related to scaling solutions mean that Ethereum is likely to remain the first step in onboarding users to NFTs and web 3.0.

As indicated in our research piece [Deciphering the Metaverse #1 - The Rise of the Multi-Chain NFT Market](#), we can see that NFT activity has spread beyond Ethereum already. And if NFTs continue to flourish on other chains, solutions that allow interoperability will be crucial.

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## Metaverse is coming, albeit slowly

After Facebook's rebrand to Meta on 28 October 2021, the metaverse discussions are already mainstream. But is metaverse here? In some form, it is already here. Social media platforms, AR (Augmented Reality) games and applications, VR (Virtual Reality) devices like Oculus are all enablers of the metaverse. Footfalls of digital gatherings speak for the general interest among people to interact and transact digitally.

However, today's solutions are centralized and do not lend much power to the user. With NFTs and blockchains letting users truly own their digital assets, it is likely that users will transact more freely within the digital universe and thrive in the crypto economy. Today, every blockchain has its ecosystem of sidechains, layer-2 solutions, decentralized exchanges, etc. Blockchains usually have bridges to other chains, but the experience of transferring assets from one blockchain to another is far from seamless. It will be interesting to see whether more generalized protocols like Cosmos' Inter Blockchain Communication (IBC) or Polkadot alleviate today's frictions and make cross-chain transactions seamless.

Although NFTs and digital assets, in general, can help realize some aspects of the metaverse, we may have to wait for some time before experiencing a full-fledged metaverse.

## **The next step in the evolution of NFT launches is to unlock fair launches**

Projects like Parallel Alpha are experimenting with new mechanisms to launch NFTs. One of their first attempts was to allow paying gas within a 24-hour window to avoid gas wars. They have also integrated with Chainlink Verifiable Random Function (VRF), allowing contracts to access randomness without compromising the functionality or security. This will help in letting all the users have equal access to rare NFTs.

The current infrastructure may support ways to launch NFTs fairly, but doing so may make the launches more complicated, in the form of extra steps like completing a transaction within 24 hours of securing a purchase, and driving non-tech-savvy participants away. As a result, it may not be beneficial for the NFT project team who wish to clear their NFT sales as soon as possible. Therefore, as long as new anticipated NFT launches are being snapped within a few blocks, it is unlikely that fair launches will be widely implemented on priority.

# Appendix: Timeline of events related to NFTs and gaming in 2021

## TIMELINE OF EVENTS RELATED TO NFTs AND GAMING IN 2021



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# 8 Macro Perspectives: 2021 Overview

George Calle, Carlos Guzman, and Abraham Eid



# Macro Perspectives: 2021 Overview

*George Calle, Carlos Guzman, Abraham Eid*

The digital asset sector sustained its bull cycle into 2021, supported by a number of external macro economic catalysts, along with mainstream and institutional involvement targeting different parts of the industry.

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## Recapping Key Developments in 2021

This section contains four timelines, broken down in the following way:

- Public Sector Activity:** Key decision makers, specifically central banks and local and national leaders, are continuing to adopt digital assets, though approaches differ. While Central Bank Digital Currencies (CBDCs) efforts are now in experimentation following their 2020 hype cycle, in 2021 we also see an emergence of local and national governments embracing cryptocurrencies.
- Institutional Adoption:** Financial institutions and corporates are becoming far more active in crypto. In 2021, banks have significantly enhanced crypto custody capabilities while staffing up trading desks. Investors now have increased access to structured products like futures ETFs, though efforts to offer spot ETFs continue to be rebuffed in the United States. Additionally, it has become far more prevalent in 2021 for companies to accept bitcoin and other cryptocurrencies as payment and hold bitcoin on their balance sheets.

- Evolving Regulation:** Regulators have been very active this year, with some countries banning bitcoin, macro-prudential regulators increasing focus on stablecoins, and regional financial regulators beginning to examine crypto-business with greater scrutiny.
- Mainstream Metaverse:** NFTs and blockchain enabled metaverses have brought a new wave of mainstream adoption and attention to the digital assets sector this year in a way not seen in previous cycles. Key highlights are auction houses selling NFTs and more broadly engaging with crypto-assets, along with large brands leveraging NFTs to appeal to new audiences. Finally, large corporations around the world are embracing the metaverse via announcements and investments.

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## Public Sector Activity

### CBDCs slowly progress with China leading the way

Following a proliferation of research papers and pilot announcements, 2020 became the year CBDCs transformed from a niche idea discussed by economists and blockchain enthusiasts towards a potential reality across small and large nations and currency zones. In 2021, conversations increased in key policy and regulatory circles, however progress seems years away in most advanced currency zones.

The Bank for International Settlements (BIS) cemented its role as the leading authority and enabler of international CBDC experimentation in 2021. In June, The BIS Innovation Hub launched centers in the Nordics and London, expanding the program to five regions. Additionally, key cross-border CBDC projects

overseen by the BIS, such as the [mCBDC Bridge](#) and [Project Dunbar](#), released findings.

2021 has not brought much clarity on the question of a potential US Dollar CBDC. In a March statement, Fed Chairman Jerome Powell reasoned that given the international importance of the dollar, the Fed maintains a significant advantage regardless of when it decides to issue CBDC. This, however, does not imply that the Fed is ignoring the issue. The Boston Fed, which houses a payments team, has been researching CBDCs for the past year and is expected to release a discussion paper by the end of 2021. Additionally, CBDC has begun to be discussed by U.S. legislators.

In Europe, European Central Bank (ECB) President, Christine Lagarde, opened the year by commenting that the Eurosystem could have a CBDC, but that it may take four years. The ECB has since launched their digital euro project.

Meanwhile, China has marched along quickly with trials of its digital currency, the Digital Yuan, separating itself from other large nations. After beginning initial experiments in 2020, the People's Bank of China (PBOC) increased provinces trialing out the new platform for domestic use in April. Additionally, that same month, the PBOC joined the BIS's Multiple CBDC (mCBDC) Bridge, which tested cross-currency transfers across China, Singapore, Hong Kong and Thailand.

Finally, CBDCs began to see implementation and deep experimentation in smaller economies, as Kazakhstan announced the "digital tenge" in April, Tajikistan started working on a CBDC in September, and Nigeria launched the "eNaira" in October.

## El Salvador doubles down on Bitcoin

Shortly after announcing a new legislative proposal to make bitcoin legal tender via a video presented to the Miami Bitcoin conference, El Salvador President Nayib Bukele signed the bill into law on June 9. While Bukele cited low rates of financial inclusion as a driver for his decision, the World Bank rejected El Salvador's request to implement bitcoin as legal tender and the International Monetary Authority went out of its way to comment that the move raises 'macroeconomic, financial and legal issues.'

On September 7, El Salvador launched the Chivo wallet the same day that the law went into effect. While users were expected to receive an airdrop worth \$30 of bitcoin, launch day presented technical difficulties, specifically regarding the transfer of money. Shortly after, citizens took to the street to protest, with some citing frustration with the limitations of the app and others overall disagreement with the policy. In the past few months, however, large banks and merchants within El Salvador have increased acceptance and credit functionalities leveraging the Chivo wallet. Additionally, Chivo wallet ATMs have proliferated in certain US cities with the intent of facilitating remittance payments between the United States and El Salvador.

Meanwhile, El Salvador has continued buying bitcoin, with Bukele often announcing purchases on Twitter. Additionally, El Salvador began trialling methods for mining bitcoin, harnessing energy released from volcanoes in October 2021.

## The first city coins reach Miami and soon New York

In 2021, embracing crypto became a strategic move utilized by newly elected Mayors in Miami and New York City. In August, Mayor Francis Suarez announced “MiamiCoin”, a cryptocurrency created by a startup, CityCoins. Residents hold and trade the cryptocurrency, which represents stake in a municipality. Those running the software earn a percentage of the coins they mint, with users receiving 70% and 30% returning to the municipality. As of writing, the city had earned \$21 million from the cryptocurrency. Meanwhile, Mayor Suarez has been extremely vocal about making it easier for crypto businesses in Miami, while hinting at the idea that revenue from the initiative could enable the city to reduce or altogether eliminate taxes.

Shortly after Eric Adams’ election in November, the mayor-elect committed to examining “*what’s preventing the growth of Bitcoin and cryptocurrency*” in New York as part of a larger push to become a more business-friendly city. In the same interview, Adams highlighted Suarez’s actions in Miami, and then a week later, shortly after the mayor took office, CityCoins announced that NYCCoin would be the next token to launch, with mining slated to begin later in November. In the meantime, Adams has increased positive remarks towards cryptocurrency, including committing to taking his first three paychecks in bitcoin.



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## Institutional Adoption

### Companies rush to add bitcoin to their balance sheets in H1 2021

After bitcoin reached record highs in the last weeks of 2020, an array of companies began allocating to kick off the new year of 2021. Nasdaq-listed Marathon Patent Group started the year off with a splash, buying \$150 million worth of bitcoin as part of the company's treasury reserves in January. Shortly after, famous investor Ray Dalio published a detailed position on bitcoin. Elon Musk stole the show a day later though, drawing eyeballs from across the financial community when adding #bitcoin to his twitter profile. Musk and his electric car company, Tesla, proceeded to have a rollercoaster relationship with cryptocurrency throughout the year. To quickly recap events, in February, Tesla added bitcoin to its balance sheet and in March began accepting bitcoin as payment. However, in May, Tesla reversed its decision to accept the cryptocurrency as payments due to energy usage concerns shortly after Musk's much anticipated Saturday Night Live appearance, all of which occurred as cryptocurrencies entered a five-month downturn from May through September.

Tesla aside, the first half of 2021 saw many companies make initial bitcoin purchases. Arguably, there is no company that embodies this movement more than Michael Saylor's Microstrategy. Microstrategy, a 30 year old data software firm, first purchased bitcoin in August 2020, though it has added significant amounts of bitcoin to its balance sheet routinely in 2021. To encourage other businesses to follow suit, Microstrategy held a 'Bitcoin for Corporations' summit

in early February with the goal of educating and encouraging corporate leaders to allocate to bitcoin.

Throughout the year, a number of well known companies purchased bitcoin, including Square, which allocated roughly 5% of its assets to bitcoin.

Additionally, WeWork, Substack and insurance giant, AXA, began accepting payments in bitcoin.

### Banks explore crypto custody and (re)explore trading

2021 marked a massive turning point for banks' perception and involvement in crypto. While banks had been exploring blockchain mainly for internal or cross-organization use cases since 2015, in 2021 we saw banks beginning to engage more directly with cryptocurrencies.

Arguably the starting point for any cryptocurrency activity is developing a strategy for custodying the assets themselves. In 2021, both financial institutions along with traditional service providers took large steps on developing capabilities. In March, PayPal acquired Curv, a crypto custody firm, nearly a month before adding functionality for users to buy, sell and hold crypto on the Venmo app. About a week later, BNY Mellon, which is the largest custodian bank in the world (~\$25 trillion assets under custody) invested in Fireblocks, another leading crypto custody firm, in response to growing institutional demand for the bank's custody services for digital assets. Later in June, State Street, which is the second largest custodian bank in the world, announced its new digital finance division and partnered with crypto custodian, Lukka, to provide crypto services to private-fund clients. To add to the explosion of activity around custody, leading financial

service provider Fiserv partnered with NYDIG, an institutional crypto services firm, to launch a third-party crypto custody solution for banks in May.

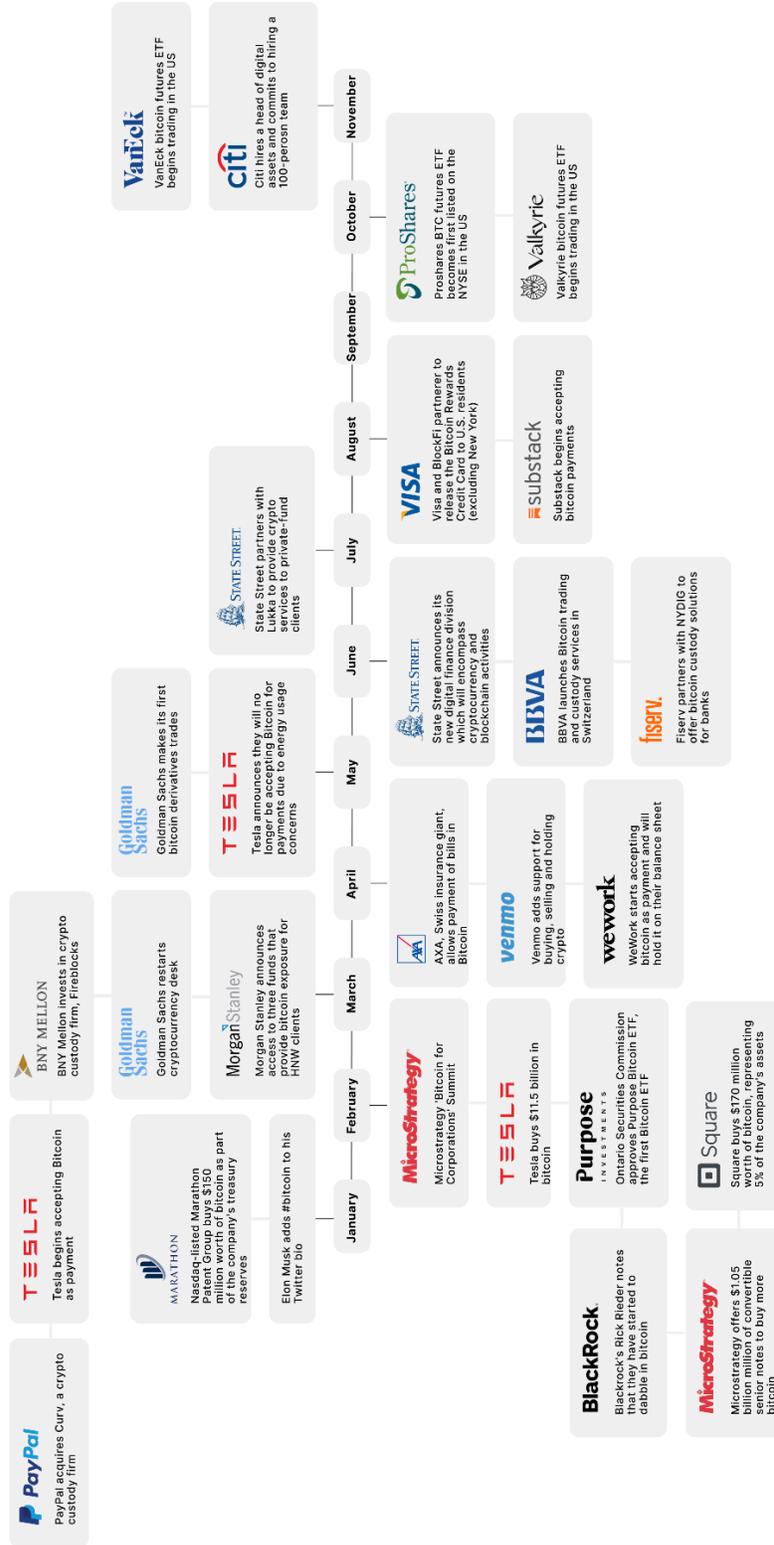
Meanwhile, Goldman Sachs, which famously launched and then quickly shut down a cryptocurrency trading desk during the 2018 bull cycle, relaunched the desk under the firm's global markets division in March. The team has since expanded, and in May executed its first bitcoin derivatives trades. Less than a week after Goldman's announcement, Morgan Stanley opened access to three funds that provide bitcoin exposure for high-net-worth clients. Later in June, Spanish bank BBVA, launched a crypto trading and custody service for Swiss private banking clients.

### **Crypto structured products emerge in the US**

More than 8 years after the Winklevoss twins' first application for a bitcoin ETF, the SEC approved three bitcoin futures ETFs in 2021, though no spot bitcoin ETFs have yet been approved.

The ProShares Bitcoin Strategy ETF (BITO) debuted on October 19. Traders witnessed day one volumes of ~\$1 billion, the second-highest on record for an ETF, a day before bitcoin broke through April's all-time highs. The second launch, Valkyrie's ETF (BTF), started trading shortly after, and VanEck's Bitcoin Strategy ETF (XBTF), which boasts fees 30 basis points lower than the ProShares and Valkyrie's offerings, launched in mid-November.

2021 INSTITUTIONAL ADOPTION TIMELINE



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## Evolving Regulation

### Stablecoins draw regulatory scrutiny

Stablecoins were a major point of focus for regulators in 2021. The rapid growth in stablecoin issuance and use that occurred in 2020 and continued through 2021 put stablecoins in regulators' radar as instruments of potentially systemic importance. Regulators have moved to clarify their stance and issue recommendations concerning stablecoins, setting the stage for further rulemaking.

The Office of the Comptroller of the Currency (OCC), the US' bank regulator, kicked off the year with an interpretive letter allowing US banks to use stablecoins for payment activities, and enabling banks to participate in validating stablecoin transactions in blockchain networks. This move built on top of previous letters released in 2020, providing further clarity to banks considering stablecoins as an efficient means of transaction settlement.

February saw the close of another chapter of Tether's saga with regulators. The company reached a settlement agreement with the New York attorney general's office concerning a probe into the company's finances. As part of the settlement, Tether agreed to pay \$18.5 million and to cease operations in New York. This settlement was followed by another in October, with Tether agreeing to pay \$41 million to the Commodity Futures Trading Commission (CFTC) for misleading claims related to the backing of its stablecoin.

Increased regulatory focus on stablecoins in 2021 culminated in November with the release of a report

outlining regulatory recommendations for stablecoins put together by the President's Working Group on Financial Markets, along with the OCC and the Federal Deposit Insurance Corporation (FDIC). While acknowledging the potential for stablecoins to have a positive impact on payments, the report expressed concern about the potential risks of runs on stablecoin reserves and the opacity surrounding reserve holdings. It recommended new legislation requiring stablecoin issuers to be insured depository institutions, effectively regulated banks with FDIC insurance.

### Some countries move to ban crypto and related activities

As many regulators throughout the world struggle to incorporate crypto into existing regulatory frameworks, some have moved to ban crypto-related activities outright. Among these, China took center stage in 2021 by moving to ban crypto mining in the summer, a move they soon followed with a comprehensive ban of cryptocurrency transactions in the fall. China justified the bans on the basis of environmental concerns and worries about financial risks related to crypto transactions. These moves are notable considering China's former position as an epicenter for crypto trading and mining activities, and underscores the desire of Chinese officials to stamp out alternatives to official means of payment and China's own centrally controlled digital currency.

China was not the only country that moved to ban crypto related activities in 2021, however. In February, the central bank of Nigeria issued a statement reiterating a ban on any dealings with cryptocurrencies on the part of financial institutions. Turkey's central bank similarly moved to prohibit the use of cryptocurrency payments in April, citing the risk of

non-recoverable losses. In May, Iran announced a four-month ban on cryptocurrency mining due to worries surrounding electricity consumption in the midst of a power crisis. Although the ban has since been lifted, it echoes the concerns that China and other countries have raised in relation to the energy cost and environmental impact of crypto mining. Meanwhile, India has been musing a potential crypto bill over the year, though exact details are not yet known.

### **Regulators step up crypto taxation and move to curb money laundering**

Regulators stepped up efforts to develop and enforce crypto tax frameworks, and combat money laundering, in 2021. In March, the IRS revealed enhanced crypto oversight capabilities as part of its 'Operation Hidden Treasure', which established a team of trained agents specialized in analyzing crypto transactions to identify omitted crypto gains in tax returns. The following month, a federal court in Massachusetts ordered Circle, and its spun off exchange Poloniex, to provide information to the IRS on US customers who conducted more than \$20,000 worth of cryptocurrency transactions between 2016 and 2020.

Beyond stepped up enforcement, regulators also moved to introduce new tax-related legislation in 2021. In August, the US senate passed a trillion-dollar infrastructure package containing language that expanded the definition of 'broker' for IRS reporting purposes to any entity performing crypto transfers on behalf of someone else. Despite protests of overly broad language launched by the crypto community, the bill was signed into law in November, handing over rulemaking responsibility to the US Treasury Department.

As part of increased efforts to fight money laundering in crypto, in September, the US Treasury imposed sanctions on Russian crypto exchange Suex, which was found to have facilitated money laundering activities on the part of ransomware gangs and scam operators, among others. In October, the Financial Action Task Force (FATF), an intergovernmental body tasked with anti money laundering policymaking, released its finalized crypto guidance. FATF provided greater clarity on its definitions of virtual asset service providers (VASPs), which it recommends meet the same standards as traditional financial companies, particularly in relation to collecting and transmitting information on parties participating in virtual asset (VA) transactions. The guidance given is broad and provides wide latitude for individual countries to define their approaches. Notably, FATF did not exclude DeFi protocols from scrutiny, suggesting that these may in some cases satisfy the criteria needed to qualify as a VASP.

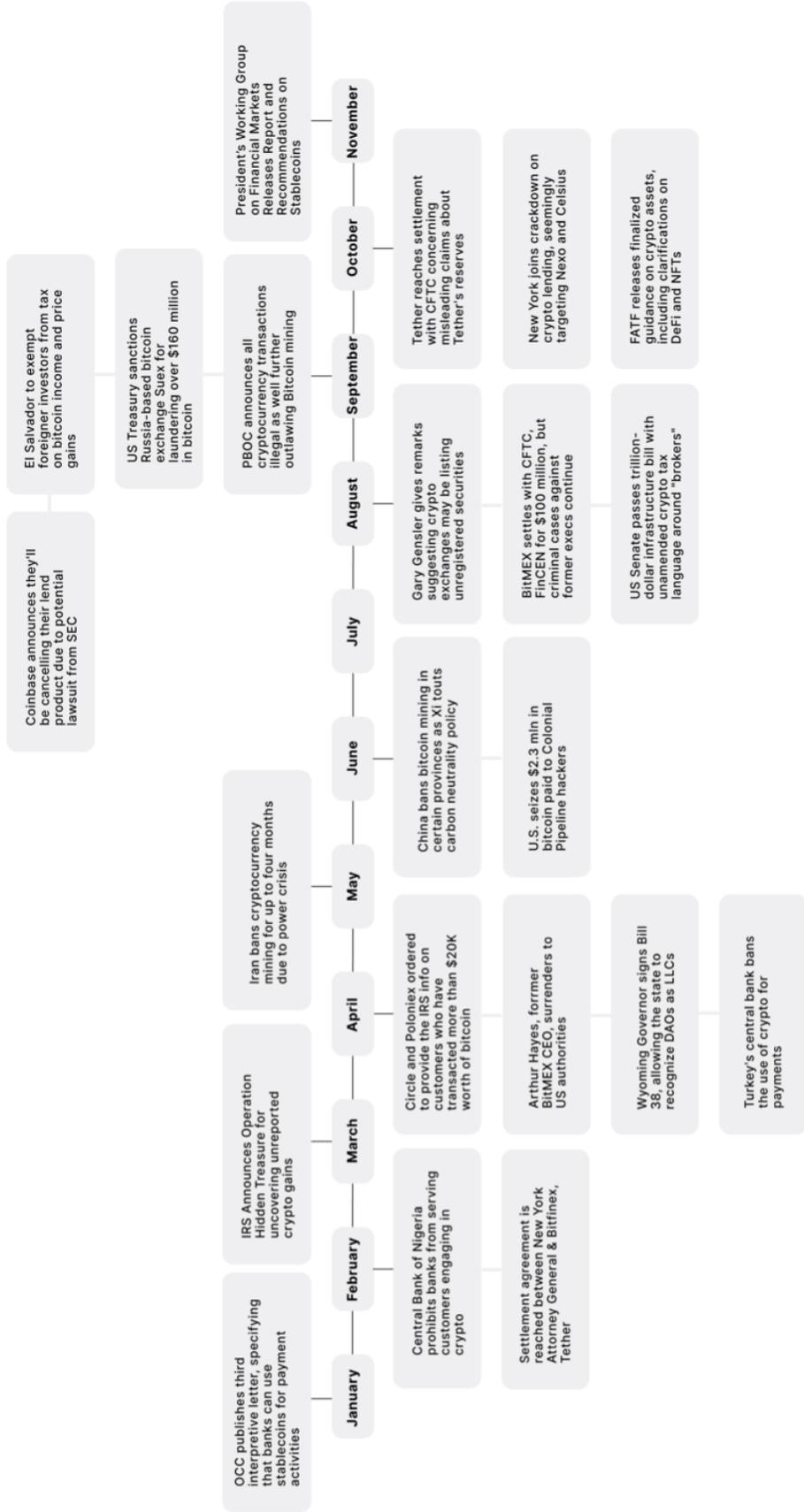
### **Developing frameworks for digital asset securities**

2021 saw a continued struggle on the part of regulators against unregistered securities in the crypto space. In August, while giving remarks before the Aspen Security Forum, SEC chair Gary Gensler commented on the likely existence of numerous unregistered securities within the digital assets space, and underscored the need to bring those into the purview of regulatory agencies. While emphasizing that existing securities laws apply to crypto assets, Gensler called for new legislation to prevent activities in crypto trading, lending and DeFi from falling through regulatory cracks.

As fully fledged frameworks develop to regulate the digital assets space, regulators have taken action in particular cases where they've identified noncompliance. In September, Coinbase announced they'd be cancelling their 'Lend' product, whereby customers would be able to earn interest by lending their digital assets, due to a notice from the SEC expressing intent to sue. In October, the New York attorney general's office joined the SEC in acting against non-compliant crypto lending platforms when it ordered Nexo Financial and Celsius Network to stop their operations in the state. The NY attorney general cited failures to register their lending products as securities with the attorney general's office as the reason for the move.

Notably, such actions by regulators have prompted companies in the crypto industry to take a more active role in lobbying for and proposing new rules for the space. In October, Coinbase published a proposal calling for the establishment of a new and distinct framework to regulate digital assets, along with a new regulatory agency dedicated to the space. These moves illustrate the continued dialogue between regulators and participants in the digital assets space as the regulatory environment evolves.

2021 REGULATORY EVENTS TIMELINE



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## Mainstream Metaverse

### **NFTs serve as early building blocks for the Metaverse**

NFTs have experienced a meteoric growth over the past year to the excitement of some and the dismay of others. Once considered a small section of the overall cryptocurrency space, NFTs have dominated mainstream discourse as many grapple with the idea of digital property implemented through token scarcity.

It has become a way to signal cultural relevance for many companies, who have either decided to purchase currently popular NFTs or release their own. Taco Bell began this movement in early March with their release of 25 taco-themed NFTs with sales proceeds going to their Live Más scholarship. Their creative idea was positively received, with the NFTs selling out in under thirty minutes. They weren't the only fast food chain to attempt a branded NFT series, with McDonalds releasing a McRib based series in November.

Rather than launch their own series, Visa decided to announce their purchase of a CryptoPunk in August for \$150,000. One of the first NFT series to ever be created, CryptoPunks represent an important piece of culture in the cryptocurrency community. Visa also accompanied this purchase announcement with a whitepaper explaining the intersection of NFTs and traditional commerce. Companies like Visa deciding to publicly announce their support of the movement serves as an unprecedented moment in the convergence of traditional firms and the wider crypto landscape.

Other companies have decided to take the opposite view, with Steam, a major gaming platform, announcing a direct ban of all games on its platform that incorporate “blockchain technology” and NFTs. The narrative associated with the environmental damage that NFTs contribute to causes an interesting polarity between supporters and detractors.

### **NFTs rejuvenate the “TradArt” world**

In an area that is typically plagued by the inability to compensate creators adequately for their contributions, the digital art space has experienced a resurgence in 2021, thanks in large part to the NFT craze.

Mike Winkelmann, better known as the digital artist Beeple, had been a long time creator who experienced moderate success in his career but had a complete change of fate that coincided with his entrance into the world of NFTs. After fourteen years of producing a collection he called “Everydays”, he sold the first 5,000 “days” of his collection at Christies with an ending bid of \$69.4 million. This would mark the first ever instance of an NFT being sold at an auction house, but would certainly not be the last of 2021. The very next month, Sothebys would auction off a series by well respected NFT artist Pak for almost \$17 million, and the auction house has added cryptocurrencies, such as ETH, as a currency for bidding. In November, Sotheby's hosted a historic auction in which an original signed copy of the Constitution was sold for \$43.7 million, the highest price ever fetched in a sale of a historic document. Though the effort did not place the winning bid, ConstitutionDAO raised over \$40 million in an attempt to purchase the document.

Naturally, large crypto exchanges were closely watching the success of digital marketplaces like OpenSea and traditional auction houses like Christies & Sothebys, and scrambled to launch their own NFT marketplaces. Early last month FTX announced an NFT marketplace while one of their largest competitors, Coinbase, announced their official NFT marketplace to be launched by end of year. To put into perspective the excitement in the lead up to Coinbase's NFT marketplace launch, there were over a million unique users that signed up for their waitlist within the first day of release.

### **The Metaverse plays a key factor in companies' roadmaps**

Prior to 2021, the term Metaverse was used sparingly, finding its origins in a 1992 science fiction novel titled "Snow Crash". With the increased usage of digital communication applications such as Zoom becoming a fixture in our daily lives, there has been a larger discussion about what the evolution of these tools would look like. The Metaverse tends to be defined differently depending upon who you ask, but we will encapsulate it as a paradigm shift in the way we interact digitally. As put by leading Metaverse analyst Matthew Ball, "The Metaverse is a massively scaled and interoperable network of real-time rendered 3D virtual worlds which can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications, and payments." In short, the Metaverse is not defined by a single purpose driven application such as gaming, but by a shared world where the entire spectrum of online activities occur.

The early stages of the Metaverse are being set forth in 2021, with multiple large companies signaling significant research and development efforts in the space. Epic games, the gaming studio behind the massively successful Fortnite, received a billion dollars in funding to support their vision of the metaverse. This will likely serve as a defining moment for the gaming industry, as developers and studios alike look to incorporate similar plans into their long term roadmap. One company that has had an unprecedented shift in it's development roadmap is Meta, previously Facebook. Referring to it not as just the next chapter for his company but "the next chapter of the internet", Mark Zuckerberg has made it clear to the world what his company's main focus is over this next decade. During their Q3 earnings call, Mark told shareholders that they will be spending \$10 billion in 2021 alone on research efforts related to Metaverse development goals. Additionally, the company expects to continue to spend at this rate for the next few years while acknowledging the lack of profitability from this bet in the near term. Similarly they have announced intentions to hire an additional 10,000 people in the EU over the next five years to help build this vision. With a complete rebranding, as well as significant funding dedicated to building the Metaverse, Meta represents the most ambitious pursuit of any company yet into making the concept a reality.

Other major companies such as TikTok, Twitter, Microsoft, and Disney have all recently announced their own plans at the intersection of crypto, NFTs, and the metaverse. With such fervor around these three areas, they're likely to be central in defining technology development through the next decade.



## 2021 Economic Data Summary

This section looks to provide an assessment of the major economic trends that have occurred quarter by quarter in 2021.

As a backdrop, we entered 2021 on the heels of experiencing one of the more volatile years in economic history. 2021 has seen a pandemic impacted hangover from the year prior along with the already established economic conditions that caused deteriorations across labor markets, supply chains, and general uncertainty regarding fiscal policy associated with rising inflation. Despite these conditions, we see a general recovery across all economic sectors fueled by confidence in a post-pandemic future.

One of the more predictive indicators for our economy, the Term spread, or difference between long and short dated treasury yields continued its upward trend from late 2020, indicating investors continuing belief in the long term growth of markets rather than opting for shorter term bond yields.

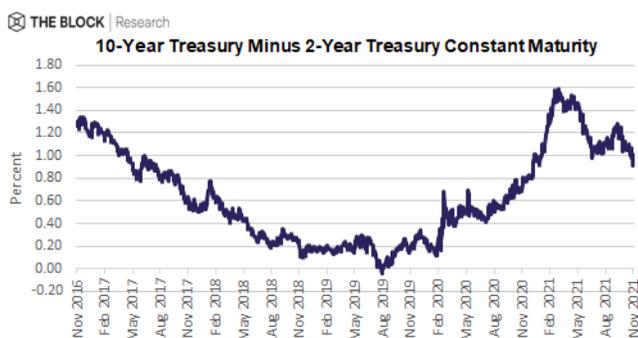


Figure 180: 10-Year Treasury Minus 2-Year Treasury constant maturity 2016 - 2017  
Source: Federal Reserve

Similarly, a good assessment of macro conditions can be found in policy decisions regarding repo (repurchase

agreement) operations. Since the New York Fed’s September 2019 engagement in the repo market to help correct the cash crunch occurring at the intersection of cash and securities, there has been ongoing involvement by the federal reserve to help keep federal fund rates within the Fed’s target range. As the Fed continues to wind down its repo involvement, 2021 has seen record activity in reverse repo agreements.

Putting it simply, with so much cash floating around, due to massive expansions in monetary supply in the past few years, financial institutions are eager to earn yield on the ample amounts of cash they are otherwise sitting on. With the Fed’s repo operations initially used as a way to prevent interest rates from increasing to levels that would hurt economic growth, the decision to engage in record amounts of reverse repos to prevent rates from falling too low has been thematic of the constant jockeying between inflation scares and growth targets.

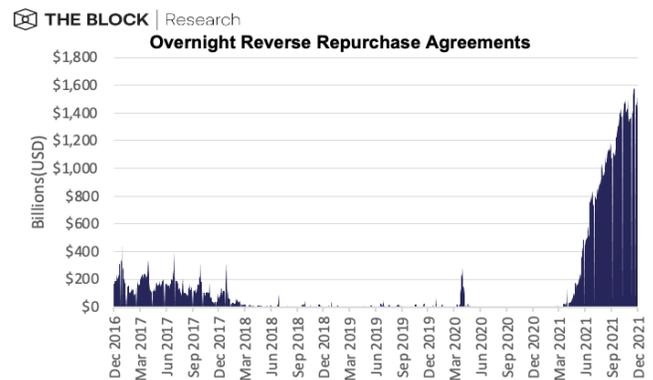


Figure 181: Overnight reverse repurchase agreements 2016 - 2017  
Source: Federal Reserve

The reverse repo purchases haven’t held too strong of a correlation to cryptocurrency markets, with the overall cryptocurrency market capitalization increasing from approximately \$1.5 trillion to \$2.9 trillion between

Mid-March to November (the same time period that reverse repos spiked in activity).

The following sections recap key macro trends across GDP, consumer activity and labor force participation for each of the first three quarters of 2021, with projections for Q4:

## Q1 2021

The first quarter of 2021 saw continued economic recovery along with the reopening of the physical economy, as well as the continued government assistance programs distributed to households and businesses.

- **GDP:** As reported by the U.S Bureau of Economic Analysis, US real gross domestic product increased at an annual rate of 6.4% in the first quarter of 2021.
- **Consumer Sentiment:** As mentioned previously, consumer sentiment experienced great recovery in Q1, with it reaching the highest levels it has seen since the COVID pandemic began in 2020. This allowed levels to reach 85%, exactly where 20 year consumer sentiment averages sit.
- **Consumer Spending:** Consumers accelerated spending by 10.7% in the quarter, compared to a 2.3% increase in Q4 of 2020. Consumer spending was greatly aided by the latest rounds of stimulus checks with a disproportionate amount of spending on consumer goods with the services industry also seeing a brief revival.

- **Labor Force Participation:** Labor force participation rates have been a key focus of economists as we attempt to make a full recovery from the rampant unemployment experienced by the pandemic. Unemployment rates stabilized month over month in Q1, averaging at 6.2% seasonally adjusted.

Compared to Q4 2020, aggregate crypto market cap increased by 240% and volumes increased by 155% in Q1 2021. The crypto market capitalization ended 2020 at a figure of \$760 billion and ended the first quarter of 2021 at \$1.9 trillion. It shouldn't come as a great surprise that cryptocurrency assets performed well amidst the general recovery of the markets in Q1 2021.

## Q2 2021

The second quarter was characterized by continued returns to normalcy and marginal increases in growth in comparison to Q1 2021.

- **GDP:** The U.S Bureau of Economic Analysis reported a 6.5% increase in seasonally adjusted GDP, below the 8.4% expected by economists headed into Q2. Slight concerns were shared by economists, worried that Q2 GDP growth numbers foreshadowed a decelerating growth environment.
- **Consumer Spending:** Personal consumption rates were more positive than expected with increased openings of retail stores and a steadily increasing number of vaccinations administered to the general public. The personal consumption rate was 11.8%, higher than the projected number of 10.5%.

- **Labor Force Participation:** Labor force participation rates were largely unchanged in Q2, partially contributing to the lower than expected GDP increase for the quarter. The unemployment rate at the end of June stood at 5.9%

The total crypto market cap dropped in Q2, beginning the quarter at \$1.9 trillion and ending it at \$1.4 trillion. Market capitalization reached an apex in May but saw a nearly 50% drop within a two week time span, beginning a multi-month range bound recovery.

### Q3 2021

With the delta variant delaying return to office plans and supply chain bottlenecks remaining an issue, Q3 confirmed economists concerns regarding a slower growth environment.

- **GDP:** Real GDP growth increased by only 2% in Q3, accompanied by a general decrease in consumer spending in comparison to previous quarters.
- **Consumer Spending:** Consumer spending increased at just a 1.6% rate in Q3, signalling decreased acceleration in spending rates accompanied by the end of government stimulus payments.
- **Labor Force Participation:** Labor force participation rates increased with unemployment rates reaching a low of 4.8% at the end of September.

The crypto markets continued their recovery in Q3, beginning the quarter at \$1.4 trillion and ending at \$1.9

trillion. The crypto markets performed well, relative strength wise, in comparison to other asset classes.

### Q4 2021

While we haven't reached the end of the year yet, we can use projections through mid-November to guide our assessment of the quarter.

- **GDP:** Expectations for Q4 are quite strong in relation to the less than stellar growth numbers of Q3, aided by less concerns regarding supply chain bottlenecks and excess household savings from previous government stimulus programs. Many leading analysts expect a 5% increase in annualized rate for real GDP growth in Q4.
- **Consumer Spending:** As shoppers rush to get their holiday items before retail inventories dry up, McKinsey analysts project a 7% increase in consumer spending for Q4 in comparison to Q4 2020.
- **Labor Force Participation:** Unemployment rates continued to decrease, down to 4.6% in October, indicating a larger return to normalcy for the labor market in comparison to previous quarters.

Crypto markets have experienced a strong quarter thus far, surpassing all time highs in total market capitalization in November with an apex of approximately \$3 trillion.

## Backtesting Popular Crypto Narratives against 2021 Economic Data

### Cryptocurrencies as an inflation hedge

The macroeconomic environment in 2021, particularly in relation to expansionary monetary policy on the part of central banks and with the backdrop of increased fiscal expenditure, has led to renewed attention to the role that crypto assets can play as hedges against inflation. Most of the focus has been on Bitcoin given the predictable nature of its programmatic monetary policy and its increased acceptance by both private institutions and governments around the world. While the narrative of bitcoin as ‘digital gold’ has been around for a while, institutional players have only come around

to adopting this view in a major way relatively recently. As JPMorgan [reported to its clients in a note](#) back in October, “institutional investors appear to be returning to Bitcoin, perhaps seeing it as a better inflation hedge than gold.”

The driving force behind this narrative becomes more obvious when looking at the growth in the supply of Bitcoin charted against the growth in the US Federal Reserve’s balance sheet, and the resulting infusion of liquidity into the economy. In the period since 2012, while the supply of Bitcoin has increased by about half, the assets in the Fed’s balance sheet have more than doubled. Institutional investors seem increasingly attracted to Bitcoin’s deflationary supply schedule as the fiat money supply continues to grow.

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#### BTC Supply vs Fed Balance Sheet Growth

■ BTC in circulation ■ Federal Reserve Total Assets

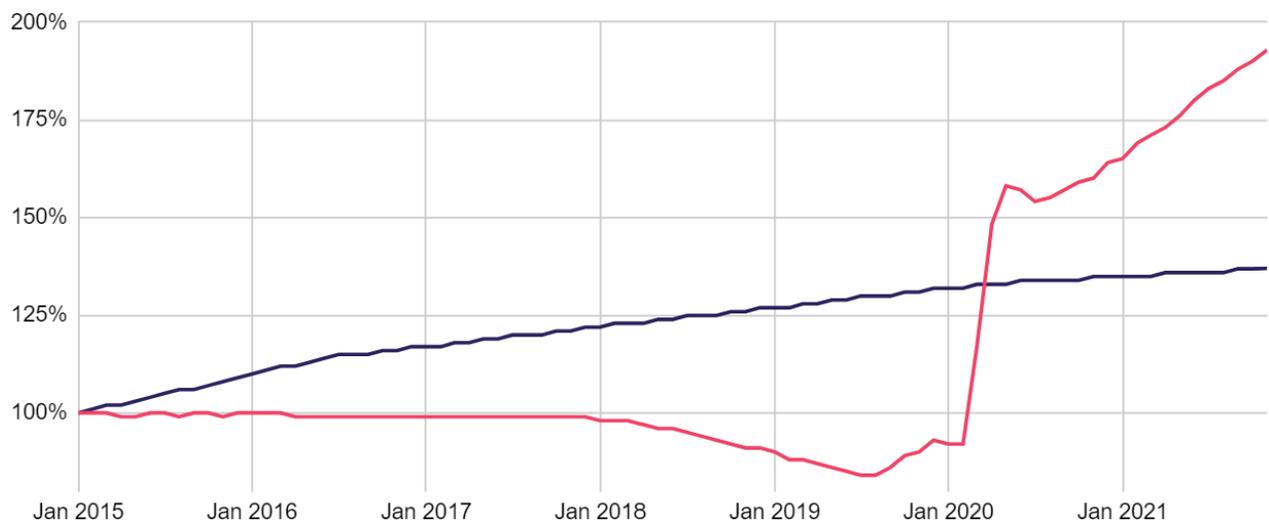


Figure 182: Bitcoin supply vs. Fed balance sheet growth 2015 - 2021

Source: Blockchain.com, Federal Reserve

However, Bitcoin’s suitability as an inflation hedge is far from proven. Bitcoin has been around for a little over a decade and as such has not been around long enough to gauge performance during periods of sustained inflation. Gold, on the other hand, has been around for centuries and has reliably performed as a safe haven asset.

Some recent academic work lends credence to the ability of Bitcoin to function as an inflation hedge. [Choi and Shin](#) at Yonsei University find that Bitcoin performs well during inflationary events in one of the only rigorous empirical studies to date on the relationship between Bitcoin prices and inflation. However, Choi and Shin’s findings challenge the notion that Bitcoin should be considered a ‘safe haven’ asset akin to gold. They find that Bitcoin and gold react very differently to stock market movements and volatility, with Bitcoin tending to respond positively to stock market price

increases, but negatively to periods of stock market volatility. In this regard, they find gold to be a better stock market hedge given positive price responses in periods of stock market volatility. Regardless, they caveat their findings with the fact that the available data for Bitcoin is limited to the very early stages of crypto market maturity that we are still in.

The jury is very much still out as to whether Bitcoin can cement itself as a safe haven asset, but continued institutional adoption points to growing belief in that possibility. Bitcoin’s returns compared to gold and other assets in recent years are no doubt driving a significant portion of the interest in the cryptocurrency. Plotting the depreciation of the dollar over the last year and a half against the stock market, commodities, and Bitcoin illustrates the latter’s attractiveness as an inflation hedge -- but past performance isn’t always a strong indicator of the future.

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USD Denominated in Equities, Commodities & BTC



Figure 183: Price return of different asset classes against bitcoin 2020 - 2021  
Source: The Block Research, Yahoo Finance

### Bitcoin as a portfolio diversification tool

A related narrative to that of Bitcoin as ‘digital gold’ is that of Bitcoin as a tool for portfolio diversification. The crux of the narrative is that Bitcoin and other cryptocurrencies are uncorrelated with other asset classes, and therefore warrant inclusion in well-diversified portfolios. There is some truth to this argument. According to data from Morningstar, Inc., Bitcoin prices over the past three years have had fairly low correlations with traditional assets. Out of several traditional asset class benchmarks, Bitcoin is most highly correlated with a broad market index of US stocks. Even then, it’s only weakly correlated, with a coefficient of 0.33. Correlations with bond and commodity benchmarks are even lower.

diversification tool, at least when hedging equity positions.



Figure 185: Rolling 36-month correlations bitcoin vs. gold price  
Source: Morningstar

#### Asset Return Trailing 3-Year Correlations

	Bitcoin	Gold
Gold (LBMA Gold Price)	0.06	
US Equity (Morningstar US Market)	0.33	0.06
Global Developed Market Equity (Morningstar DM xUS)	0.33	0.03
Global Emerging Market Equity (Morningstar EM)	0.23	0.17
US Corporate Bonds (Morningstar Core Bd)	0.1	0.52
US 10+ yr Treasuries (Morningstar US 10+ Tsry Bd)	-0.09	0.37
Commodities (Bloomberg Commodity)	0.15	0.03
Nominal Major Currencies	-0.24	-0.55

Note: All indexes priced in USD  
Source: Morningstar, Data as of September 2021

Figure 184: Asset return trailing 3-year correlation  
Source: Morningstar

However, it’s worth noting that Bitcoin price correlation to the same benchmark of US stocks has been trending upward since 2020, indicating a recent tightening in the relationship between the two asset classes. In that regard, gold may remain a stronger portfolio



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