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CRYPTO-IN-REVIEW
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CRYPTO IN REVIEW

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1.

Introduction

If 2020 was the **The Year of the ₿ull**, then 2021 was without a doubt the year crypto went mainstream. Last year, the cryptoasset industry experienced breakthroughs in adoption, regulation, policy, broader infrastructure development, technical upgrades, and on top of it all, all-time high prices. The industry also saw crypto enter mainstream pop culture amid the rise of memecoins like DOGE, NFTs proliferating and catching the attention of high-tier celebrities, and speculation over the future of the metaverse.

With newfound hype surrounding cryptoassets came an increased awareness of the inefficiencies present in existing financial systems, ostensibly accelerating a generation's shift away from antiquated financial products and into digital assets. Accompanying this shift were traditional financial institutions dipping their toes into crypto in an attempt to play catch-up, all the while crypto veterans pushed forward in improving existing systems and creating new ones.

From China's crypto mining exodus to the launch of the first BTC exchange-traded funds (ETFs) in North America to the country-wide acceptance of BTC as legal tender in El Salvador, 2021 will surely go down in the crypto history books. While it is impossible to capture every single development that has occurred in 2021, in this year's Crypto-in-Review the Kraken Intelligence team discusses the top themes witnessed and provides an outlook of what may come in 2022.

2.

Cryptoasset Performance

The Year's Performance

For the third year in a row, the broader cryptoasset market closed higher in what remains a macro bull market trend. As a whole, the market finished 2021 up +187%, which pales in comparison to 2020's return of +310% but is well ahead of 2019's +58% return. With BTC having a rich history of dictating the macro trend and 4-year market cycles, all eyes are on the digital gold for clarity as to whether the broader cryptoasset ecosystem can continue posting outsized returns or if history will repeat and bring us a bear market after wrapping up another 4-year market cycle.

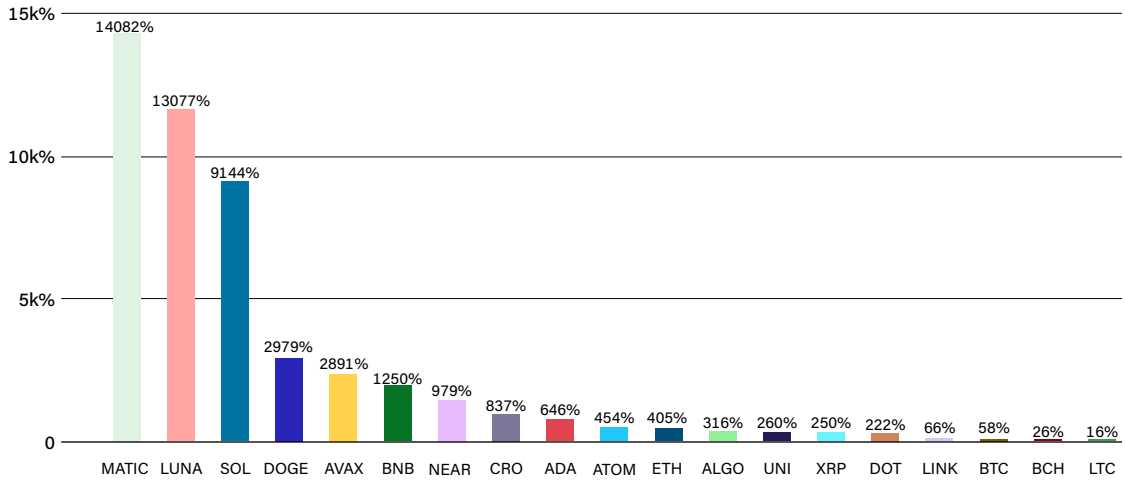
While it remains unclear what lies ahead in 2022, BTC and most cryptoassets finished the year higher and outperformed most traditional financial assets, such as the S&P500, the NASDAQ, gold, government bonds, and high yield bonds. Be that as it may, there exists a great disparity between different cryptoasset sectors as innovation and speculation sweep across each sector at different periods throughout the year and in varying intensities. Such is especially evident when looking at the overall trend of BTC's "dominance," or share of market capitalization, in 2021. Although past performance is not indicative of future returns, knowing how many of the largest cryptoassets performed last year, their relationship with BTC, and how each sector performed can help provide insight into where speculation and innovation were most rich and what to keep an eye on in 2022.

Looking at the top 20 cryptoassets by market capitalization (excluding stablecoins), one will find a significant disparity in returns. First and foremost, the self-proclaimed "DOGE killer," Shiba Inu (SHIB), which launched in 2020, was the year's outperformer after amassing an astronomical +41.8M% return. Meanwhile, the laggard among the pack was LTC, a source code fork of Bitcoin created in 2011, with a relatively light +16% return. This difference alone speaks to the harsh reality that all cryptoassets are at risk of being

usurped by a new cryptoasset capable of stealing mindshare from the market and rising to prominence. It's also worth noting that BTC was the third-worst performer of the 20 largest cryptoassets by market capitalization with a return of +58%—well below the average and median return of +2.24M% and +646%, respectively. Notably, the average and median readings drop to +2,524% and +454%, respectively, when excluding SHIB (the year's outlier).

Figure 1

Top 20 Cryptoassets Returns

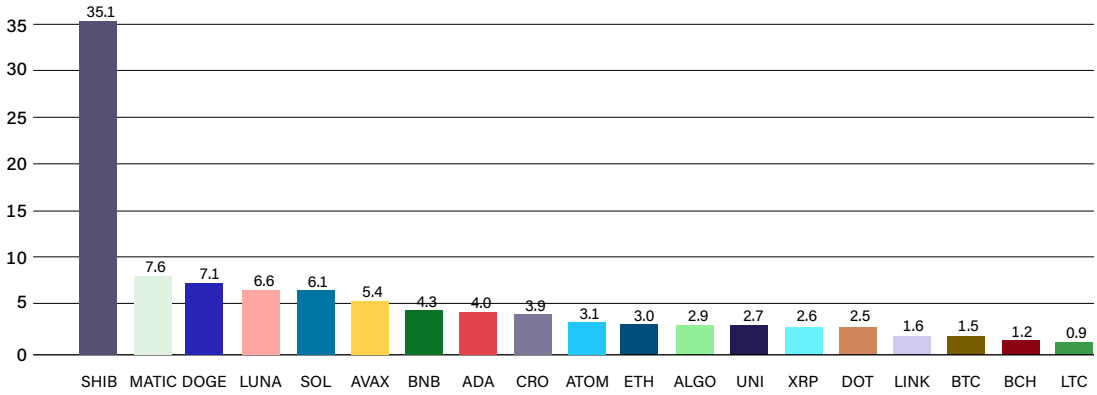


Source: Kraken Intellegence, Cryptowatch (SHIB not included for visualization purposes)

When accounting for only downside volatility, or what is commonly known as the "Sortino ratio," BTC was the third-worst performing cryptoasset with a ratio of 1.5. Additionally, LTC remained the underperformer with a ratio of 0.9 and SHIB the outperformer with a ratio of 35.1. MATIC, DOGE, LUNA, and SOL were also among the top 5 cryptoassets with Sortino ratios that came in well ahead of the group's average and median readings of 5.3 and 3.5, respectively. However, they exhibited a moderate amount of difference relative to absolute returns.

Figure 2

Top 20 Cryptoassets Sortino Ratio



Source: Kraken Intelligence, Cryptowatch

Altcoin Season All Year Long

Last year's performance proved that the law of large numbers, or the phenomenon that an asset cannot sustain the same growth as it increases in market capitalization, and an increasing risk tolerance in the market has resulted in BTC underperforming relative to peers and altcoins as a whole stealing market share and mindshare. The ebbs and flows associated with market participants shifting their preference for altcoins in favor of BTC and vice versa can help explain the short- and medium-term shifts in the market. However, taking a step back and comparing and contrasting the movement of both cohorts, one will see a much bigger trend in 2021.

BTC had several historic moments during which it sustained reversions to normalized levels of dominance, yet the trend for 2021 is broadly defined by altcoins taking a greater share of market capitalization.

The year started with BTC's dominance sitting at just under 70% before entering into a 5-month downtrend to hit a low of 39% by June before bouncing higher over summer. The downtrend coincided with the broader market relentlessly trending higher before

Figure 3

BTC Dominance

Source: Kraken Intellegence, TradingView

selling-off in May and spending several months rebounding slowly. Because BTC is viewed by many as the safe-haven asset within the cryptoasset ecosystem, market participants tended to rotate back into BTC in times of weakness to preserve their wealth and avoid succumbing to drawdowns that hit altcoins hardest. With 2H2021 being less eventful than 1H2021 when altcoins were going wild and made up the lion's share of the market's momentum, it comes as no surprise that BTC's dominance was largely range-bound between 40% and 50% in 2H2021. Should the price of BTC resume its upwards trajectory, one could expect the digital gold to outperform in 2022 and dominance to trend higher. On the flip side, a bullish 2022 could mean that dominance trends lower as market participants increasingly develop a preference for altcoins.

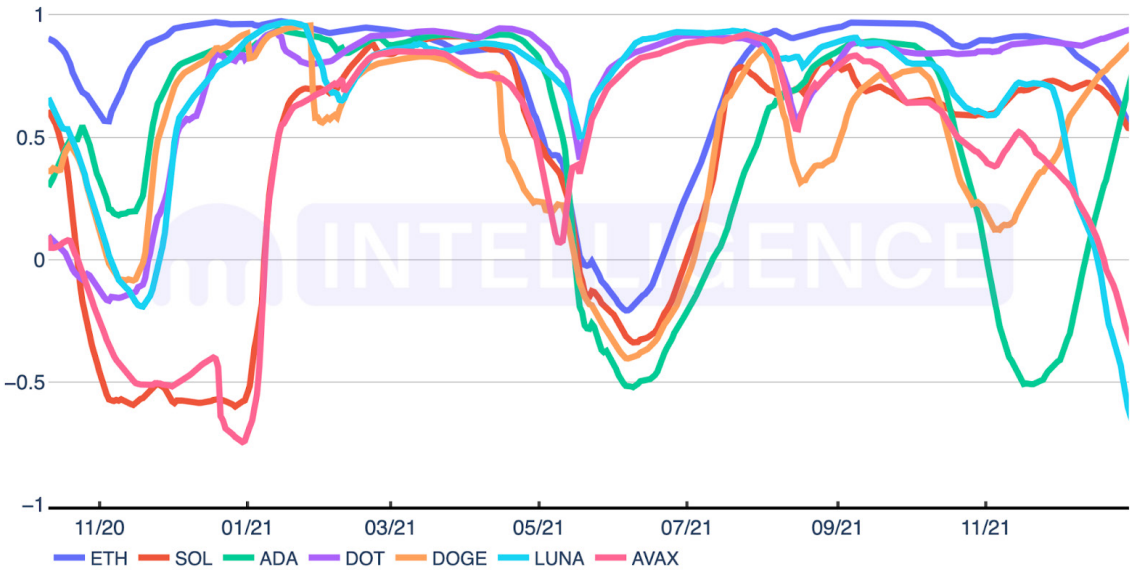
While altcoins continue to go through "alt season" cycles where they outperform BTC, they remain, by and large, highly correlated with BTC for the bulk of 2021. This is despite expectations that the BTC's correlation should logically fall as the asset class matures. Per

figure 4, BTC's 90-day rolling correlation with ETH, SOL, ADA, DOT, DOGE, LUNA, and AVAX was especially strong in 1Q2021 and 2H2021. With that said, irrespective of one's portfolio allocation and level of interest in BTC, digital gold continues to dictate the macro trend for the market. For this reason, one ought to keep a close eye on BTC throughout 2022.

Not only did altcoins exhibit a strong positive correlation with BTC in 2021, but they also continued to possess a high beta relative to BTC. That is to say, they're much more volatile than BTC. For instance, a beta of 1 means that an altcoin is equally as volatile as BTC. However, a beta of 2 means that an altcoin is twice as volatile as BTC. The utility of beta lies in its ability to tell us exactly how much more or less of a swing in either direction an altcoin moves in response to BTC's move higher or lower.

Figure 4

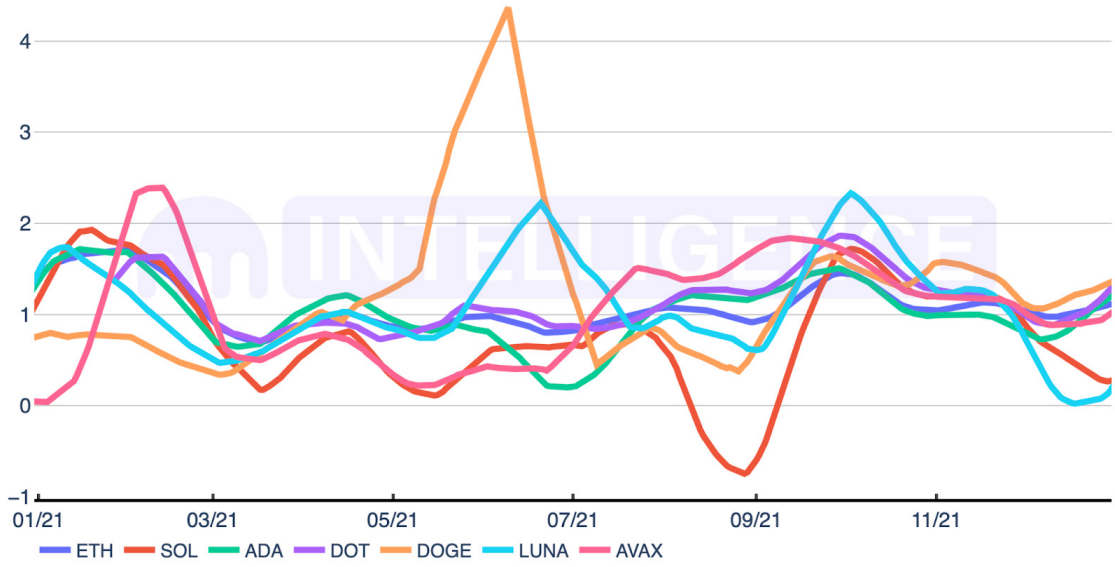
90-Day Rolling Correlation w/ BTC



Source: Kraken Intelligence, Cryptowatch

Figure 5

Rolling 30-Day Beta to BTC



Source: Kraken Intelligence, Cryptowatch

As shown in figure 5, BTC's rolling 30-day beta with several of the largest altcoins by market capitalization are often well above a reading of 1. However, there were several instances in 2021 when most of the largest altcoins were at a reading of roughly -0.50. Not to mention, there were a few outliers in 2021, such as DOGE or SOL, which were either substantially more volatile than BTC or a fraction as volatile. So while BTC continues to exhibit a strong, positive correlation with many altcoins, the altcoins are also, on average, considerably more volatile than BTC. It should come as no surprise that BTC underperformed its peers given last year's bull market.

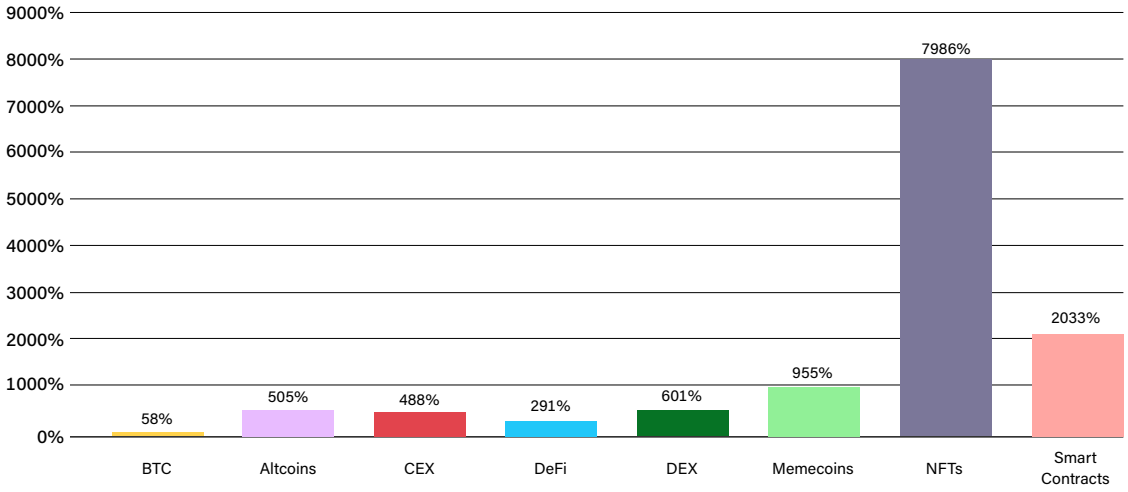
By taking a step back to look at the performance of various crypto sectors in 2021, one can better understand why many of the top 20 cryptoassets performed as well as they did, why several large-cap and medium-cap cryptoassets rose to prominence and the top themes of 2021. Per figure 6, we'll see that altcoins, as a whole, far outpaced BTC's relatively uninspiring +58% gain with a 1-year return of +505%. Of the various cryptoasset sectors, one will see that NFT-related tokens, such as THETA, CHZ, AXS, AUDIO, far outpaced any

other sector in 2021 and posted a return of nearly +9,000%. NFTs saw unprecedented demand primarily because they are easy for crypto newcomers to understand, and momentum existed in the broader market to fuel their growth.

While no other sector came close to NFTs, smart contract platforms posted a respectable +2,022% return in 2021, and DEX coins came second with a +601% return. The strength in smart contract platforms, such as ETH, SOL, ADA, DOT, and MATIC, may be attributed to the fact that 2021 marked a pivotal year for all of these platforms in terms of innovation, adoption, and user growth. Accordingly, it is no surprise that these infrastructure layers outperformed cryptoassets tailored to decentralized applications (dApps). Though an eventful year for NFTs and smart contracts, DeFi as a sector underperformed all others in 2021 with a return of +291%. Also, readers should note that "memecoins," which rose to prominence at the start of the year thanks to DOGE and continued to attract market interest with the likes of SHIB, generated an unfathomable return of +16.2M%. Because DOGE and SHIB drove much of said return, readers should take the outperformance on behalf of memecoins with a grain of salt. Excluding SHIB and DOGE, memecoins posted the lowest gains of any other sector with a +8% return. However, as the cryptoasset ecosystem matures and innovates, one shouldn't necessarily write off these community coins as some have done already.

Figure 6

Sector Returns



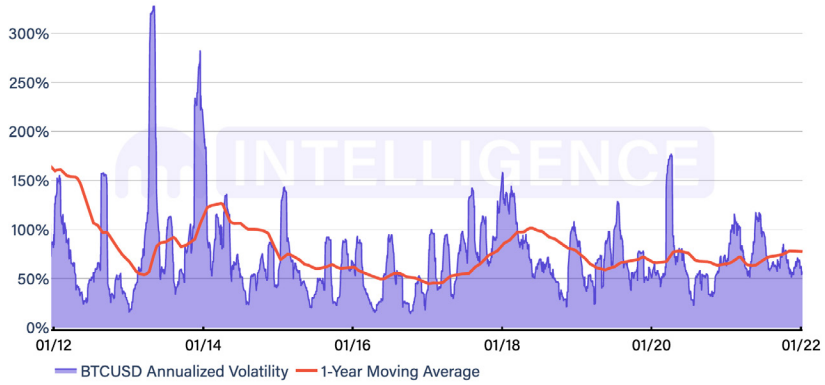
Source: Kraken Intelligence, Cryptowatch (excludes DOGE and SHIB in "Memecoins" for visualization purposes)

Bitcoin's Outlook

It's anyone's guess as to what to expect in 2022, as BTC and the broader cryptoasset market is widely known for throwing a few curve balls each year thanks to the asset class being highly volatile. However, when looking at BTC's historical volatility, one will see that it has a rich history of approaching, if not surpassing, 100% annualized volatility. Relative to traditional financial assets, such as the S&P 500, such a reading is nearly 5–12x greater than what legacy market participants are used to. For instance, in 2021, we saw two separate occasions where BTC's annualized volatility climbed past 100% amid both a parabolic jump to the upside and sudden drop lower. Be that as it may, it ought to be noted that volatility continues to trend down, as evidenced by the 1-year moving average, over time as BTC becomes an increasingly mature asset. So while we can surely expect to see some fireworks in 2022, it's fair to argue that 2022, as a whole, most likely won't be as volatile as prior years. But that doesn't mean one shouldn't brace for explosive moves in the new year.

Figure 7

BTCUSD Annualized Volatility



Source: Kraken Intelligence, Cryptowatch

Unlike many market participants had hoped for, 2021 concluded without BTC going parabolic and surpassing the psychologically significant $100,000 level. BTC might have posted a handsome +58% return, but the year ended on a rather uneventful note. As

disappointing as it may have been to some, other market participants see BTC's slow climb higher as an indication that BTC's market cycles continue to get longer and the slow march upward presents a ripe opportunity for BTC to hit unprecedented levels without abruptly entering into a bear market.

Surely there is no telling where and when BTC might hit a market cycle top before trending lower and establishing new levels of support. However, looking at BTC's Logarithmic Growth Curve, one will see that BTC has plenty of room to run before entering into what could be argued "overbought" territory. If we look as far back as 2011, we'll find that the logarithmic trendlines in figure 8 indicate where BTC would have to climb to or fall to in order to enter into what would be considered "overbought" or "oversold" given historical price action. While both trend lines creep higher with each passing day, as of January 2022, this model suggests BTC's support resides around $26,300 and $33,800 and resistance may exist around $114,200 and $146,800. Accordingly, if one were to expect 2022 to be the year that BTC sees its bull market conclude, one could expect BTC to at least climb up to $141,200. Similarly, if one were to expect 2022 to bring about a bear market, it stands to reason that BTC could fall as low as $26,300. But with BTC residing in the 50 percentile of the logarithmic growth curve's $25,295–$142,895 range as of January 2022, the case could be made that the broader market trend is up for the taking by either the bulls or the bears.

Figure 8

BTCUSD Logarithmic Growth Curve

Source: Kraken Intellegence, Cryptowatch

As difficult as it may be to know where exactly BTC is headed, we can lean on BTC's historical monthly performance to get a rough sense as to what to expect in 2022. Looking out at the first quarter of the year, we'll see that January, February, and March are typically favorable months for BTC—returning an average of +9%, +17%, and +8%, respectively. However, it's not until 2Q2022 that one could expect BTC to post its biggest returns—assuming BTC can remain in a macro bull market uptrend. As of year-end, the average return for April, May, and June sit at +46%, +28%, and +10%, respectively. Said differently, while last November and December failed to live up to expectations, the start of 2022 and even the first-half of the year could bring about bullish price action should history repeat. This is especially true when considering that the new year is set to proceed with what was BTC's fourth worst annual performance since 2011, posting an underwhelming +58%.

Figure 9

BTCUSD Historical Returns

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2011	75%	22%	-15%	352%	182%	68%	-13%	-37%	-38%	-35%	-6%	53%	1521%
2012	5%	-20%	-1%	3%	4%	27%	41%	6%	24%	-10%	19%	8%	186%
2013	54%	63%	171%	34%	-8%	-31%	18%	33%	-3%	59%	451%	-24%	5365%
2014	7%	-32%	-20%	-6%	36%	1%	-9%	-20%	-18%	-12%	17%	-15%	-57%
2015	-31%	12%	-6%	-4%	-1%	18%	10%	-18%	4%	32%	14%	19%	35%
2016	-16%	18%	-4%	8%	17%	25%	-8%	-6%	6%	14%	2%	29%	125%
2017	-3%	20%	-12%	27%	60%	2%	19%	74%	-12%	47%	49%	29%	1332%
2018	-25%	14%	-37%	36%	-18%	-15%	21%	-8%	-8%	-4%	-37%	-11%	-73%
2019	-10%	63%	7%	27%	61%	27%	-5%	-8%	-15%	10%	-18%	-5%	92%
2020	30%	-9%	-25%	35%	10%	-3%	24%	3%	-8%	28%	43%	47%	304%
2021	14%	37%	30%	-2%	-35%	-6%	18%	14%	-7%	41%	-7%	19%	58%
Average	9%	17%	8%	46%	28%	10%	11%	3%	-7%	15%	48%	13%	808%
Median	5%	18%	-6%	27%	10%	2%	18%	-6%	-8%	14%	14%	19%	125%

Source: Kraken Intelligence, Cryptowatch

On-Chain Outlook

Though market data may point to a more bullish outlook for BTC, it seems that on-chain data paints a slightly more cautious picture. While metrics such as BTC's Spent Output Profit Ratio (SOPR) have looked better in the past, BTC's net position change on exchanges and HODL Waves point to a more positive outlook as there doesn't appear to be any abnormal selling despite the year-end pullback. With on-chain data failing to confirm whether the year-end price drop was a healthy retracement or full-blown trend reversal, market participants should watch several on-chain metrics heading into 2022 that could provide more clarity on the market's trend.

Spent Output Profit Ratio (SOPR)

The SOPR is a metric used to estimate where a UTXO-based cryptoasset, like BTC, stands in a bear or bull cycle. SOPR attempts to measure whether market participants are, on average, selling at a profit or loss. It is calculated by taking a spent output (i.e., BTC sent in a transaction) and dividing its realized value (USD) by its value at creation (USD). In short, SOPR is the price "sold" (sent) divided by the price "paid" (received). Note that the SOPR is only an estimate of profitable BTC sales as not every on-chain transaction is a sale.

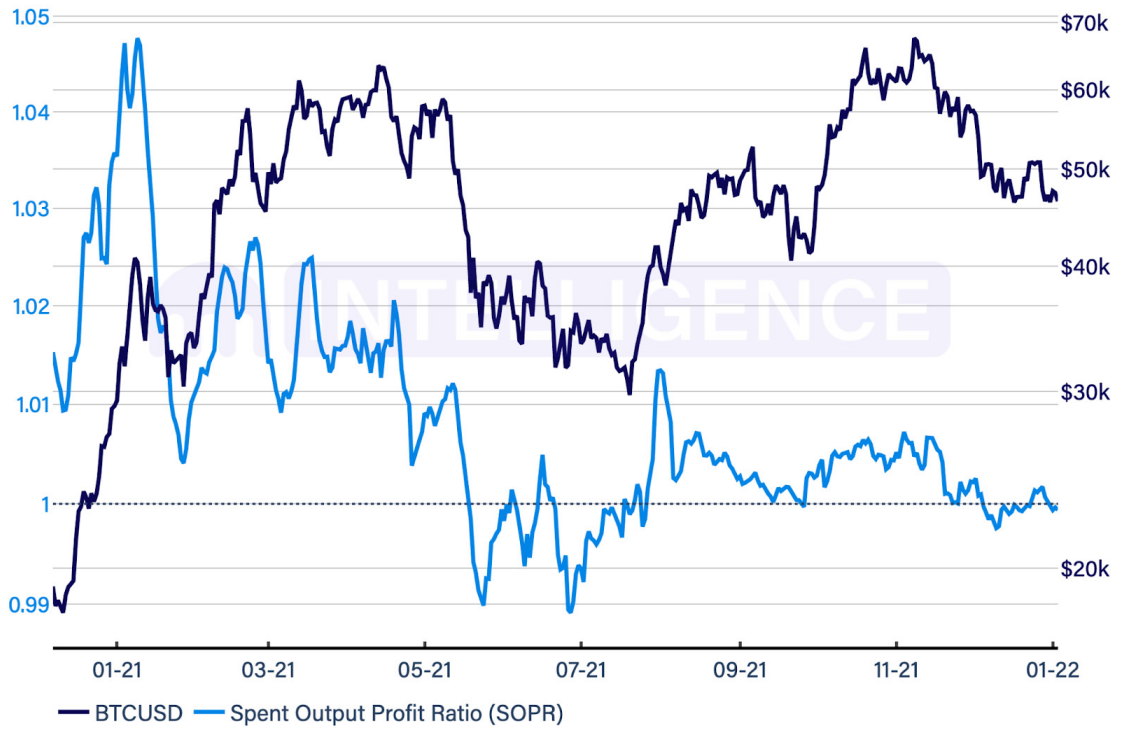
Consider the following framework when attempting to interpret a cryptoasset's SOPR:

- **SOPR < 1**—Indicates most BTC being sold at a loss, signaling a potential bottom.
- **SOPR > 1**—Signals most BTC being sold for a profit, history suggests a local top might be close.
- **SOPR = 1**—Implies a relatively high amount of BTC being sold at or around the price purchased, meaning market participants are uncertain about where price may go.

With the SOPR indicator tending to oscillate around a reading of 1, a bounce in a downtrend could signal the end of a bull market correction, while a breakdown could signal a trend change. Considering that the SOPR broke through the long-standing support level of 1 during BTC's price retracement at the end of the year, some may conclude that BTC has entered a temporary bear market as it did over the summer. However, there have been several instances in the past where the SOPR indicator mean reverted to 1 before bouncing higher as the market concluded a corrective phase. Should BTC's SOPR break back above 1 and remain there, it would indicate that the latest pullback was just a healthy market retracement. Though if the SOPR reaches a reading of 1 but fails to break out, we could enter another temporary bear cycle.

Figure 10

BTC's Spent Output Profit Ratio (SOPR)



Source: Kraken Intelligence, Coin Metrics

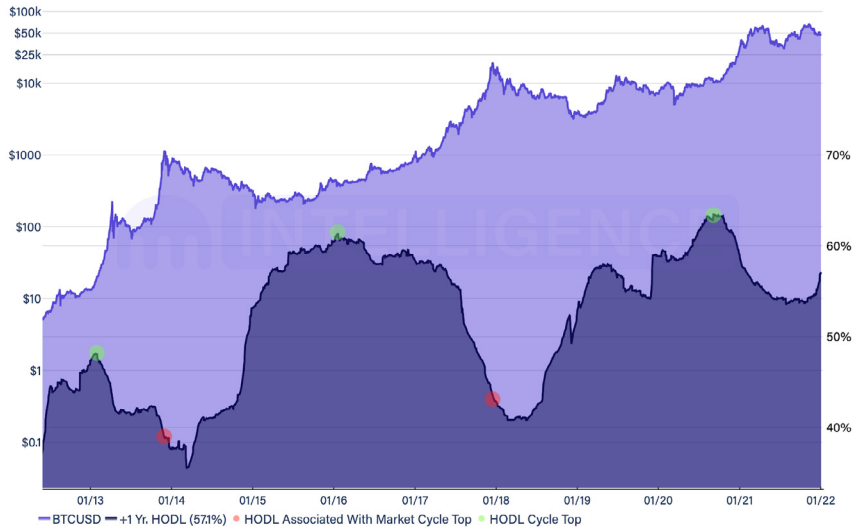
HODL Waves

BTC's HODL Waves, which reflect the percentage of BTC's circulating supply that hasn't moved over a specific time, shows that long-term BTC holders aren't panicking at these levels. The HODL Waves metric lends insight into BTC holding and spending behavior changes. When plotted against BTC's price, one can better understand which market participants (long-term, medium-term, or short-term holders) may be fueling selling pressure.

Looking at the percentage of coins that haven't moved in at least a year shows that long-term holding conviction is uptrending after moving sideways for the past several months. However should the market weaken further and dormant coins begin to be sold off, BTC's existing supply shock would fade as more immediately marketable BTC supply grows. Though such would imply that the bears have taken market control for the moment, for the time being it seems that the bulls have yet to lose the battle.

Figure 11

Bitcoin's +1 Year HODL Waves



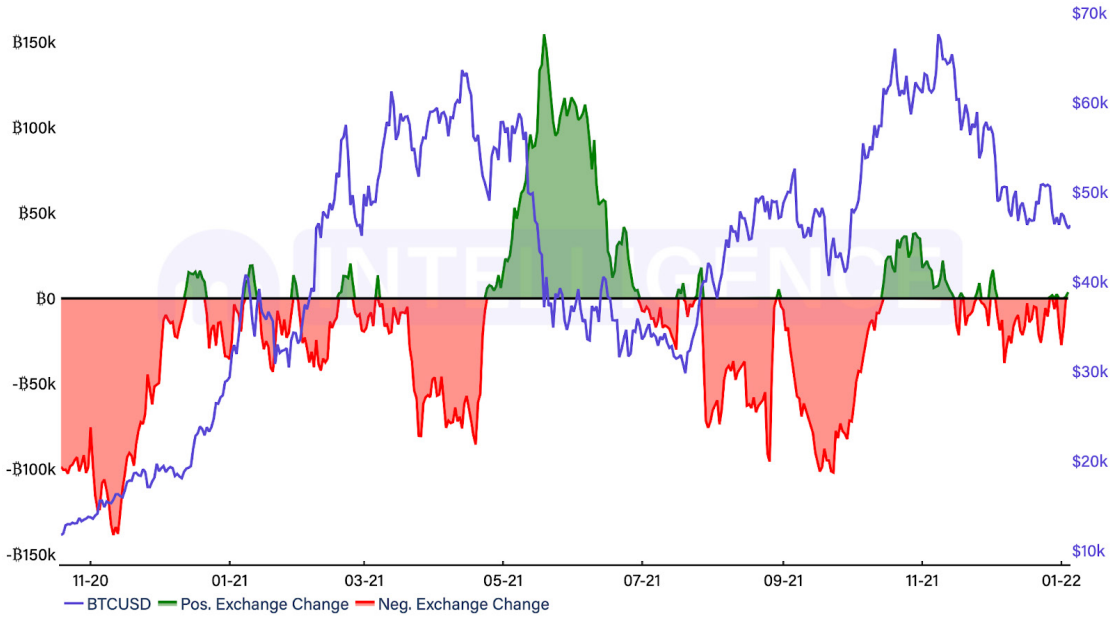
Source: Kraken Intelligence, Glassnode

Exchange Net Position Change

BTC's exchange supply also suggests there isn't as much panic in the market as some think. As of year-end, the indicator has continued its June 2021 downtrend, indicating that there hasn't been abnormal selling regardless of the latest market pullback from all-time highs. In fact, BTC has continued to flow off exchanges where market participants are likely stowing them away for long-term holding. Such suggests that though both market and on-chain metrics are giving off mixed signals while BTC is nearly -33% off of all-time highs seen in November, BTC's macro uptrend remains intact for the time being.

Figure 12

BTC Net Position Change



Source: Kraken Intelligence, Glassnode

3.

Biggest Developments of 2021

Several developments emerged in 2021 that either accelerated the adoption and success of BTC and cryptoassets as a whole or served as a headwind that gave market participants a reason for pause. Despite the ups and downs and the market's retracement from all-time highs set in November, crypto ended the year in a great position. The industry's adoption, innovation, and investment have never looked better and despite the asset class' volatility and unpredictability, the road ahead looks promising. While several notable developments took place last year, a handful of events and themes dramatically shaped 2021.

El Salvador: Legal Tender

At the Bitcoin 2021 conference in June, El Salvador's President Nayib Bukele, a tech-savvy millennial, announced plans for his country to legalize BTC as tender and integrate it into his country's economy.[1] On September 7, El Salvador became the first country to adopt BTC as legal tender, enabling residents to use the digital asset in any transaction, from buying a cup of coffee to paying taxes. As part of the country's adoption, President Bukele promised $30 of BTC for each user of the country's preferred wallet provider, Chivo, and the government agreed to a $150M fund to facilitate transactions between USD and BTC.[2]

Although the crypto community was largely in favor of the adoption, concerns arose that the country's adoption could bring instability and unnecessary risk to the country's economy. President Bukele promoted his country's adoption by acknowledging that the technology would help bring Salvadorans into the economy, given that roughly 70% of citizens don't have bank accounts. Bukele also argued that BTC would be faster and cheaper to get remittances from abroad and could free the indebted nation from the hold

of the traditional global financial system. Lastly, the move by Bukele was part of a broader goal of appealing to crypto entrepreneurs who are paving the way for what many believe to be the next big wave of innovation.[3]

Since then, the Salvadoran government has added more BTC to its treasury, announced plans to issue a $1B "bitcoin bond" to fund the construction of its "Bitcoin City" and buy more BTC. Proceeds from its bond will also be used to begin mining BTC using power harnessed from a volcano, which inspired other Latin American countries, such as Panama, to explore the adoption of BTC. With El Salvador paving the path of BTC adoption on a sovereign level, one can expect further adoption by the country in 2022 and perhaps others to follow in the nation's footsteps.[4]

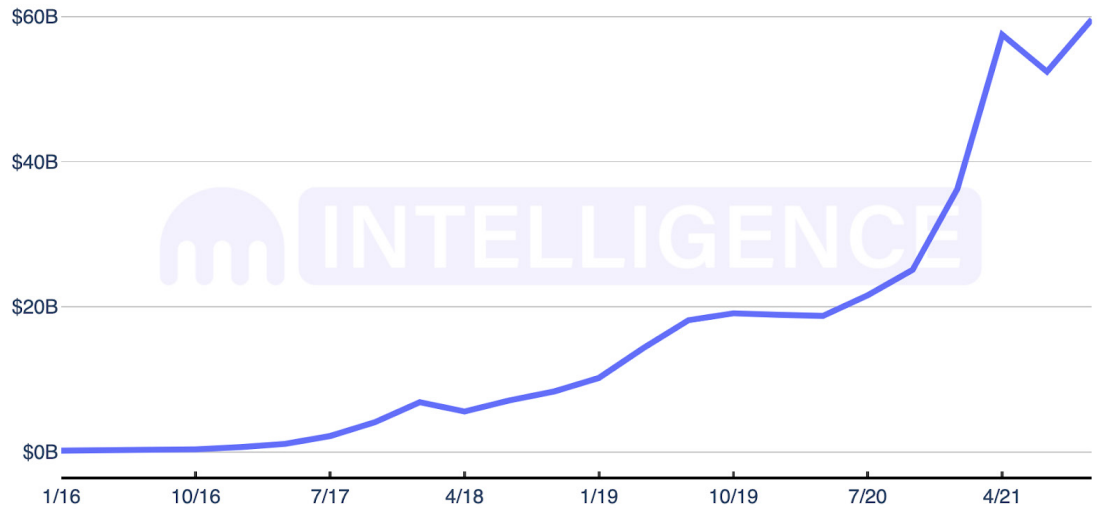
Institutional and Corporate Adoption

Although the broader cryptoasset market has seen notable institutional and corporate adoption over the past few years, 2021 unequivocally goes down as the biggest year for the asset class in terms of adoption from both cohorts. Not only did multiple financial institutions and corporations gain exposure to the asset class, but capital inflows from new and existing crypto-focused investment vehicles took off. Assets under management (AUM) of crypto dedicated investment funds has soared from $36.25B in January 2021 to $59.6B as of October 2021.[5]

Market participants should note that part of this jump in AUM year-over-year is attributable to legacy financial institutions and investors investing directly into crypto-focused funds. For instance, earlier in the year, NYDIG raised $100M from Liberty Mutual Insurance, Star Insurances, and others, and Fidelity purchased a $20M stake in Marathon Digital Holdings.[6] The number of crypto-focused funds also grew from 804 in 2020 to 851 in 2021, the bulk of which is represented by crypto-related hedge funds rather than venture capital.[7]

Figure 13

Crypto Funds Assets Under Management (Millions)



Source: Kraken Intelligence, Crypto Fund Research

As impressive as last year's growth was for crypto-dedicated investment funds, interest, support, and adoption from legacy financial institutions were most notable given their relative underexposure to the asset class. These developments included the following:

- BlackRock authorized two of its funds to invest in BTC.[8]
- Morgan Stanley began offering clients access to BTC funds.[9]
- BNY Mellon said it would hold and transfer BTC on behalf of its asset management clients.[10]
- State Street said it was providing the infrastructure for a new bank-grade trading platform for digital assets and would go live mid-year.[11]
- KiwiSaver Growth Strategy (a $350M retirement plan operated by New Zealand Wealth Funds Management) allocated 5% of its assets to BTC.[12]
- Investment bank Cowen announced plans to offer crypto custody services to hedge funds and asset managers.[13]

- Hedge fund behemoth Point72 said its looking to invest into cryptoassets.[14]
- J.P. Morgan became the first bank to offer its retail wealth clients access to crypto funds.[15]
- Neuberger Berman approved its $164M commodities-focused mutual fund to invest indirectly in BTC and ETH.[16]
- Franklin Templeton said it was hiring staff to execute BTC and ETH trades.[17]
- Soros Fund CEO/CIO Dawn Fitzpatrick said billionaire investor George Soros' family office has invested in BTC.[18]
- J.P. Morgan launched an in-house BTC fund for wealthy clients.[19]
- Harvard, Yale, and Brown's endowment stated they've been buying BTC since 2020.[20]

Well respected traditional finance gurus also expressed interest and/or support for BTC and the broader cryptoasset market. Ray Dalio calls BTC "one hell of an invention" and has considered a new fund aimed at offering protection against the debasement of fiat money by investing in BTC.[21] Howard Marks changed his mind on BTC after previously dismissing its value.[22] Wall St. veteran Anthony Scaramucci said BTC is as safe as owning bonds and gold. Scott Minerd, CIO of Guggenheim, suggested that BTC's fair value is between $400K and $600K. Paul Tudor Jones said he prefers Bitcoin over gold as a hedge against inflation and said he is setting up an investment fund aimed at crypto.[23,24,25] Later in the year, billionaire Barry Sternlicht, a co-founder of $95B investment firm Starwood Capital Group, said gold is "worthless" and that he is holding BTC because every government in the "western hemisphere" is printing endless amounts of money.[26]

A cohort of corporates also added BTC and other cryptoassets to their balance sheet in 2021 as part of a broader treasury management strategy that would reduce exposure to the U.S. dollar, hedge against inflation, and provide upside to an emerging store of value. The biggest champion of 2021 was publicly listed software company MicroStrategy, which purchased an additional ₿50,000 over the course of the year and made up 6.5% of the total ₿1,468,560 (7% of BTC's ₿21M supply) that sits on the balance sheet of publicly-traded corporates.[27]

Figure 14

Publicly traded companies with more than ₿1,000 on balance sheet

Company	Country	Symbol	Bitcoin Owned
MicroStrategy LLC	US	NADQ:MSTR	₿121,043
Tesla, Inc.	US	NADQ:TSLA	₿43,200
Square Inc.	US	NADQ:SQ	₿8,027
Marathon Digital Holdings	US	NADQ:MARA	₿7,453
Coinbase Global, Inc.	US	NADQ:COIN	₿4,487
Hut 8 Mining Corp	CA	NADQ:HUT	₿4,450
Galaxy Digital Holdings	CA	TSE:GLXY	₿4,000
Bitcoin Group SE	DE	ADE.DE	₿4,000
Riot Blockchain, Inc.	US	NADQ:RIOT	₿3,995
Bitfarms Limited	CA	NASDAQ:BITF	₿2,973
NEXON Co. Ltd.	US	TYO:3659	₿1,717
Argo Blockchain PLC	US	OTCPK:ARBKF	₿1,268
Hive Blockchain	CA	CVE:HIVE	₿1,266
Seetee AS	NO	AKER:NO	₿1,170

Source: BitcoinTreasuries.net

However, corporate adoption didn't just exist in terms of adding digital assets to balance sheets, but also in the integration of crypto-related products into existing businesses. For instance, Mastercard disclosed plans to support crypto payments for merchants.[28] Tesla announced support for crypto payments.[29] Japanese e-commerce giant Rakuten enabled support for crypto purchases.[30] Visa announced a pilot to settle USDC on its network and a partnership with over 50 crypto companies to enable client crypto usage.[31] PayPal launched its crypto checkout service, and Venmo added support for crypto purchases.[32,33] Not only that, but Block (formerly Square) CEO Jack Dorsey said the company was considering a "bitcoin mining system based on custom silicon and open source for individuals and businesses worldwide."[34,35,36,37,38]

Elon Musk Flips

BTC experienced one of its biggest "wins" earlier in the year when electric car manufacturer Tesla had announced that it invested $1.5B in BTC and planned to accept crypto as a payment method for its cars.[39] It was then on March 24, 2021 that Tesla officially enabled support for BTC payments, igniting a wave of bullish price action in anticipation of other large corporations accepting BTC and other cryptoassets as payment.[40] Because of the size of Tesla and the cultural significance of Elon Musk, the electric car manufacturer's adoption was perceived as one of Bitcoin's biggest turning points in history. To many market participants, this was the start of a new era for BTC. However, the excitement and momentum quickly faded in May 2021 when Elon Musk said on Twitter that Tesla had "suspended vehicle purchases using bitcoin" out of concern over "rapidly increasing use of fossil fuels for bitcoin mining."[41]

To crypto enthusiasts, Musk's change in stance on BTC was a devastating blow to the cryptosset; those in crypto saw the news as disappointing not only because of its impact on future corporate adoption, but also because many believed Musk's comments on BTC mining being harmful for the environment as factually incorrect and founded on incomplete information. To those outside of crypto, it reinforced a narrative of "bitcoin being a waste of energy" even further—thereby damaging market sentiment and serving as fuel for long-time BTC critics to take another jab at the nascent digital asset.

While BTC derisked on the news and critics continued to fire shots, supporters banded together to shed light on the realities of BTC mining and its impact on the environment. For instance, the Bitcoin Mining Council was formed with a mission of promoting "transparency, share best practices, and educating the public on the benefits of Bitcoin and Bitcoin mining."[42] Shortly after launching, the organization produced a research report in June showing that 56% of BTC mining is powered by sustainable energy sources.[43] Nearly a month later, Musk stated at a virtual panel discussion hosted by the Crypto Council for Innovation that Tesla will "most likely" resume accepting BTC as a form of payment once at least 50% of BTC mining is run on renewable energy.[44]

Although the year ended without any news of future adoption or acceptance of BTC from Musk's Tesla, the billionaire did state that he and his company still own BTC and do not intend to sell. Accordingly, one could expect 2022 to bring about further clarity from Tesla on its plans to accept or integrate BTC and other cryptoassets into its businesses.

China FUD

Unsurprisingly to many crypto veterans, a slew of headlines came out in 2021 from Chinese media indicating that the Chinese government and central bank had "banned" BTC yet again. Both entities took action to limit the trading and mining of the digital asset in the country. While the broader market derisked on the news, many who have been in crypto for several years know that China has postured against crypto several times in the past and has taken several steps to rid the country of any crypto presence in favor of their local, digital RMB program.

On May 19, 2021, China reiterated its 2013 and 2017 stances that financial institutions can't provide crypto-related services, in addition to announcing a further crackdown on BTC miners and trading.[45] A week later, inner Mongolia announced 8 proposed measures to restrict BTC mining.[46] On June 9, 2021, BTC miners in Xinjiang and Qinghai were ordered to close operations, followed by Sichuan ordering state-owned energy suppliers to cut power to 26 local mining farms on June 18, 2021.[47] A few months later, China's central bank said on September 24, 2021 that all crypto-related transactions are illegal. While each one of these headlines weighed on sentiment and price, many veterans looked to the past to see for themselves how BTC has, on average, gone on to trend higher following said headlines. As shown in figure 15, there have been more than a dozen instances since 2013 where the Chinese government or central bank has cracked down on BTC and crypto.

Figure 15

China Headlines and BTC Return

Date	News Announcement	1D Return	7D Return	30D Return	90D Return
12/5/13	China bans banks from handling BTC trades and declares BTC illegal tender	-18%	-14%	-19%	-35%
3/21/14	A false report stating that the PBOC will halt all BTC transactions is released	-1%	-12%	-13%	4%
4/3/14	BTC38, one of China's biggest BTC exchanges, closes its doors to new deposits following the PBOC's clampdown on crypto	0%	-19%	-2%	45%
4/28/14	BTC China suspends yuan deposits from the China Merchant Bank amid pressures from the PBOC	1%	-2%	31%	34%
9/4/17	China bans ICOs and financial institutions from providing crypto-related services	3%	-2%	-2%	160%
9/11/17	Reports from Chinese media surface that the government plans to close down crypto exchanges	0%	-3%	14%	258%
1/4/18	China clamps down on preferential treatment for BTC miners	12%	-13%	-39%	-55%
4/8/19	China state planner says they want to eliminate BTC mining	-2%	-5%	13%	117%
5/19/21	China reiterates its 2013 & 2017 stance that financial institutions can't provide crypto-related services	-14%	-11%	-11%	22%
5/21/21	China announces a crackdown on BTC miners and trading	0%	-4%	-5%	25%
5/25/21	Inner Mongolia announces 8 proposed measures to restrict BTC mining	2%	-4%	-10%	28%
6/9/21	Baidu, Zhihu, & Weibo censor keywords related to major crypto exchanges, BTC miners in Xinjiang and Qingha are ordered to shut down operations	-2%	3%	-1%	58%
6/18/21	Sichuan orders state-owned energy suppliers to cut power to 26 local mining farms	-1%	-12%	-17%	26%
9/24/21	China's central bank says all crypto-related transactions are illegal, according to a Q&A statement on PBOC's website	-5%	-2%	42%	19%
Average:		-2%	-7%	-1%	53%
Median:		-1%	-5%	-4%	27%

Source: Kraken Intelligence

However, BTC has returned an average and median return of +53% and +27%, respectively, approximately 90-days after each crackdown from China. While one could expect the world's second-largest economy to crackdown on BTC further, history suggests that any weakness that follows could most certainly present a unique opportunity for long-term market participants.

A Bitcoin Exchange-Traded Fund (ETF)

After years of speculation, filings, and wait periods, regulators approved the first publicly-traded BTC futures ETF in the U.S. On October 15, 2021, the U.S. Securities and Exchange Commission (SEC) greenlit BTC futures ETFs, with ProShares confirming on October 19 that it will launch a BTC futures ETF for trading on the NYSE Arca on October 19 under the ticker BITO.[48] The ProShares BTC futures ETF boasted trading volume of more than $1B, marking the second most heavily traded ETF debut to date.[49] But demand didn't slow down then, as on November 11 ProShares' BITO surged to the top 2% of all ETFs in total trading volume with over $1.4B worth of inflows.[50] Although BITO took the rank as the most heavily traded BTC ETF, others emerged alongside the leader later in the year. On October 22, the Valkyrie Bitcoin Strategy ETF went live for trading, followed by VanEck's BTC futures ETF on November 15th and Global X Blockchain & Bitcoin Strategy ETF on November 16.[51,52] As of year-end, aggregate assets under management (AUM) by the four aforementioned ETFs stood at a whopping $1.4B.

Figure 16

US-Based BTC Futures ETFs

EFT	Inception Date	AIUM ($)	Prem./ Disc. to NAV	Trading Volume
ProShares Bitcoin Strategy ETF (BITO)	10/18/21	$1,170,118,000	0.79%	$182,375,000
Valkyrie Bitcoin Strategy ETF (BTF)	10/22/21	$72,338,500	0.39%	$16,219,261
VanEck Bitcoin Strategy ETF (XBTF)	11/15/21	$16,005,500	1%	$1,024,809
Global X Blockchain & Bitcoin Strategy ETF (BITS)	11/16/21	$8,557,417	-0.8%	$458,437

Source: Kraken Intelligence, Market Watch

While the first BTC ETFs launched in the U.S. last year, several other countries secured a BTC ETF of their own—a sign of further global adoption for the digital asset. For instance, on February 11, 2021, Canadian regulators approved the first publicly-traded BTC spot ETF in North America, the Purpose Bitcoin ETF, which amassed $42IM in AUM in its first two

days of trading.[53] Also, on March 19, Brazil became the first LatAm country to get its first BTC ETF.[54] On August 19, French regulators approved asset manager Melanion Capital to begin offering a BTC ETF in the European Union.[55] On November 7, the Australian Securities and Investments Commission (ASIC), gave the green light to long awaited spot exchange-traded funds (ETFs) in the world's two largest cryptoassets.[56] Lastly, on November 29, Singapore-based fund manager Fintonia Group launched the country's first spot BTC fund after receiving approval from the Monetary Authority of Singapore (MAS).[57]

Though market participants now can gain exposure to BTC via the legacy markets and the race towards the first U.S. BTC ETF is over, there remain several regions worldwide where a BTC ETF doesn't exist. We also have yet to see a number of BTC spot-based ETFs surface throughout the globe. For instance, in the U.S., the SEC has yet to approve a BTC ETF based on BTC spot holdings, and many continue to compete in the race to receive the first approval. That said, 2022 ought to lend insight into institutional demand given the rise of various BTC and other cryptoasset ETFs. The year ought to also bring forth the launch of new crypto ETFs in other regions of the world, thereby opening and unlocking the ability for many legacy market participants to gain exposure to the digital asset. More specifically in the U.S., market participants can expect investment managers to continue taking a shot at securing the first BTC spot-based ETF in 2022.

4.

Adoption

While "adoption" is the name of the game for all cryptoassets, it's not exactly clear what "adoption" looks like given it's not all that well-defined. This lack of clarity is partially due to the fact that there's an endless list of ways in which you can measure adoption—wallet counts, active user base, on-chain activity, market caps, total value locked, social media followings, demographics of holders, stadium advertising deals, government contracts, commercial partnerships, etc. The list goes on.

No matter how you define it, 2021 was a historic year for crypto and certainly a year that saw a landmark shift in the public image of the industry, due in part to many of the metrics mentioned above. In this section, we look into a number of notable adoption metrics that epitomize 2021's growth and are worth keeping an eye on going forward. In addition, we also recap major events that occurred throughout the year with respect to the adoption of Bitcoin and cryptoassets by nation states, local governments, and institutional investors, as well as key developments in Central Bank Digital Currencies (CBDCs).

User Growth & Activity

One of the more concrete measures of adoption is the number of users/holders. Since Bitcoin and Ethereum are the two most successful protocols in terms of user base, longevity, and market capitalization, we will focus on both as a proxy for broader industry adoption.

We can get a good glimpse of user growth and activity by investigating two on-chain metrics, *live addresses* and *monthly active addresses* (*MAA*). Live addresses is the total number of unique addresses with balances above a certain limit, for which we use 0.001 BTC, 0.01 BTC, 0.1 ETH, and 0.01 ETH, which correspond to levels of approximately $40 and $400 at present value (see figure 17). By basing these limits in native units instead of dollars, it ensures the observed growth in addresses is due to on-chain activity rather than market fluctuations. Therefore the live addresses metric gives insight into the relative scope for the absolute size and growth of a community.

Figure 17

Bitcoin and Ethereum Equivalent Prices (End of Year)

Year	0.001 BTC	0.01 BTC	0.01 ETH	0.1 ETH
2016	$1.02	$10.21	$0.08	$0.84
2017	$14.98	$149.82	$8.84	$88.40
2018	$3.94	$39.43	$1.55	$15.50
2019	$6.99	$69.85	$1.27	$12.70
2020	$32.13	$321.27	$7.74	$77.40
2021	**$47.33**	**$473.30**	**$37.38**	**$373.80**

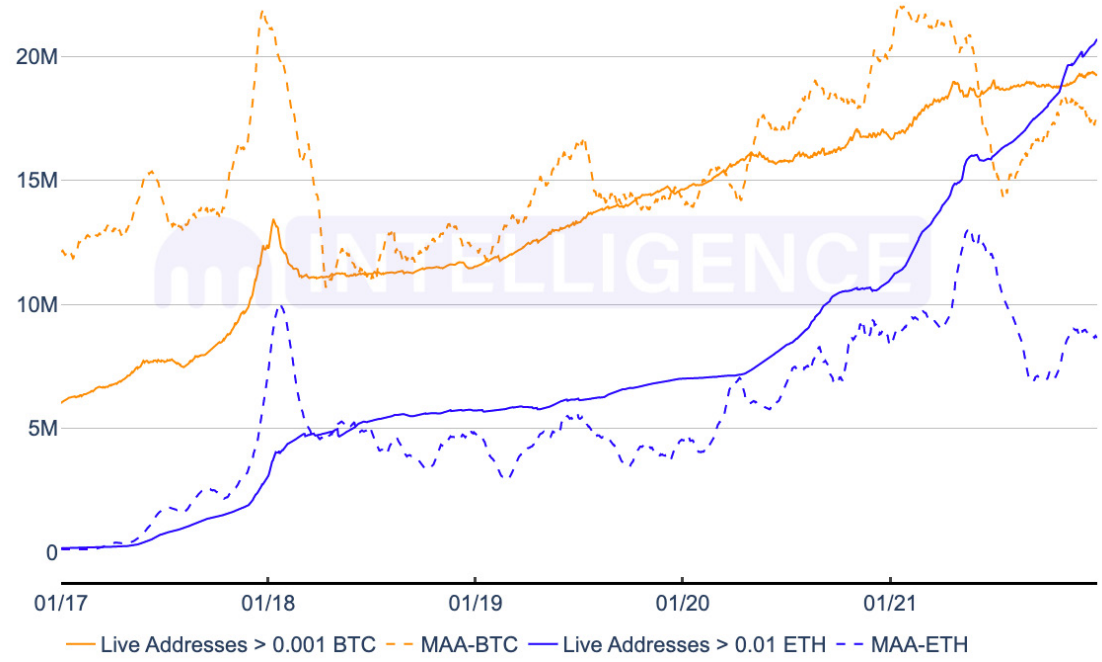
Source: Kraken Intelligence, CoinMarketCap

To get an indication of how active each community is, we can use MAA to see the number of unique addresses that have participated in on-chain activity over the past 30 days, such as sending or receiving a payment, submitting an on-chain vote, mining activity, and more.[58] It should be noted that MAA will count addresses below the balance threshold used for the live addresses metric. Therefore, it is possible for MAA to be larger than live addresses.

First, looking at live addresses larger than $40 (figure 18), we see both networks have seen significant and sustained growth over the past 5 years. While growth remained flat for nearly all of 2018, it started to pick up in 2019 and has held steady since. Between 2020 and 2021, one will find that Ethereum's growth took off in the summer of 2020 and eventually surpassed Bitcoin live addresses in late October 2021.

Figure 18

Bitcoin & Ethereum User Growth and Activity—Addresses > $40 Present Value



Source: Kraken Intelligence, CoinMetrics

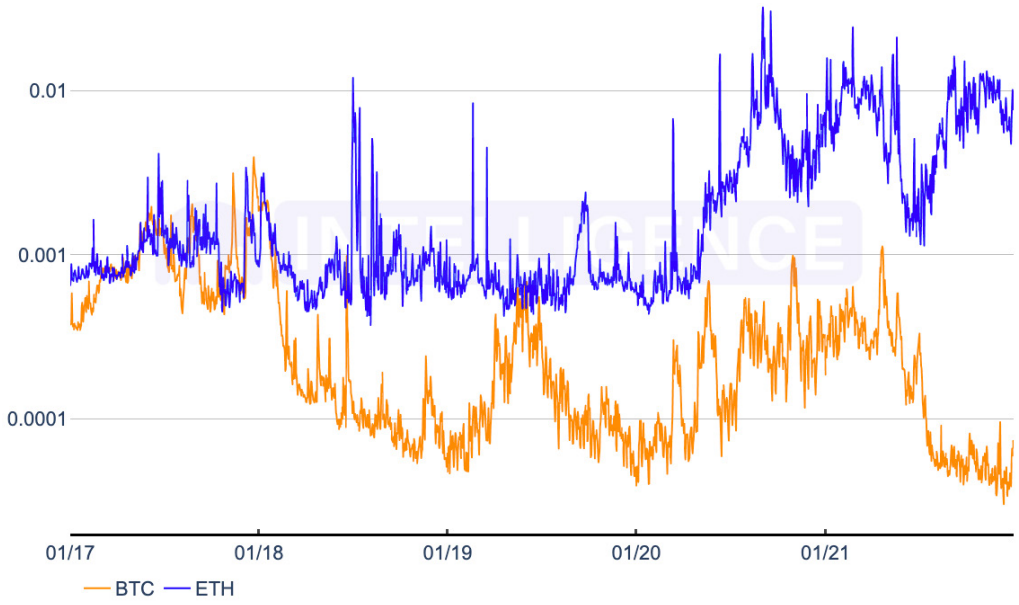
However, this does not seem to paint the entire picture; one element to consider is transaction fees. If a wallet has less money than it costs to send that money, then those funds are stuck and not worth retrieving unless the account holds more assets such as ERC-20 coins or NFTs. Similarly if transaction fees are expected to consume say 50% of

a user's funds when they try to empty their account, they are far less likely to do it. As a result, the live addresses metric would show these addresses to be "live" even though the user doesn't have enough money to do anything or they abandoned the account.

This happens to be the case for Ethereum. As shown in figure 19, in the middle of 2020, average transaction fees on Ethereum increased 10-fold to 0.01 ETH. This coincides with the large spike in addresses larger than 0.01 ETH as well as the popularity of DeFi and NFTs on Ethereum. While this demand was real, as evidenced by the transaction fees, and addresses truly did increase likely with the popularity of DeFi and NFTs on Ethereum, the live address growth seen in figure 18 is misrepresentative, as it now consists of a number of zombie addresses that cannot be emptied. Bitcoin experienced a similar issue in late 2020 and early 2021 but to a lesser degree.

Figure 19

Bitcoin & Ethereum Average Transaction Fees (Native Units)



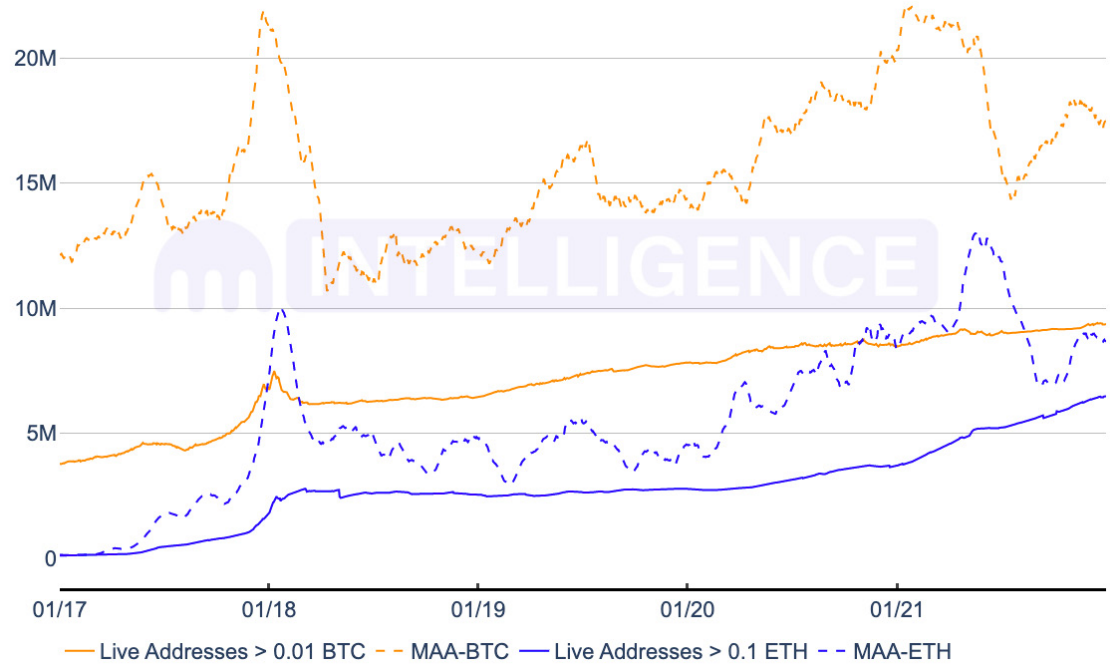
Source: Kraken Intelligence, CoinMetrics

To reduce the effect of zombie zombie addresses, we shift focus to live addresses with $400 (0.01 BTC and 0.1 ETH). Looking at figure 20, we can see this greatly reduces the growth in Ethereum live addresses relative to Bitcoin. This is likely a better indication of on-chain growth between the two platforms and shows Bitcoin still holds about 3M more live addresses than Ethereum. However, this chart does indicate Ethereum addresses grew at a significantly faster rate in 2021 compared to Bitcoin. Per figure 21, the network grew faster in terms of absolute and percentage growth. Ethereum experienced an increase of 2.74M live addresses in 2021 while Bitcoin correspondingly grew by 886K live addresses. This implies either new people are joining crypto and skewing towards Ethereum and/or that Bitcoin users are diversifying into the Ethereum ecosystem. In all likelihood, it is a combination of both.

There is a caveat. The comparison of the two projects isn't entirely apples-to-apples. The proliferation of Ethereum-based NFT mints and DeFi airdrops, both of which aren't as prevalent on Bitcoin, may incentivize users to create multiple Ethereum accounts. It is also possible duplicate accounts on Ethereum are incentivized by some opportunities such as *miner extractable value* (*MEV*) where users can create bots and pay miners to extract value in DeFi activities through the manipulation of transaction ordering such as front running and other techniques. Therefore, the relative growth between networks in terms of live addresses is potentially skewed on Ethereum and may not reflect the true number of *unique* new users.

Figure 20

Bitcoin & Ethereum User Growth and Activity—Addresses > $400 Present Value



Source: Kraken Intelligence, CoinMetrics

Figure 21

Bitcoin & Ethereum Annual Growth Summary—Addresses > $400 Present Value

	Addresses > 0.01 BTC			Addresses > 0.1 ETH		
Year	**Count**	**Growth**	**Growth %**	**Count**	**Increase**	**Growth %**
2016	3,775,178	—	—	107,403	—	—
2017	6,739,580	2,964,402	79%	1,793,865	1,686,462	1570%
2018	6,457,193	-282,387	-4%	2,553,149	759,284	42%
2019	7,810,424	1,353,231	21%	2,779,602	226,453	9%
2020	8,465,658	655,234	8%	3,700,717	921,115	33%
2021	**9,351,714**	**886,056**	**10%**	**6,435,973**	**2,735,256**	**74%**

Source: Kraken Intelligence, CoinMetrics

Shifting focus to MAA, we can see the metric generally moves in step with live addresses and surges in times of volatility as seen in December 2017 and January 2018 during the ICO craze. Explanations include new users joining the community as they learn more about the industry and inactive users returning to capture volatile moves. MAA is also amplified by increased deposits into exchanges that often use a routing method to forward user-deposited funds to the exchange's master wallet, which contributes towards MAA, but leaves live addresses unaffected as underlying users are consolidated into few cold storage addresses (i.e. live addresses remains unaffected assuming users are not liquating their personal wallets below the threshold for live addresses).

We see the correlation between MAA and live addresses breakdown when the MAA for both networks drops off significantly in the spring and summer months of 2021. This timing coincides with the exodus of miners from China and the ensuing correction in markets. MAA eventually recovers for both networks to a certain degree, but it seems Bitcoin recovered more so than Ethereum. This is likely due to transaction fees as discussed earlier but could also be indicative of miner activity.

Given both of these points, we conclude MAA is not a good metric for determining the absolute size of a community at any single point in time as it is very prone to high fluctuation in times of volatility and network disruption. However, we can derive a signal from a combined upward trend of both live addresses and MAA. This results in higher conviction in the validity of live address growth and implies an increase in user adoption.

Overall, the data shows both blockchains are persistently growing, including at the current $400+ threshold, which is a good indicator for the relative growth of each platform. That said, the data is not indicative of the overall size of the community for each asset as off-chain platforms such as centralized exchanges, PayPal, Robinhood, ETPs/ETFs, etc. enable their users to own cryptoassets without creating an on-chain wallet. Therefore, this data represents a conservative *lower bound* for the size of user adoption at the $400+ threshold.

Nation States

Irrespective of their stance, nation states were vocal last year in their approach to the crypto industry. El Salvador made history by being the first country to adopt BTC as legal tender, while other countries chose to go with their own implementation of digital currency, known as Central Bank Digital Currencies (CBDCs).[59] This move towards CBDCs sparked a debate within the industry, questioning whether CBDCs would accelerate or dampen the adoption of the broader crypto industry.

The adoption of CBDCs saw meaningful traction as central banks worldwide were met with a growing appetite for more efficient inter- and intra-national payment systems. This coincided with the introduction of cryptoassets that provided a quicker and cheaper means of payment and a broader trend of societies going cashless. Private tech companies such as Meta (formerly Facebook) developing Diem (formerly known as Libra), its digital stablecoin, also played a part in this nudge towards creating CBDCs. By 2Q2021, most nations had announced a plan regarding the development of a CBDC, with interest most pronounced in emerging and developing economies.[60] While the applications of CBDCs are numerous, they're generally a digitized form of the nation's existing fiat currency. Though the concept of CBDCs is inspired by distributed ledger technologies, they remain a form of centralized money issued and controlled by the state, antithesis to the philosophy of non-sovereign money.

According to central banks around the world, CBDCs could help relieve some of the limitations in existing national payment systems by acting as an affordable payment method to seamlessly transfer funds across different accounts while reducing costs and inefficiencies tied to low interoperability.[61] In cases of limited cash access/acceptance points and low cash circulation, CBDCs could guarantee the public access to central bank money. In terms of limitations, central banks believed that CBDCs could cause the disintermediation of the commercial banking sector, accelerate bank runs at times of financial distress, and create an environment where central banks play too large a role in the financial system.[62]

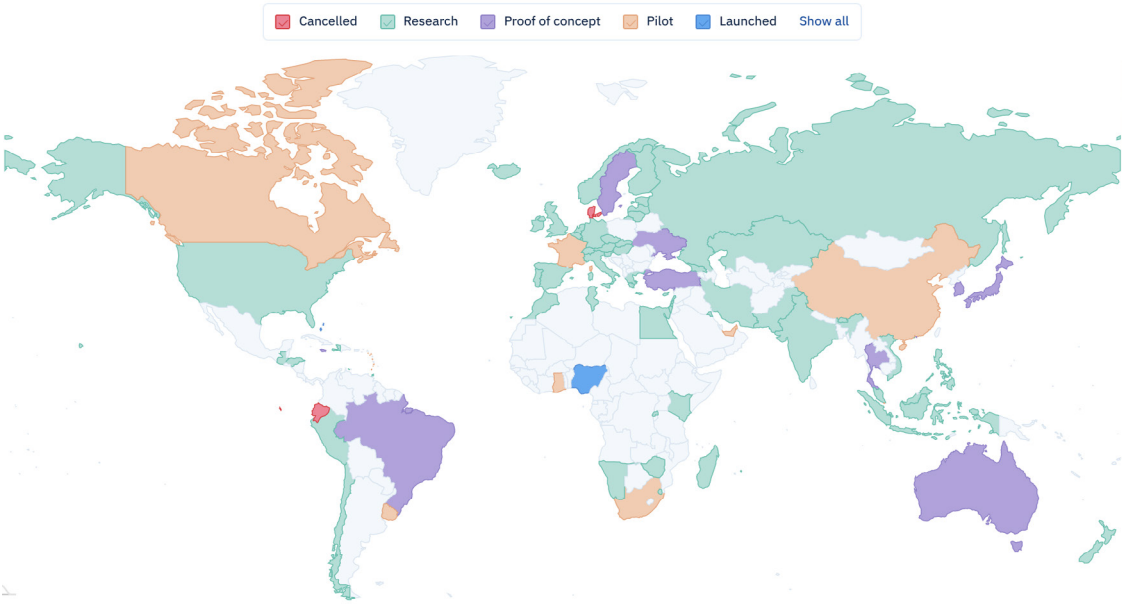
The effects of the COVID-19 outbreak of 2020 carried well into 2021, and the need for an inclusive, remotely accessible, simplified, and efficient mode of money was apparent. With countries going into lockdown and social distancing, the trend of online spending and going cashless was further highlighted. This raised a critical conversation around the difference between cryptoassets and CBDCs, and whether one would render the other useless. Some argued that the usage of cryptoassets and CBDCs could have an overlap, where either one could be a viable option for those looking for an efficient mode of money in light of the societal and cultural changes we experienced in 2021. However, delving into the architecture and purpose of CBDCs, it becomes evident that the two are strikingly different assets that carry different impacts to their end users.

While cryptoassets were founded on the tenets of decentralization, privacy, inclusion, and individual agency, CBDCs are designed and maintained by centralized entities: a nation's central bank and government. Cryptoassets provide inclusivity by empowering individuals to take control of their personal financial information and provide access to decentralized financial services. On the other hand, CBDCs are a digitized version of existing fiat currencies and will likely invite a greater presence of governments into financial systems. CBDCs also carry significant security and privacy concerns, as they can lend governmental authorities insight into the financial transactions of individuals, which result in failed adoption of CBDCs even if successfully created. Given the two very different purposes behind cryptoassets and CBDCs, it's likely that they will continue to coexist and serve a different audience. It's also possible that the development and launch of CBDCs could lead to greater adoption of cryptocurrencies, as businesses become equipped with the infrastructure to accept digitized forms of money and the average person becomes familiar with the concept of virtual currencies. Some believe that CBDCs could also directly compete with stablecoins, which are essentially tokenized fiat money. However, as a cryptoasset, stablecoins operate on a public blockchain and provide the security and privacy of a decentralized network, unlike CBDCs. Only time will tell how CBDCs will develop to operate on a national and international level.

In figure 22, we look at the different countries and their respective stages of a CBDC development. For a deeper understanding, please refer to our **report on CBDCs.**

Figure 22

Global landscape of CBDCs



Central Bank	Region	CBDC	Announced	Current Stage
Europe				
Bank of England	United Kingdom	Britcoin	2014	Research
Sweriges Riksbank	Sweden	e-krona	2016	Proof of concept
Swiss National Bank	Switzerland	e-franc	2018	Research
Norges Bank	Norway	—	2018	Research
Bank of Russia	Russia	Digital Ruble	2018	Research
Eurpoean Central Bank	Euro Area	Digital Euro	2019	Research
Czech National Bank	Czech Republic	—	2020	Research
National Bank of Georgia	Georgia	—	2020	Research
Central Bank of the Republic of Turkey	Turkey	Digital Lira	2020	Proof of concept

Central Bank	Region	CBDC	Announced	Current Stage
Asia-Pacific				
People's Bank of China	China	e-CNY	2016	Pilot
Bank of Japan	Japan	Digital yen	2019	Proof of concept
The Central Bank of Taiwan	Taiwan	—	2019	Research
Bank of Korea	Republic of Korea	—	2020	Pilot
Bank of Thailand	Thailand	—	2020	Research
Reserve Bank of India	India	—	2020	Research
Oceania				
Reserve Bank of Australia	Australia	—	2020	Research
Reserve Bank of New Zealand	New Zealand	—	2020	Research
Americas				
Central Bank of Brazil	Brazil	Digital Real	2016	Research
Central Bank of Bahamas	Bahamas	Sand Dollar	2016	Launched
Eastern Caribbean Central Bank	Eastern Caribbean Economic and Currency Union (OECS/ ECCU)	DCash	2019	Pilot
US Federal Reserve	United States	—	2019	Research
Bank of Canada	Canada	E Dollar	2019	Research
Bank of Guatemala	Guatemala	iQuetzal	2020	Research
Central Bank of Chile	Chile	—	2020	Research

Source: CBDC tracker
Canceled: Countries that canceled or decommissioned a CBDC.
Research: Countries that have conducted first explanatory CBDC research.
Proof of Concept: Countries that are in an advanced research stage and have published a CBDC proof of concept.
Pilot: Countries that have developed a CBDC that is tested in a real environment either with a limited number of parties or on a wide scale.
Launched: Countries that officially launched a CBDC.
National CBDCs listed are those envisioned for retail use (vs. wholesale). For more detail, please see our report on CBDCs.

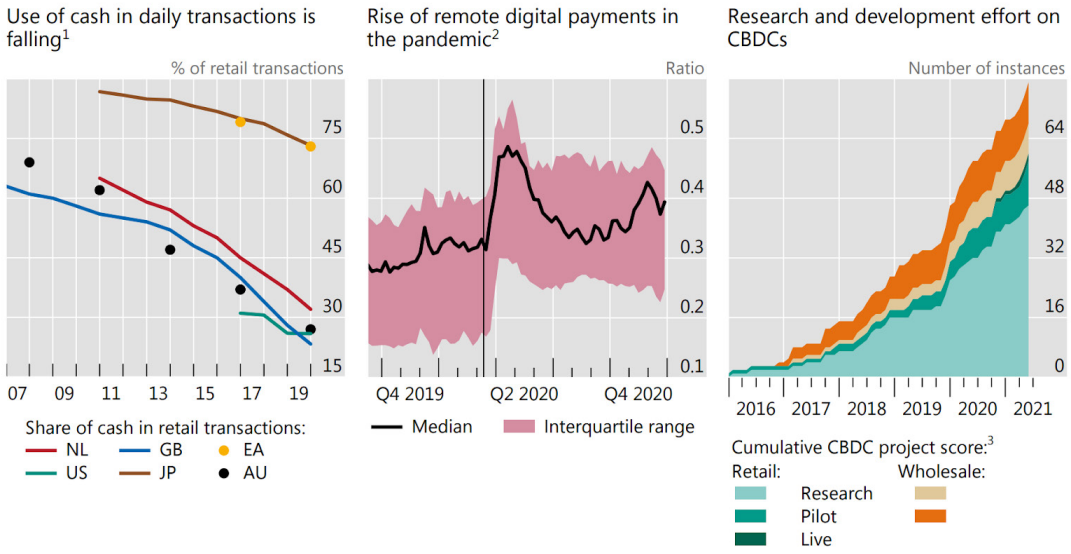
Outlook on CBDCs

Central Bank Digital Currencies (CBDCs) are closer to becoming a global reality as many nations in the world have made strides in their development within the past year. Some nation states that were once against CBDCs began their research phase and those who have been researching began pilot testing their national e-currencies. A combination of the lifestyle changes we have had to endure as a global community due to the pandemic and the explosion of the crypto market has set the foundation on which nations examine their national currency in the context of cryptocurrency. This sentiment is confirmed in

figure 23. Apart from the overall uptake of digital payments, a shift in spending patterns and payment trends also revealed the lack of inclusion in economies with large, unbanked populations. Consequently, many central banks around the world quickly pushed forward with research, development, and trial of CBDCs.

Figure 23

Change in digital payment trends and its impact on CBDC developments



Source: Bank for International Settlements (BIS) Annual Economic Report

Looking forward, it's anticipated that CBDCs will conitnue to be a focal agenda item of central banks around the world. National governments benefit from greater visibility into financial systems, the ability to potentially streamline monetary policy, financial inclusion, as well as the ability to create a potential revenue in the form of taxation. We believe the incentives are strong enough to encourage continued research and development in CBDCs in the year ahead.

While most are currently in the research or pilot testing phases, it may be a while until we see the actual implementation of CBDCs. The applications of CBDCs can vary significantly depending on how a nation wishes to configure it for its chosen purposes, which is likely to result in a long trial period where different use cases are tested. As CBDCs inch closer to launch, we will likely see countries with high internet penetration rates and smartphone usage develop CBDC integration methods, ones that will seamlessly meld it into existing financial systems and applications for the ease of the end-user. This may happen independently by private companies or through a collaboration between central banks and large tech companies that will develop or integrate it into their existing products.

However, there are challenges that central banks must address before these currencies can successfully launch as they are currently intended to function. Defining the parameters of a CBDC in a way that will not result in a destabilized economy or commercial banking sector, bringing about high adoption rates in a way that does not erode national currencies, enabling interoperability without crossing financial borders and jurisdictions, are among some of the larger concerns that will be reflected in the final design of each CBDC.[63] As more countries begin to trial their CBDCs, we believe these boundaries and intentions for each CBDC will become clearer, and give us a better understanding of how they will begin to co-exist with other CBDCs as well as existing national currencies.

Crypto Levels Up

Regulatory Maturity

Bitcoin appeared to be the talk of the town in almost every major country this year. Even international regulators, such as the International Monetary Fund (IMF) and the Bank for International Settlements (BIS), felt obligated to step in to share their opinions in light of the industry's maturation and growth over the past year.[64] While this level of regulatory scrutiny may seem like a headwind for the Bitcoin industry on the surface, many market

participants agree that this is a necessary step for Bitcoin to achieve mainstream adoption in the long haul. Moreover, it shows how much Bitcoin has matured since the infamous 2017 bull run. Bitcoin's regulatory maturity was particularly evidenced by key milestones, including the long-awaited launch of the first BTC exchange-traded funds in the U.S. and El Salvador accepting BTC as legal tender.

Bitcoin Exchange Traded-Funds (ETFs)

While many contend that investing in a BTC ETF offers virtually no benefits compared to purchasing BTC directly on a spot exchange, the acceptance of BTC ETFs throughout North America in 2021 was a bold testament to the rapid adoption of Bitcoin and may lay the groundwork for the next wave of Bitcoin adoption.

Canada

Canada's financial regulator approved the first publicly-traded BTC ETF in North America on February 11, 2021—the Purpose Bitcoin ETF.[65] The launch of a BTC-based ETF in Canada was noteworthy because it indicated that pending BTC ETF applications were likely moving towards approval, which proved to be the case. As of year-end, five total Canada-based BTC ETFs launched and have since amassed roughly ₿51,295 ($2.5B).

Figure 24

Canada-Based BTC ETFs

ETF	Launch Date	# of BTC	Value Today	% of Total Supply
Purpose Bitcoin (BTCC)	12/18/21	₿22,411	$1,035,473,826	0.11%
CI Galaxy Bitcoin Fund (BTCG)	3/5/21	₿3,248	$150,070,010	0.02%
3iQ CoinShares Bitcoin ETF (BTCQ)	4/19/21	₿21,237	$981,230,540	0.10%
Ninepoint Nitcoin Trust	5/6/21	₿2,736	$126,413,653	0.01%
Evolve Bitcoin ETF (EBIT)	9/29/21	₿1,663	$76,836,954	0.01%
Total:		**₿51,295**	**$2.4B**	**0.24%**

Source: Kraken Intelligence, BitcoinTreasuries.org

United States

In arguably the most highly-anticipated event since the May 2020 **halving**, Bitcoin's first ETF in the U.S. launched on October 19th—albeit an ETF tied to futures rather than the spot market. This ETF launch reflected the growing maturity of Bitcoin and other cryptoassets as investment managers have sought approval for a BTC ETF from regulators for eight long years.[66] Unlike previous BTC ETF applications, these ETFs were structured to own BTC futures contracts and were filed under mutual fund rules, said to provide "significant investor protections" by SEC Chair Gary Gensler.[67]

The ProShares BTC futures ETF (BITO) saw a massive capital inflow in its first week, trading $250M worth of shares in the first 15 minutes and a whopping $320M in the first 30 minutes.[68] The ETF saw so much demand that it had the second heaviest-traded ETF debut on record and became the fastest fund to reach $1B in AUM in the first 48 hours.

Since then, several other BTC futures ETFs have launched, such as VanEck's XBTF and Global X's BITS. However, these BTC-linked ETFs have experienced muted uptake relative to the first and second U.S.-based BTC futures ETFs from ProShares and Valkyrie, respectively.

Figure 25

US-Based BTC Futures ETFs

ETF	Inception Date	AUM ($)	Prem./ Disc. to NAV	Trading Volume
ProShares Bitcoin Strategy ETF (BITO)	10/19/21	$1,170,118,000	0.79%	$182,375,000
Valkyrie Bitcoin Strategy ETF (BTF)	10/22/21	$72,338,500	0.39%	$16,219,261
VanEck Bitcoin Strategy ETF (XBTF)	11/15/21	$16,005,500	1%	$1,024,809
Global X Blockchain & Bitcoin Strategy ETF (BITS)	11/16/21	$8,557,417	-0.8%	$458,437

Source: Kraken Intelligence, Market Watch

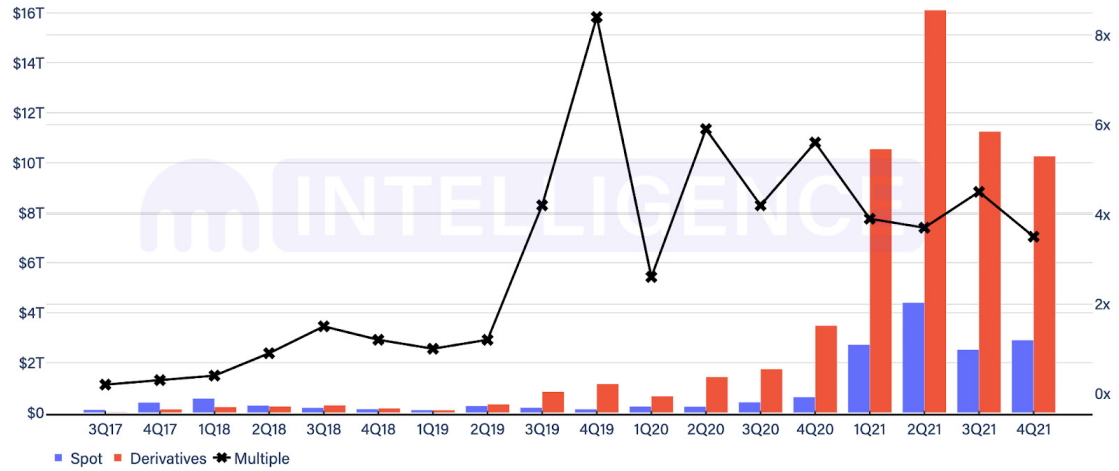
Several funds that applied for spot-based BTC ETF hoped to ride the momentum of the successful futures-based ETFs, but the SEC has shown no intentions of listing such investment vehicles in the near-term because they continue to believe there is potential harm to investors. Historically, the regulator has chosen to postpone BTC ETF decisions, maximizing their statutory extensions. In some cases, this results in applicants pulling their application to outright avoid rejection and reapply after addressing certain risks highlighted by the regulators. Recently, the SEC appeared sure-footed, rejecting VanEck's BTC spot ETF application on November 12, stating that the ETF still isn't "designed to prevent fraudulent and manipulative acts and practices" and "to protect investors and the public interest."[69] For experienced market participants, this news proved unsurprising given prior comments from SEC Chairman Gary Gensler. The regulatory sentiment for a BTC spot-based ETF in the U.S. was so bearish that Fidelity, the world's fourth-largest fund manager, opted to launch a BTC spot ETF in Canada on November 30 instead of waiting for the SEC to come around.[70]

Crypto Derivatives

Crypto derivatives saw their fair share of growth this year with volume rising to roughly $16T in the second quarter during BTC's initial rise to $65,000. While volume on both crypto spot and futures platforms declined notably in the third and fourth quarters, volume metrics remained orders of magnitude higher relative to prior years. 4Q2021 alone saw more volume than all of 2020. Year-over-year, spot volume across Kraken and its peer group of spot and derivatives exchanges grew +687% and +543%, respectively.

Figure 26

Spot Volume vs. Derivative Notional Volume



Source: Kraken Intelligence
Note: Multiple = Derivatives Notional Volume ÷ Spot Volume (Spot exchanges include Kraken, Bittrex, Binance, Binance US, Bitfinex, Bitstamp, Coinbase, Gemini, Poloniex; derivatives exchanges include Kraken Futures, Bitfinex, OKEx, Bybit, CBOE, Deribit, Bakkt, FTX, HuobiDM, CME, BitMEX, Binance)

Compared to spot markets, derivatives markets have not grown more top-heavy (i.e., derivatives volume outpacing spot volume) than usual and remain at levels lower than those seen all through 2Q–4Q2020. Despite the massive growth in both spot and derivative markets, the ratio of derivatives volume to spot volume remains relatively flat on the year at 3.8x. Such suggests that although the crypto industry continues to rise, its top-heavy market structure where derivatives outsize the underlying spot market doesn't appear to be diverging further—a healthy sign for a maturing industry because it implies that the spot market is catching up to the **growth we saw in derivatives years ago**.

TradFi Endorsements: Put Your Money Where Your Mouth Is

2021 saw growing interest from traditional financial interests, including renowned investors, public companies, cities, and even countries. These cohorts gobbled up over 7% of the total 21 million BTC supply, 3.86% of which are sitting in ETFs, 1.25% held by countries, 1.17% in public firms, and more than 0.8% that are held by private companies.

Tesla, MicroStrategy, and Block (formerly Square) were the notable players this past year, continuing the trend from 2020. With U.S. CPI (inflation) at 30-year highs, inflation narratives from the likes of investors like Paul Tudor Jones are increasingly turning the spotlight on BTC as an inflation hedge. Adoption from this cohort during 2021 further proved that the largest institutions and high net worth individuals are developing higher conviction in cryptocurrencies as a legitimate asset class.

Figure 27

Bitcoin Treasuries Overview

	# of BTC	Value Today	% of Total Supply
ETFs	₿809,848	$37B	3.86%
Countries	₿263,308	$12B	1.25%
Public Companies	₿244,623	$11B	1.17%
Private Companies	₿174,068	$8B	0.83%
Totals:	**₿1,501,406**	**$69B**	**7.15%**

Source: Kraken Intelligence, BitcoinTreasuries.org

Publicly-Traded Companies

Tesla

After Tesla CEO Elon Musk first expressed interest in purchasing BTC on December 20th, 2020, during a conversation with Microstrategy's Michael Saylor, Tesla announced in an SEC filing on February 8th that it bought $1.5B worth of BTC for "more flexibility to further diversify and maximize returns."[71] Tesla also said it would start accepting BTC payments for its products "subject to applicable laws and initially on a limited basis," making it the first major automaker to do so.[72] Musk, after deciding to no longer accept BTC payments months later, subsequently reignited his belief in crypto by stating that he would reconsider accepting BTC payments at Tesla if the mining industry were to run on roughly 50% renewable energy.[73,74]

Block

After Jack Dorsey's Block, formerly Square, purchased $50M of BTC in October 2020 for its treasuries, the firm announced in February 2021 that it more than tripled that number by putting 5% of cash reserves into BTC, or $170M at the time. Block continues to promote Bitcoin by dedicating itself to furthering its development through Spiral (formerly Square Crypto), Block's non-profit Bitcoin development fund. Block CEO Jack Dorsey is such a strong proponent of Bitcoin that he said at the Bitcoin 2021 conference in Miami, "If I were not at Square [now Block] or Twitter, I'd be working on bitcoin."[75] Nearly six months later, Dorsey stepped down from his CEO role at Twitter and some speculate he is dedicating more time to Bitcoin, given his previous comments.

Seetee AS (Subsidiary of Aker ASA)

On March 8, 2021, Norway-based Aker ASA launched a BTC-focused venture capital firm called Seetee AS and made its first purchase of ₿1,170 ($59M at the time of sale).[76] Seetee's goal is to hold these coins over the long-term while investing in BTC-based companies and occasionally adding to their BTC reserves in the process. Aker and Seetee have particularly focused on ESG-focused BTC companies.

Meitu

Photo-editing app Meitu, a publicly-traded firm in Hong Kong, acquired a total of Ξ31,000 and about ₿941 in March and April, valued collectively at $100M at that time. Meitu's press release said, "The Board believes cryptocurrencies have ample room for appreciation in value and by allocating part of its treasury in cryptocurrencies can also serve as a diversification to holding cash in treasury management (which is subject to depreciation pressure due to aggressive increases in money supply by central banks globally)."[77] Meitu followed these comments by saying they are looking to implement blockchain into their apps.

Palantir Technologies

CFO Dave Glazer of Palantir Technologies, a publicly-traded software company co-founded by Peter Thiel, said the firm began accepting BTC as a form of payment on May 11. Glazer added that investing in BTC as a treasury reserve asset is "definitely on the table." The CFO didn't elaborate on the timeline for parking reserve assets in BTC but noted that Palantir has $151M in adjusted free cash flow that could go toward BTC "and other investments."[78]

MicroStrategy

MicroStrategy holds more BTC than any other public company worldwide. The Nasdaq-listed business intelligence firm remained the bull of the year with a purchase of ₿50,575 throughout 2021 at an average price of $49,158, amounting to a total of roughly $2.5B. Notably, MicroStrategy purchased less BTC each quarter, regardless of price fluctuations.

Figure 28

MicroStrategy 2021 Financial Results

	1Q2021	2Q2021	3Q2021	4Q2021
Funds Raised	$1.05B	$500M	$400M	$414M
BTC Purchased	₿20,857	₿13,759	₿8,957	₿10,350
Purchase Price	$1.1B	$529M	$420M	$572M
Avg. Price Per BTC	$52,087	$38,467	$46,876	$55,292
Total Holdings	₿91,326	₿105,085	₿114,042	₿124,392
Total Purchase Price	$2.2B	$2.7B	$3.2B	$3.8B
Value Today	$4.5B	$5.1B	$5.6B	$5.7B
Total Avg. Price Per BTC	$24,214	$26,080	$27,713	$30,159

Source: Kraken Intelligence, MicroStrategy[79,80,81,82]

Soros Fund

BTC's price spiked about +10% on October 5 to around $55,000 following a *Bloomberg* interview with Dawn Fitzpatrick, Head of George Soros's hedge fund, Soros Fund Management, which revealed that the investment firm owns some BTC.[83]

Nexon

Japanese gaming giant Nexon purchased ₿1,717 for $100M at an average price of $58,226 on April 28.[84] The move was apparently a hedge against inflation according to an announcement by Owen Mahoney, the President and CEO of Nexon, who said, "Our purchase of bitcoin reflects a disciplined strategy for protecting shareholder value and for maintaining the purchasing power of our cash assets (…) In the current economic environment, we believe bitcoin offers long-term stability and liquidity while maintaining the value of our cash for future investments." This purchase represented less than 2% of Nexon's total cash and cash equivalents on hand.

Institutional Investors

J.P. Morgan

In a May report, J.P. Morgan noted that institutional investors were switching from BTC to gold, but still maintained that the cryptoasset could hit $140,000 in the long term. However, the bank renewed its short-term confidence in BTC as the cryptoasset continued to rise, pointing to assurances by U.S. policymakers that they wouldn't follow China in banning the usage or mining of crypto as a catalyst for the rise. The banking giant also said, "The recent rise of the Lightning Network and 2nd layer payments solutions helped by El Salvador's Bitcoin adoption" was a boon for BTC as well.[85]

With the renewed confidence came a change of sentiment as J.P. Morgan shared another note with clients in October stating that institutional investors were now flocking to BTC as they may be increasingly seeing it as a better inflation-hedge than gold.[86] At the time of the report, BTC was up +87% year-to-date compared with gold's +7.3% rise in the same period.

Kevin O'Leary

Shark Tank TV star and renowned businessman Kevin O'Leary also announced in October that his crypto holdings outweighed the allocation of gold in his portfolio. However, O'Leary still advocated for holding both crypto and gold as he said comparisons between the two assets are irrelevant, noting, "I have 5% in gold. Crypto for the first time is more than gold for me, and I'm going to keep my gold. I see no reason to sell it." O'Leary concluded that his crypto portfolio allocation is around 6% and that he plans to reach 7% by year's end with investments divided among digital assets and blockchain companies. O'Leary also stated that he is no longer just "betting on the price of Bitcoin anymore" as he emphasized the potential of the broader ecosystem, "There's so many other ways to invest, particularly in blockchain opportunities. Solana, Ethereum, you know, I mean, there's so many different layer ones. And then, of course, layer two is the derivatives that are put on top of the Ethereum, Solana and all the others." The businessman concluded that he doesn't "see a situation where cryptos are going away" due to the U.S. government banning crypto in the future because he thinks the government doesn't want to fall behind in payments tech innovation.[87]

Mark Cuban

Fellow Shark Tank TV star and billionaire investor Mark Cuban doubled-down on his bullish crypto sentiment this year during a conversation with Bitcoin enthusiasts on Twitter in October. Cuban admitted at the time that, because of its algorithmic scarcity which makes BTC limited in supply by design, "[t]he one thing that BTC has as a HUGE advantage is that is has [sic] ZERO competition as a SOV [store of value]."[88] Cuban sees BTC as an asset that will appreciate as demand increases for this reason, and has gone as far as saying that BTC is a better store of value than gold.[89] Cuban is so bullish on BTC that he predicts that it, along with ETH, will be viewed as "safe havens" in the future.[90] This means that BTC and ETH would be seen as an asset that would at least retain its value in the face of macro market turbulence. However, Cuban argued that BTC is "not a cure for any financial system" and "it's not a hedge to anything."[91] While Cuban sees BTC as an excellent store of value, he doesn't view it as a medium of exchange used commonly for transactions due to factors like taxes and fees.[92,93]

Paul Tudor Jones

Billionaire hedge-fund Manager Paul Tudor Jones made waves in May 2020 with his initial endorsement of BTC as a hedge against "great monetary inflation." At the time, Jones said BTC reminded him of gold in the 1970s and added, "The best profit-maximizing strategy is to own the fastest horse [...] If I am forced to forecast, my bet is it will be Bitcoin."[94] Nearly 1.5 years later on October 20th, 2021, PTJ's sentiment on BTC only appears to have grown stronger as he announced that he now prefers BTC over gold as a hedge against inflation.[95] The billionaire concluded, "Listen, I said then, I said now, I've got crypto in single digits in my portfolio. I have a small trading position at our fund. I do think we're moving into an increasingly digitized world."[96]

Money Managers

While 2021 was certainly a year that cryptoassets were finally embraced by institutions, a December survey found that money managers believe there will be a market-wide correction in 2022.[97] The survey was conducted by CoreData Research in October and November and surveyed 500 institutional investors across multiple countries, including four central banks, more than 20 sovereign wealth funds, and more than 150 corporate pension plans. The study found that digital assets are the "top contender" for a "major correction" in 2022, with nearly 75% of institutions polled saying they're not an appropriate investment for most retail investors. Despite the bearish sentiment, 28% of all institutions surveyed currently invest in cryptoassets, nearly 33% of which plan to increase their crypto allocations in 2022. Overall, 8% of all institutional investors surveyed—whose combined total of assets managed clocks in at $12.3T—plan to increase their allocations in the new year. Moreover, about 40% said they recognize cryptoassets are a legitimate investment option though central banks will eventually need to regulate them.

Cities, Countries, and Governments

Figure 29

Countries and Governments That Own BTC

Country/Government	# of BTC	Value Today	% of 21m
Bulgaria	₿213,519	$9.9B	1.02%
Ukraine (govt)	₿46,351	$2.1B	0.22%
Finland	₿1,981	$91.6M	0.01%
El Salvador	₿1,391	$64.3M	0.01%
Georgia (govt)	₿66	$3.1M	0.00%
Total:	**₿263,137**	**$12.2B**	**1.25%**

Source: Kraken Intelligence, BitcoinTreasuries.org

Miami, Florida

Miami Mayor Francis Suarez was one of the most notable Bitcoin evangelists of 2021. The Mayor first expressed interest in BTC on December 29, 2020, stating that he was "open to exploring" the idea of putting 1% of the city's treasury reserves into BTC. Just under a month later, the city of Miami uploaded a copy of the Bitcoin white paper to its municipal website on January 27, 2021 and Mayor Suarez emphasized his commitment to "turn Miami into a hub for crypto innovation."[98]

The Mayor slightly changed gears to discuss BTC mining in March, saying that the majority of BTC is mined outside of the U.S. using dirty energy and suggested Miami could set up a BTC mining hub for national security reasons. Suarez doubled-down on this stance in June after China announced its BTC mining ban, causing local miners to move their operations overseas to North America, Kazakhstan, Russia, and others. At the time, Suarez said Miami's doors are open to BTC miners in China who are currently scrambling to find a new home after Beijing made it clear that their days of mining in China are numbered.

In August, the Miami Mayor launched the city's own cryptoasset, dubbed MiamiCoin, which is used to fund infrastructure projects and events in the city. MiamiCoin was the first CityCoin released, which is a project that allows people to invest in a city by buying tokens.[99] MiamiCoin allows residents to contribute STX tokens to a CityCoins smart contract and "stack" (similar to Ethereum staking) tokens to yield STX or BTC rewards for the city. The idea was that anyone can mine MiamiCoin or other CityCoins as they are released, and if the project took off, investors would be able to passively earn BTC simply by owning the MiamiCoin because it is built on the Stacks platform.[100]

Miami also issued a request for a proposal in October to allow the city's employees to get paid in BTC and residents to pay fees and taxes in BTC. Furthering his support of Bitcoin, Suarez did not hesitate to accept a challenge from popular crypto influencer Anthony Pompliano on November 2nd to become the first American politician to accept their paycheck in BTC. "I'm going to take my next paycheck 100% in bitcoin... problem solved!," said Suarez at the time.[101]

New York City, New York

On November 3rd, BTC-friendly candidate Eric Adams won the New York City mayoral race.[102] Despite being one of the world's biggest traditional financial centers, New York has had a controversial relationship with crypto for years due to its BitLicense regime. The tables may be turning now as Adams committed to making the city crypto-friendly, starting with plans to examine factors hindering the growth of BTC and crypto in the state.[103] A day after the election, NYC Mayor-Elect Eric Adams said in a Twitter reply to pro-crypto Miami Mayor Francis Suarez that he plans to take his first three mayoral paychecks in BTC, stating, "(i)n New York, we always go big, so I'm going to take my first THREE paychecks in Bitcoin when I become mayor. NYC is going to be the center of the cryptocurrency industry and other fast-growing, innovative industries! Just wait!"[104]

Following NYC Mayor-Elect Eric Adams' commitment to take his first three paychecks in BTC and make NYC a crypto hub, Adams announced interest in educating the youth about digital assets. Adams said, "(w)e must open our schools to teach the technology, to teach this new way of thinking."[105] The Mayor-Elect, who will take office on January 1, 2022, also indicated plans to encourage NY businesses to accept BTC and other crypto as a form of payment, saying he would "tread carefully" and "get it right." Adams furthered his support for crypto with the launch of NYCcoin mining with CityCoin on November 17.[106] Though it's yet to be determined, it appears that for the first time since 2014 New York may be evolving towards an increasingly pro-crypto location.

El Salvador

Standing shoulder-to-shoulder with the U.S.-based BTC futures ETF news, El Salvador shocked the world on June 5, 2021 at the Bitcoin 2021 conference in Miami with an announcement that it would become the first country to make BTC legal tender. The Salvadoran government announced on November 1 that it would use profits from its Bitcoin Trust account (FIDEBITCOIN), which holds ₿1,391 ($72M) after its latest purchase of ₿21 on December 21, to construct 20 schools.[107,108] President Nayib Bukele's spokesperson said profits from previous BTC purchases would benefit the people and that the government won't touch Salvadoran taxes for the project. The construction reportedly supported the expansion of crypto education for locals and was part of the 400 schools planned for the "My New School" program, an education expansion incentive that the Central American Bank for Economic Integration approved $200M in financing for in October 2020.[109] Because BTC ended up finishing the year lower, El Salvador had a -10.7% unrealized loss on their BTC investment as of year-end.

This past year was marked with meaningful mainstream, global adoption. This was seen through network user growth and activity, the involvement of nation states in developing CBDCs, international regulators such as the IMF and BIS stepping in to

opine on the crypto industry's growth, as well as traditional financial institutions launching highly-anticipated BTC ETFs to satisfy the growing demand for crypto-related ETFs. Furthermore, we saw public companies, investment firms, tech giants, fund managers, and public figures publicly endorse BTC and the broader crypto market. Countries and governments also followed suit with multiple cities in the U.S. and nations like El Salvador going pro-BTC. The level of adoption from major players we witnessed in 2021 speaks volumes of the explosive growth in interest and alludes to the breakthroughs to come in the year ahead.

5.

The Head Honcho: Bitcoin

With Bitcoin making up roughly 45% of the the industry's market capitalization and as the most widely held cryptoasset among market participants, it is worth dialing into events that highlighted Bitcoin's advance during 2021.

The Lightning Network

Since its launch in 2018, the Lightning Network (also known as Lightning, or LN) has been slow to meet the initial excitement around its potential as a payments platform. Lightning is a layer-2 scalability solution built on top of Bitcoin that allows users to create payment channels among each other to instantly send and receive BTC with virtually no fees. LN transactions are conducted off-chain in its sub-network of payment channels anchored to the Bitcoin blockchain. These transactions are later reconciled on the Bitcoin blockchain as channels are closed. In other words, transactions in these payment channels require 0 confirmations and are only settled on the Bitcoin blockchain when a payment channel is opened or closed.

The LN aims to reduce network congestion by providing instant and inexpensive transactions while achieving a throughput of approximately 1M transactions per second. While the LN has hitherto failed to fuel widespread adoption and make BTC an even more efficient medium of exchange, optimism resurfaced after El Salvador announced that it would accept BTC as legal tender and launched its own Lightning-based wallet. Per figure 30, the LN's capacity in 2021 went parabolic and surged more than +508% year-over-year to roughly ₿3,292 ($186M).

Figure 30

Bitcoin's Lightning Network Capacity

Source: Kraken Intelligence, 1ML

Speaking to the massive adoption that the LN saw in 2021, the total number of LN nodes more than doubled, LN channels increased by nearly +130%, the average channel capacity increased by +39% in BTC terms, and the average node capacity increased +163% to nearly $10,000. The number of LN nodes has been growing so fast that there are now more than 2x more LN nodes than conventional Bitcoin full nodes. Should global LN adoption continue to grow at this rate, Bitcoin may be able to claim its status as a viable "medium of exchange" and as a "store of value." Recent findings indicate that the LN's current capacity, wallet payment volume, growing rate of adoption, and the switch from online services to everyday usage leaves an ambitious future for the LN. The research predicts that 90% of Salvadorians over the age of 15 could have access to LN payments by 2026 and 50 million global LN users, representing $17B in annualized payments for transactions like remittances and household expenditure by 2030.[110]

Figure 31

Year-Over-Year Bitcoin Lighting Network Overview

Metric	1/1/21	Current Reading	YoY Delta
Network Capacity (USD)	$30.7M	$153.5M	+400%
LN Node Count	15,440	32,363	+110%
LN Node Count with Active Channels	8,120	19,201	+136%
Channel Count	36,410	84,149	+131%
Average Channel Capacity	₿0.03	₿0.04	+36%
Average Node Capacity	$3,784	$7,995	+111%

Source: Kraken Intelligence, 1ML

Taproot Soft Fork Upgrade

Bitcoin's long-anticipated Taproot upgrade activated on November 14 after near-unanimous consensus among miners, meaning that roughly 99% of miners signaled approval for the upgrade during its trial period. The soft fork was the first major upgrade to the network since the contentious Segregated Witness (SegWit) soft fork which paved the way for the Lightning Network in 2017. The Taproot upgrade enhanced Bitcoin's smart contract flexibility, transaction efficiency, privacy, and security. The soft fork packaged 3 Bitcoin Improvement Proposals (BIPs) that synergistically empower users and rolled out the red carpet for vast innovation on Bitcoin:

1. **Schnorr Signatures (BIP340)**—Introduced a new and improved type of digital signature used for sending transactions that is more secure, lightweight, and flexible than the existing digital signature scheme. Schnorr signatures also introduces a new technique that makes Bitcoin multi-sig transactions (where multiple parties endorse a single transaction) and complex smart contracts (where predetermined conditions must be met to execute a transaction) more scalable, private, and efficient by combining keys and signatures of these types of transactions rather than recording them individually on the blockchain.

2. **Taproot (BIP341)**—Specified a new transaction type known as Pay-to-Taproot (P2TR) that is configured to accept Schnorr signatures. Taproot built on the privacy innovations of Bitcoin's most recent SegWit upgrade and implemented something called Merklized Alternative Script Trees (MAST), which are widely used in cryptography to hide private user data from the public. MAST's implementation on Bitcoin also should provide greater scalability, transaction throughput, and efficiency, since less user data is recorded on the blockchain.

3. **Tapscript (BIP342)**—Updated Bitcoin's Script coding language used to write BTC transaction parameters in order to accommodate Schnorr Signatures and Taproot technology for those that opt-in to the upgrade. Tapscript also made it easier to implement future updates to Bitcoin by allowing new types of opcodes (transaction instructions) to be more seamlessly introduced.

Using Taproot technology, Bitcoin can host massive smart contracts with tens of thousands of signatories while obscuring all participants and retaining the size of a single signature transaction. Moreover, some contend that Taproot, combined with Lightning Network will advance BTC's utility from primarily a "store of value" to an efficient "medium of exchange" by allowing for more transaction throughput, upgrading the network's core cryptography to ensure network security, and inspiring more developers to work on Bitcoin by enabling complex DeFi smart contracts, among others. Diving into the details, key aggregation allows Bitcoin to compete with higher-throughput blockchains such as Ethereum, which is the primary breeding ground for DeFi projects. Users speculate that Taproot will enable DeFi networks on Bitcoin like Sovryn, Thorchain, and Portal, among others. These smart contracts can theoretically host massive multi-signature vaults (e.g., requiring over 1,000 signatures) that lock BTC up for usage in the smart contract while costing the same as a single-signature transaction. Before Taproot, operating these complex smart contracts with this many signatories was prohibitively expensive. Though complex smart contracts have been easy to create and enforce on other blockchain networks for years, Taproot is anticipated to lay the technical foundation needed to accelerate DeFi on the Bitcoin network.

This sounds phenomenal in theory as it implies an overall smoother user experience in the long-term and potentially invites vast innovation on the Bitcoin network, but many market participants now wonder whether Taproot is living up to the hype. Notably, significant technical upgrades on a decentralized protocol with a large number of stakeholders requires time for adoption to take place. Though Taproot underwent at least four years of thorough testing before activation, exchanges, wallet service providers, and custodians still must extensively battle-test any new technology before using it to ensure it doesn't introduce new vulnerabilities. That being said, renowned crypto-related service providers are showing their confidence in Taproot by adopting it relatively quickly. As of year-end, more than 40 hardware wallets, software wallets, web wallets, and exchanges have adopted Taproot technology for deposits or withdrawals, including: Ledger Nano, BitGo, Blockstream Jade and Green, Electrum, Wasabi, and Specter.[111] Moreover, more than 65% of nodes (9,582) are running Bitcoin software that contains Taproot code. The adoption of Taproot software does not necessarily deem it a success, but is a prerequisite to the potential of the technology in years to come.

Figure 32

Bitcoin Node Software Distribution

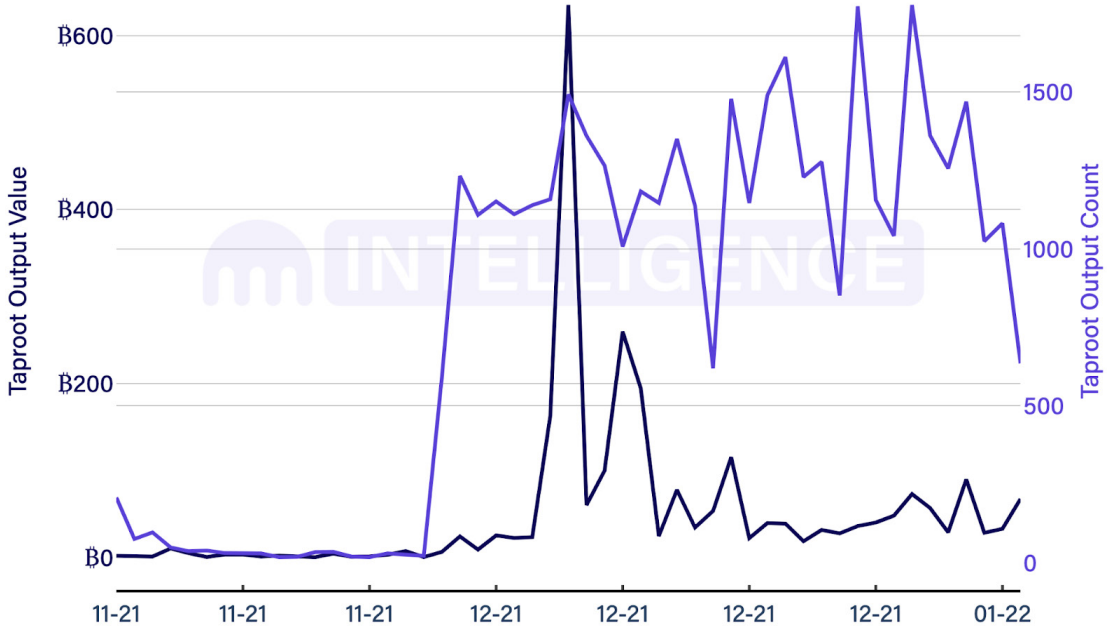
User Agent	Count	Share (%)
Satoshi 22.0.0 (Taproot)	6,733	45.70%
Satoshi 0.21.1 (Taproot)	2,849	19.30%
Satoshi 0.21.0 (SegWit)	1,555	10.60%
Satoshi 0.20.1 (SegWit)	517	3.50%
Satoshi 0.20.0 (SegWit)	340	2.30%

Source: Kraken Intelligence, Clark Moody Dashboard

Market participants commonly feared that Taproot transactions wouldn't receive network-wide adoption, which would minimize the utility brought by the technological advancement. However, since Bitcoin's Taproot activation on November 14, there have been over 40,500 Pay-to-Taproot (P2TR) outputs created worth more than ₿2,550. Such implies that market participants are hitherto adopting Taproot slowly but surely, meaning that an increasing share of BTC have and will continue to become even more secure.

Figure 33

Bitcoin Taproot Outputs



Source: Kraken Intelligence, Clark Moody Dashboard
Note: The data in figure 33 tracks Taproot outputs created, not Taproot output spends.

China's Mining Exodus

As seen in figure 34, Chinese miners accounted for most of Bitcoin's hash rate (roughly 60–70%) throughout most of Bitcoin's history. However, the Chinese Communist Party (CCP) turned hostile last year and implemented an outright mining ban in May 2021, leading to a multi-billion dollar reversal of fortune for China.

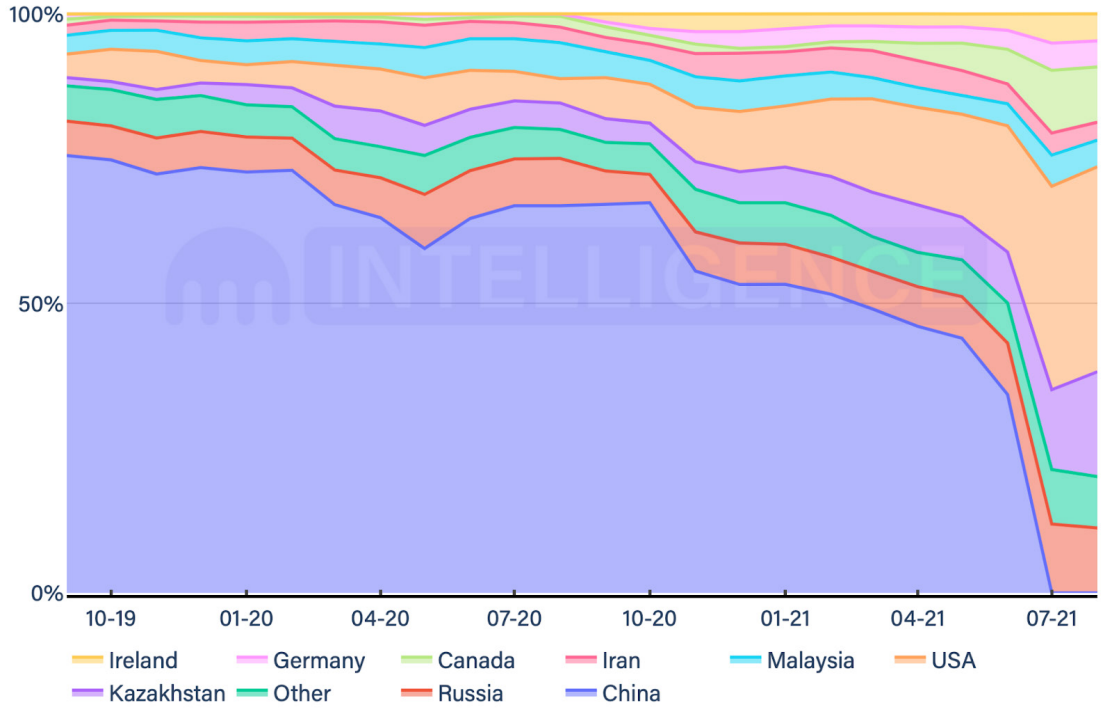
The departure of miners from China proved to be a major boon for miners in North America, Kazakhstan, and Russia, among others. A Cambridge Centre for Alternative Finance study released in October showed that the U.S. is now the epicenter for BTC Mining, growing from 17.77% in April to 35.4% of the global hash rate by the end of July. The U.S. was followed by Kazakhstan (18.1%), which saw its hash rate double since 2Q2021,

Russia (11.2%), and Canada (9.6%). China's mining ban and renewed Bitcoin crackdown wiped the global dominance it maintained due cheap electricity production from coal-fired and hydropower generation. China dropped from 43.98% of the global hash rate in September 2019 to virtually 0% by July.[112,113]

Mining firms have been buying large swathes of new equipment and expanding their operations in light of the opportunity presented by China's crackdown on mining and BTC's recent rally. Over 3Q2021, seven publicly-listed BTC mining firms in the U.S. alone mined ~7.5% of BTC blocks. Those firms were holding over ₿20,000 (~$1.1B) as of September.[114] Although it's improbable that all of the BTC mining in China has stopped, the lion's share of it has dropped out of major mining pools.

Figure 34

Evolution of Bitcoin's Hash Rate Share By Country

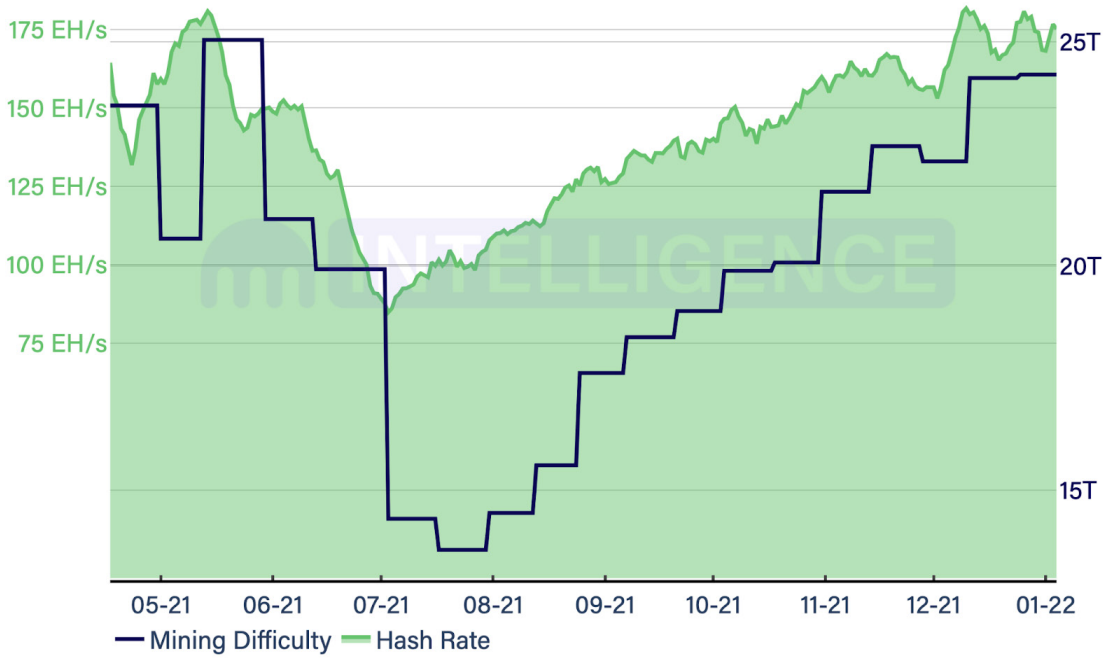


Source: Kraken Intelligence, Cambridge Centre for Alternative Finance

China “banning” Bitcoin happened so frequently that it practically became a meme. However, this time around was different. The China State Council's crackdown on BTC trading and mining on May 21 marked the council’s first discussion of BTC mining at a committee meeting. In what appeared to be a repeat of history, the news out of China caused a knee-jerk reaction, sending BTC down from highs around $65,000 to lows of roughly $30,000 by early July. The industry has drastically changed over the past few years. Such news from China could have caused a full-blown market reversal into a multi-year bear cycle should this have happened in 2017, for example. In this case, the news proved a short-term impact for BTC, as the cryptoasset bounced back to hit new all-time highs of nearly $69,000 six months later. Still, broader market forces have since sent the leading cryptoasset tumbling back down below $50,000 as of year-end.

Figure 35

Bitcoin Hash Rate vs. Difficulty



Source: Kraken Intelligence, Coin Metrics

Outside of price action, the exodus of miners from China caused a whopping -60% reduction in hash rate over two months to roughly 84 exahashes per second (EH/s). This reduction in hash rate led to four-straight negative difficulty adjustments, an all-time record, for a total mining difficulty correction of -45%. Since then, we've seen a rapid reversal to all-time highs in hash rate into the close of 2021. This bounce saw 9 consecutively positive difficulty adjustments, which was also a new record for Bitcoin. Though the network temporarily became less secure and prices entered a downtrend, some argue that this drop in hash rate and quick rebound is a bullish indicator in the long run as it indicates Bitcoin mining is becoming more decentralized and cleaner with China's dominance out of the picture.

The Stock-to-Flow (S2F) Model

For years, market participants have heavily relied on popular BTC analyst Plan B's Stock-to-Flow (S2F) model as a guide for future BTC price and an explanation of past price performance. The model attempts to predict price performance by measuring BTC's growing scarcity and price action around **the halving**, a hard-coded event that mathematically prescribes a downtrending supply inflation rate (i.e., disinflation) until total supply approaches ₿21M around the year 2140.

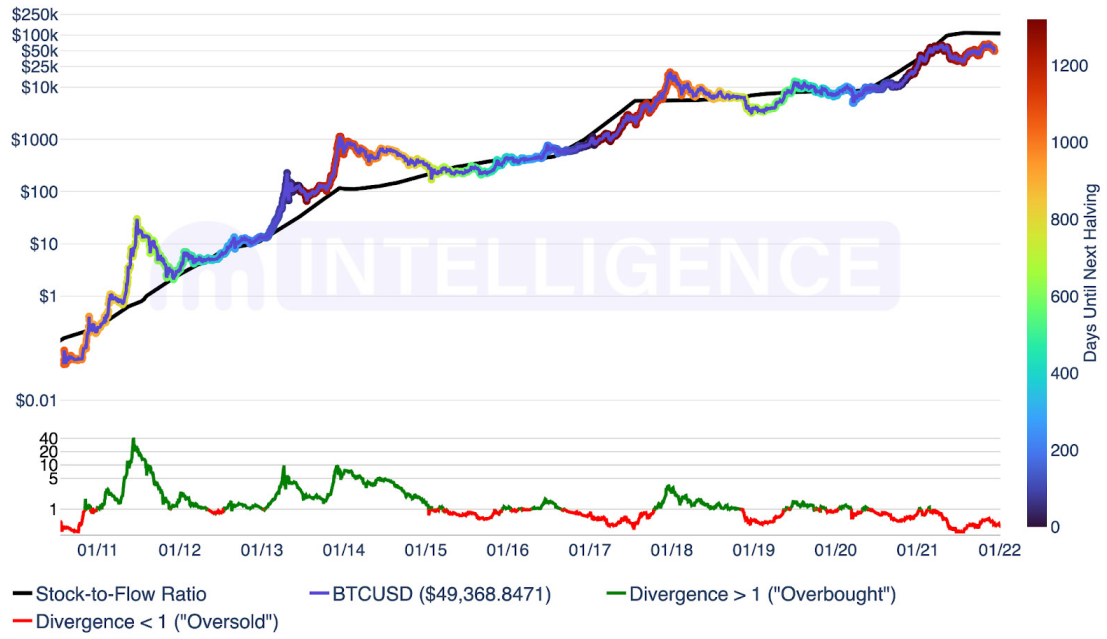
Figure 36 shows that the model predicted that BTC would reach a new all-time high of more than $85,000 roughly one year after the May 2020 halving and $106,000 by the end of 2021. BTC has come a long way since the May 2020 halving, growing over +500% to roughly $51,000 at the time of writing. Though BTC managed to hit an all-time high of roughly $69,000 in November, it was well off the S2F model's target. Still, the S2F model has yet to be invalidated and must fall back down below roughly $25,000 before becoming verifiably inaccurate.

Moreover, BTC's divergence from its "implied price" target grew so large that it hit an all-time low over the summer when BTC fell to lows of about $30,000. For reference, the last time BTC's S2F divergence reached these levels was in 2011 when BTC was trading hands

at a few cents per coin. Because a divergence like this indicates that BTC may be oversold, some market participants may argue that this was a bottom signal and that BTC has more upside potential in the new year.

Figure 36

Bitcoin's Stock-to-Flow (S2F) Model



Source: Kraken Intelligence, Glassnode

Bitcoin saw massive technological growth and maturation in 2021 thanks to the activation of Taproot, El Salvador's adoption of the LN, and the global redistribution of hash rate after China's mining crackdown in May, to name a few. As such, the leading cryptoasset is positioned to gain greater utility as a medium of exchange and a platform for large DeFi smart contracts in the future. Moreover, previous fears that China held too great a share of Bitcoin's hash rate and was hypothetically capable of taking over the network have effectively been quelled—making Bitcoin a significantly more robust and decentralized asset.

6.

Infrastructure: Release the Lis

2021 was a historical year for crypto infrastructure. As a reminder, "infrastructure" can be viewed as ***Web3** infrastructure*, or the projects that make up the ***Web3 stack***. A critical layer in this stack are Layer-1 (L1) smart contract blockchain platforms, such as Ethereum, which act as a settlement layer for transactions and smart contracts.

Due to high demand for DeFi and NFTs, evidenced by persistent network congestion on Ethereum, L1 platforms very much stole the show throughout the year as a new class of L1 platforms, known as *3rd-generation blockchains*, emerged from adolescence and saw monumental wave of development which resulted in each of them establishing their own DeFi and NFT ecosystems. These platforms include projects such as Solana, Cardano, Polkadot, and Avalanche. As a result of the developments and demand for L1 offerings, these projects saw wide adoption, gaining magnitudes of popularity on social media platforms and drawing in a new generation of users into crypto. Further, the underlying cryptoassets powering these L1 platforms (e.g. ETH, SOL, ADA, DOT) well outperformed the broader crypto market, Bitcoin in particular, due to market participants finding great value in their utility.

In addition to L1s, significant upgrades were also seen by Layer-2 (L2) solutions and blockchain-agnostic supporting infrastructure solutions, which humbly assisted L1s in their runup of adoption throughout the year and laid critical groundwork for future innovation and adoption of scale.

Layer-1 Smart Contract Platforms

One of the highest performing asset classes in 2021 was L1 smart contract platforms. A driving factor behind why L1 assets performed so well is because it became clear throughout late 2020 and early 2021 that a strong demand exists for the functionality and financial opportunities provided by Ethereum, such as in smart contracts, dApps, DeFi and NFTs.

The reason the L1 asset is so important with respect to these applications is because the L1 protocol acts as the base settlement layer around which an entire ecosystem of dApps, supplemental layers, and sidechains are built. The base layer protocol generally provides the strongest layer of security in the ecosystem, and if it fails then all other dApps and layers fail. In contrast, if a dApp or L2 protocol fail, the L1 protocol remains unaffected as well as all other dApps and supplemental layers in the ecosystem (assuming they aren't dependent on the failed protocol). The base layer's omnipresence in its ecosystem results in the L1 asset seeing broad utility for use in protocol security, transaction fees, DeFi liquidity, NFT trading, and more. This utility results in incredible demand for and adoption of (i.e. acceptance by users, exchanges, and merchants) L1 assets in comparison to tokens powering dApps and supplemental service networks (e.g. storage solutions, oracle solutions).

While Ethereum was successful in showcasing the potential of L1 smart contract platforms, it's high demand resulted in network congestion; with average transaction fees reaching more than $60 per transaction, users were eager to find something usable on a more regular and predictable basis.[115] In addition to scalability issues, both Bitcoin and Ethereum caught fire for their energy consumption throughout the year—as a byproduct of their Proof-of-Work (PoW) based consensus models, it is estimated the two networks together consume more power than Saudi Arabia.[116] These setbacks combined with the demand for L1 protocols directed attention toward *3rd-generation blockchains*, a new class of L1s that aim to solve such issues.

3rd-Generation Blockchains

Third-generation blockchains are blockchain networks designed to provide smart contract functionality with an emphasis on scalability, interoperability, and sustainability. These blockchains attempt to address commonly held views on the limitations of networks like Bitcoin and Ethereum, which are considered *1st-generation* and *2nd-generation blockchains*, respectively.

- **Scalability**—ability of a blockchain to support a growing number of users and devices. With global adoption in mind, for most of these projects that means users in the billions. Common measures of scalability are *throughput* (i.e. transactions per second or TPS) and *latency* (i.e. the time it takes for a transaction to be confirmed).
- **Interoperability**—ability of a blockchain to interact with other blockchains and external resources such as APIs, whether that is to share state or information between two platforms or to trigger execution/computation on each other's platforms.
- **Sustainability**—this comes in two forms: *environmental sustainability* referring to the protocol's ability to operate with a low carbon footprint and *protocol/ecosystem sustainability* through the use of on-chain governance and a community treasury or funding resource.

Third-generation blockchains include a family of projects such as Ethereum 2.0, Cardano, Polkadot, and Solana. These projects are often branded in Twitter circles as "Ethereum killers" as they are considered a threat to Ethereum's reign in the smart contract space. However, efforts to engineer interoperability suggest these projects strive to co-exist alongside Ethereum, as well as one another, resulting in a multi-chain, decentralized Web3 ecosystem.

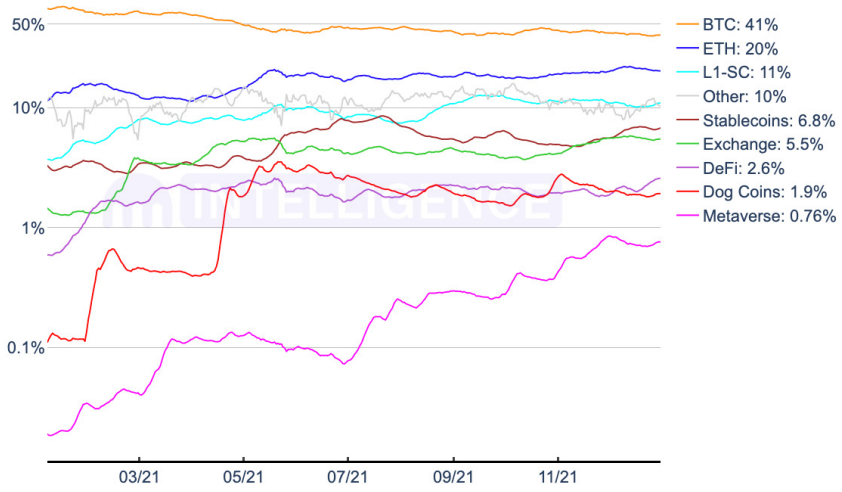
Attention in 2021 was further placed on 3rd-generation blockchains due to the sustainability goal they embrace. Blockchain "sustainability" is comparable to the Environmental, Social, and Governance (ESG) values that have taken investors by storm in traditional financial markets. Most 3rd-generation blockchains address this through the implementation of **Proof-of-Stake (PoS)**, which is estimated to reduce energy consumption by more than 99.9% in comparison to PoW.[117]

Layer-1 Smart Contract Sector Performance 2021

While many of these L1 blockchains initially launched back in 2017–2019, this past year saw significant strides in them moving closer toward their "final form", catching a wave of adoption with a consequential step up in asset values. Figures 37 and 38 illustrate how well L1 smart contract (L1-SC) protocols performed relative to other crypto assets. In total, L1 blockchains took a total 16.2 dominance percentage points from BTC, which lost a total 27 percentage dominance points to all other sectors.

Figure 37

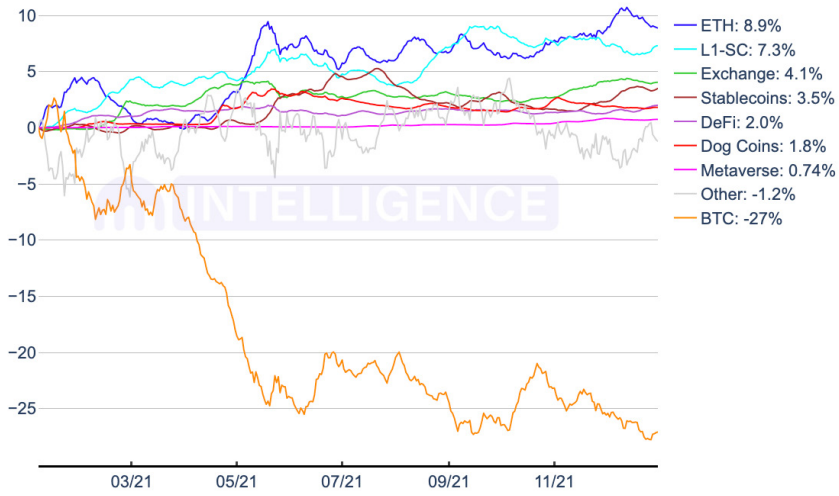
Market Capitalization Dominance by Sector



Source: CoinGecko, TradingView, Kraken Intelligence
(See Appendix A for list of assets that makeup indexes)

Figure 38

Change in Market Capitalization by Sector 2021 (Dominance Points)



Source: CoinGecko, TradingView, Kraken Intelligence
(See Appendix A for list of assets that makeup indexes)

Looking at figure 38, we can see BTC was the only to drop in dominance of the assets and indexes shown. Additionally, the "Other" sector, which represents the market cap dominance not encompassed by the projects which make up the indexes (see Appendix A for details), holds relatively steady across the year. This is important to note because market cap dominance is a zero-sum game (i.e. dominance must always sum to 100%). Therefore, since "Other" held steady, we can confirm gains seen across the assets and indexes came directly from the dominance loss of BTC rather than elsewhere in the market. This in combination with the total value of cryptoassets growing by ~$1.5T (+191%) over the year indicates one or both of the following:

1. Inflows of capital largely entered crypto via LIs, either through trading or by the launch of new projects
2. Inflows of capital entered crypto via BTC, and legacy BTC holders diversified into LIs

The reality is likely a combination of the two. This may not come as a surprise to some due to the law of large numbers which implies the growth potential of an asset decreases the larger it becomes, meaning as the crypto industry grows, one can expect BTC's strong dominance over the industry to be diluted, as the smaller market caps carry more growth potential. It should also be noted that the 2017 ICO bull run saw a similar pattern of rotation from BTC into altcoins, so this observation is not necessarily new.

That being said, looking at figure 39 we can see many of these assets saw extremely large growth in their circulating supplies, suggesting tokens entering the market through vesting schedules rather than mining or staking. In fact over 50% of the market cap growth in LIs (not including ETH) observed in 2021 came from projects whose circulating supplies grew by over 100% throughout the year. Since the corresponding asset prices of these projects also skyrocketed with returns ranging from 423% to 11,281%, this suggests much of the market cap dominance growth in LIs came from venture capitalists and insiders who were seemingly reluctant to sell their vested tokens rather than from new capital entering via markets or from the rotation of BTC into LI assets. Nonetheless, the magnitude of wealth appreciation is nothing less than impressive.

Figure 39

L1 Asset Returns and Circulating Supply Growth 2021

	Start of 2021			End of 2021					
Asset	Rank	Price	Market Cap	Rank	Price	Mkt. Cap	Price Return	Mkt. Cap Gain	Circulating Supply Growth
SOL	20	$1.52	$0.07B	1	$172.51	$53.26B	11,281%	76,242%	571%
ADA	2	$0.18	$5.66B	2	$1.36	$43.40B	646%	666%	2.7%
DOT	1	$9.36	$8.79B	3	$27.54	$29.41B	194%	235%	13.7%
AVAX	18	$3.21	$0.23B	4	$101.54	$24.67B	3,066%	10,418%	232%
ALGO	17	$0.33	$0.26B	5	$1.73	$10.98B	423%	4,061%	695%
NEAR	16	$1.54	$0.33B	6	$15.42	$9.28B	1,005%	2,676%	151%
ATOM	6	$6.46	$1.54B	7	$30.24	$8.61B	368%	461%	19.7%
TRX	46	$0.03	$1.92B	8	$0.08	$7.92B	190%	313%	42.2%
VET	8	$0.02	$1.21B	9	$0.08	$5.66B	352%	366%	3.1%
HBAR	19	$24.67	$0.21B	10	$0.30	$5.53B	838%	2,523%	180%
FTM	21	$0.02	$0.04B	11	$2.11	$5.35B	12,388%	12,397%	0.1%
EGLD	14	$24.67	$0.37B	12	$239.44	$4.86B	870%	1,221%	36.1%
ETC	11	$5.67	$0.66B	13	$34.64	$4.57B	511%	594%	13.7%
XTZ	7	$2.02	$1.52B	14	$4.35	$3.79B	116%	150%	15.9%
EOS	3	$2.60	$2.46B	15	$3.08	$3.01B	19%	22%	3.3%
ONE	22	$0.004	$0.04B	16	$0.23	$2.62B	5,294%	6,904%	29.9%
KSM	12	$72.64	$0.65B	17	$280.63	$2.52B	286%	287%	0.0%
NEO	9	$14.29	$1.00B	18	$26.16	$1.84B	83%	83%	0.2%
WAVES	13	$6.19	$0.62B	19	$14.66	$1.46B	137%	138%	0.3%
XEM	5	$0.20	$1.83B	20	$0.13	$1.13B	-38%	-38%	0.7%
ZIL	10	$0.08	$0.95B	21	$0.08	$1.08B	-5%	14%	19.6%
ONT	15	$0.44	$0.35B	22	$0.67	$0.59B	52%	66%	9.1%
Overall		–	$30.7B		–	$232B	–	654%	–
Total Crypto Mkt. Cap		–	$794B		–	$2310B	–	191%	–

Source: Kraken Intelligence, CoinGecko

Top L1's of 2021

A select few L1 projects have risen to prominence over the past year with respect to market capitalization and adoption. While they are all categorized as L1s, they are each designed differently with their own unique approaches to building 3rd-generation infrastructure. Each of these design differences comes with their set of tradeoffs; therefore there is no perfect protocol that is best suited for all applications. This supports the hypothesis of a multi-chain future, corroborated by the broadly positive performance across multiple platforms in 2021.

Figure 40

Top L1's by Market Capitalization

Project	Native Asset	Asset Price	Max Supply	Circulating Supply	Circulating Market Cap	YTD Gain
Ethereum	ETH	$3,738	—	119M	$444.9B	411%
Solana	SOL	$173	—	309M	$53.3B	10682%
Cardano	ADA	$1.36	45B	32.0B	$43.4B	663%
Polkadot	DOT	$27.5	—	1068B	$29.4B	213%
Avalanche	AVAX	$102	720M	243M	$24.7B	3103%
Cosmos	ATOM	$30.2	—	285M	$8.6B	412%

Source: Kraken Intelligence, CoinMarketCap

Ethereum

Ethereum, the second largest blockchain by market capitalization saw an impressive +411% return in 2021. The blockchain also experienced high user growth with a +74% increase to 6.44M live addresses holding at least 0.1 ETH due to increased demand for DeFi applications and NFT markets powered by Ethereum. The demand for these services resulted in a surge in gas fees, with the network experiencing average transaction fees reaching all-time highs over $60 per transaction in May, September, and November.[118]

In August, EIP-1559 was implemented, which made changes to the bidding mechanism for transactions to reduce transaction fee variability and introduced a burning mechanism where a portion of transaction fees are permanently removed from circulation.[119] Through 2021, the update resulted in the burning of more than 1.34M ETH ($5B).[120]

The EIP-1559 upgrade was followed by the Ethereum 2.0 Altair upgrade, which successfully activated on the Ethereum 2.0 Beacon Chain in October.[121] This was the last upgrade to the Beacon Chain until the long awaited "merge" which is slated for 1H2022 and transitions Ethereum to a PoS-based consensus network.[122]

Alongside upgrades, Ethereum also saw the successful rollout and initial adoption of critical L2 scaling solutions such as Polygon, Arbitrum, and Optimism which are expected to host more of the network's activity as those solutions develop further and user demand increases.

Solana

Solana saw a meteoric rise throughout the year and was by far the best performing L1 asset of these top projects, with over a +10,000% return on the year for the SOL token. The platform's mainnet-beta launched in March and initiated the inflation of the total supply of the SOL token, enabling stakers to begin receiving staking rewards.[123]

The network's rise took place throughout the remainder of the year as Solana-based DeFi protocols and NFTs saw increased adoption by users. Drivers of platform adoption include Solana's cheap transaction fees, fast confirmation times, and high transaction throughput. In fact, the Solana founding team claims the network can reach over 50K TPS. However this number is a misrepresentation in comparison to what other projects call TPS, as transactions on Solana include critical consensus messages that all blockchains have but don't process as transactions.[124,125] In addition to user adoption, the project also secured a deal with privacy browser Brave to make it the default protocol for dApp support in the browser, exposing Solana to Brave's 42M monthly users.[126]

The year didn't come without hiccups for Solana as the network experienced a major 17-hour blackout after a denial-of-service disruption which caused the nodes to fall out of sync and required a manual shut down and resync to bring the network back online.[127] The network also faced accusations throughout the year of being a centralized network as some have argued most of the active stake is likely held by insiders of the project, among other reasons.[128]

Cardano

Cardano's ADA saw an impressive +663% gain over the year, as the 3rd best performing smart contract platform. In 2021, the blockchain rolled out several important upgrades. One of these upgrades completed Cardano's gradual transition from a federated network to a network fully run by community nodes (rather than nodes run by the founding organization).[129]

Other important upgrades include the Mary hard fork in March 2021, which introduced native tokens and NFTs to the blockchain as well as the Alonzo hard fork in Sept 2021, which introduced smart contract functionality to the blockchain.[130,131] Despite the launch of smart contracts, the network is still waiting to see the launch of dApps on the network due to the postponed installment of a critical piece of development infrastructure known as Plutus Application Backend, which is expected to greatly decrease the development time of dApps.[132]

In addition to upgrades, Input Output Global (IOG), the team behind the development of Cardano, secured several partnerships, such as one with DISH Network which will provide over 8 million Boost Mobile consumers with decentralized identity via IOG's Atala PRISM, as well as a Cardano-based loyalty program for Boost.[133] IOG also made deals with African governments of Ethiopia, Burundi, and Zanzibar, to pilot the use of blockchain technology for education systems, identity, and more, marking a first for deals of their kind in the industry. [134,135,136]

Polkadot

Polkadot and its canary network, Kusama, completed several milestones with the launch of parachains on their respective networks. Kusama initially launched in June with five parachains and then went on hold to monitor network performance before starting them back up again in September. The relay chain now has over 3M KSM ($874M) locked across 20 parachains and 4 crowdloans, which equates to over 31% of the total KSM supply.[137] Polkadot saw the launch of parachains on its relay chain in November and has completed six auctions thus far with over 116M DOT ($3.5B) locked across 6 parachains and 14 crowdloans, which equates to over 10% of the total DOT supply.[138] Parachain slot auctions for both chains remain active.

Avalanche

Avalanche is another project that saw a meteoric rise in 2021, seemingly out of nowhere. Over the course of the year, Avalanche's AVAX soared 3,103%, second to only Solana among the top L1s. Similar to Solana, Avalanche saw this rise as a result of users looking to sidestep Ethereum's high gas fees and relatively slower network.

Avalanche's latest price run came after the launch of the Avalanche Bridge in late-July, which enabled users to bridge assets between Avalanche and Ethereum for 5x cheaper the cost than Avalanche's previous bridge that had launched earlier in the year.[139]

Later in the year, Avalanche announced a strategic alliance with the "Big Four" accounting firm, Deloitte.[140] This alliance is intended to improve recoveries from natural disasters and public health emergencies by leveraging Avalanche to improve the security and efficiency of Federal Emergency Management Agency (FEMA) reimbursements.

As with Solana, Avalanche has also received criticism of centralization in response to its initial token distribution which saw 42% of the initial supply go to insiders.[141]

Cosmos

The Cosmos ecosystem underwent a series of exciting upgrades and launches in 2021. The self-proclaimed "Internet of Blockchains" launched its GravityDEX in June, which enables swaps across any two blockchains in the Cosmos ecosystem.[142] Further, the project also saw its Inter Blockchain Communication (IBC) go live, which enables any two blockchains in the ecosystem to communicate with each other.[143]

In addition, the broader Cosmos ecosystem also had an impressive year. The project is home to Binance Smart Chain, Terra, THORChain, and Crypto.com who combined add up to just over $133B in market capitalization. However, despite this combined value the market capitalization of Cosmos' ATOM token only comes in at $8.6B in market capitalization. A reason for this is because each of the blockchains utilize their own validator set and aren't secured by the ATOM token, and in PoS-based protocols, it is generally considered that the value of the PoS token is partially derived from the value it secures. Only blockchains that tie into the *Cosmos Hub* are secured by the ATOM token, but the Cosmos team is planning to gear up the Cosmos Hub with "value-add services" such that the hub acts as a "port city" for the ecosystem, which introduces more forms of utility for the ATOM token.[144]

L1 Social Media Analysis

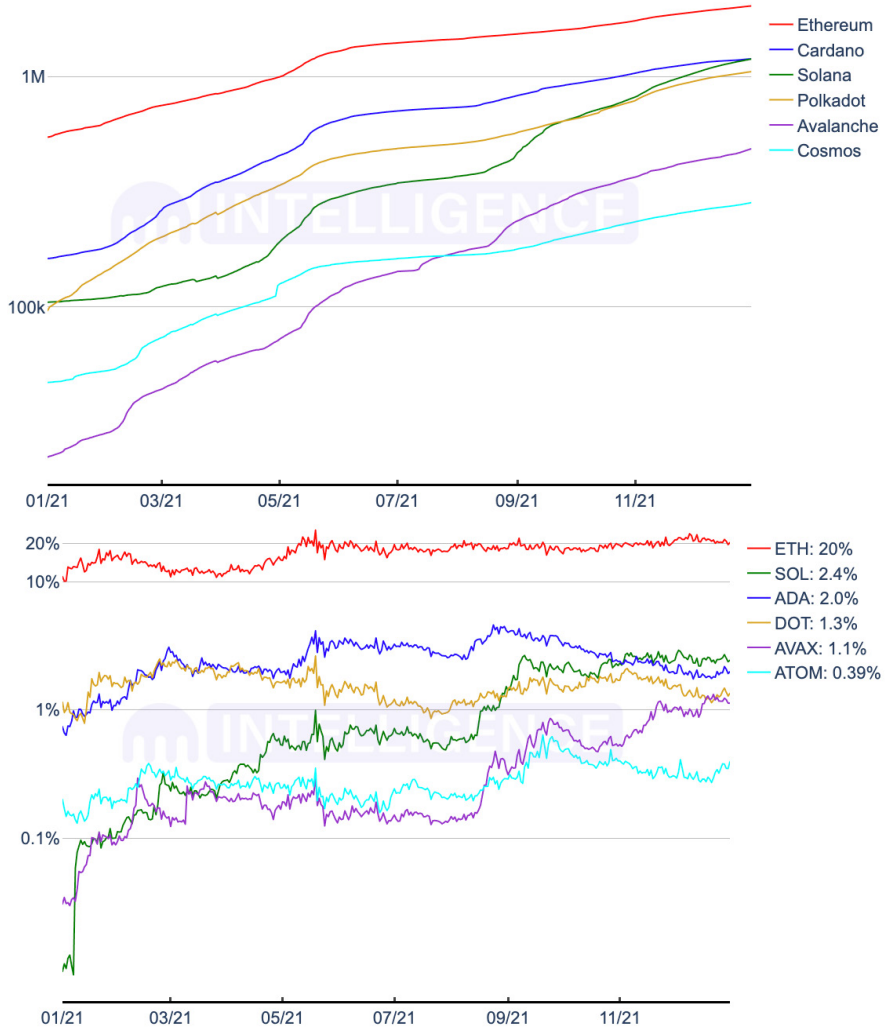
In addition to the outstanding market performances seen throughout the year, we can also turn to each platform's social media presence to get an indication of each project's growth in popularity and adoption. Looking at figure 41, we see each platform saw high growth in Twitter followers over the course of the year. We assume an increase in following implies an increase in social popularity, which is a proxy for adoption. This relationship, however, is not certain and it is not the case that a follower necessarily equates to someone using a protocol or investing in a project.

Comparing the social data presented in figure 41 against each project's market dominance performance in figure 42 over the year, the charts show a clear resemblance to one another. Between the logarithmic separation of Ethereum, Cardano, and Polkadot in

March, the surges experienced by Solana in May and September, and the flippening of Avalanche over Cosmos in August, it is clear there is an association between Twitter followings and price movement.

Figure 41 and 42

Layer-1 Twitter Follower Growth 2021 / Layer-1 Market Capitalization Dominance



Source: Kraken Intelligence, SocialBlade (41)/ Kraken Intelligence, CoinGecko (42)

Taking the analysis a step further in figure 43, we can break followers down by project to get a closer look at the joint followers that projects share with each other; this allows us to see what proportion of each project's followers are also following other projects, as well as what proportion of a project's followers only follow that project. The *lone follower* proportion of a project is the proportion of its followers that only follow that project, and the *joint follower* proportions are the proportion of followers that project shares with another project. Per figure 43, we see that 62% of Cosmos followers also follow Polkadot, while only 17% of Polkadot followers also follow Cosmos.

The biggest takeaway from figure 43 is that Polkadot is the most jointly followed project across all other projects, despite having a follower base of 925K followers while Ethereum has a follower base of 1.89M followers. This is key to point out because a larger follower base increases the likelihood of being popular among other projects. This is what makes Polkadot's prominence in joint followership somewhat of an anomaly that could prove to be a strong signal of the protocol's engagement over time. In contrast, we can see Cardano is the least popular with respect to joint followings, other than with Ethereum, and this is despite the project having the second largest follower base.

While these followings don't equate to participation or financial interest in a given project, there is a correlation between the two as discussed by the trends between figure 41 and figure 42. Therefore, the set of joint followings may lend insight into how markets might rotate over time, and per figure 43, one could argue that Polkadot may see an increased rate of user adoption in comparison to others as the platform and its parachains continue to rollout.

Figure 43

Breakdown of L1 Follower Relationships

			% of a Project's Joint followers w/ Another Project*					
Project	**Total Followers**	**Lone Follower Proportion**	**Ethereum**	**Cardano**	**Solana**	**Polkadot**	**Avalanche**	**Cosmos**
Ethereum	1,875,802	61%	—	23%	18%	21%	8%	7%
Cardano	1,115,937	41%	39%	—	27%	33%	12%	10%
Solana	988,702	37%	34%	30%	—	40%	20%	13%
Polkadot	925,317	25%	43%	40%	43%	—	19%	17%
Avalanche	418,470	31%	36%	31%	47%	43%	—	19%
Cosmos	255,460	16%	49%	43%	51%	62%	31%	—
		Most jointly followed	2	1	1	2	—	—
		2nd most jointly followed	1	—	2	3	—	—

Source: Twitter, Kraken Intelligence, data as of 11/30/21

Overall, all of these projects saw notable growth in their social media followings this past year, and this growth was associated with a surge in their respective market values. This is great news not only for the individual projects but also for the crypto community as a whole given the intertwined nature of these networks, both in terms of interoperability and community following. While joint followings are likely to change over time, the data shown in figure 43 provides a useful snapshot in time for the end of 2021. It displays the result of the evolution of these projects and their communities over the past year, most of which emerged from adolescence. It was certainly a year of high development, growth, and volatility, and tracking how these social connections evolve as the industry matures may prove to be a strong signal for community development on L1 platforms.

Beyond the Base Layer

Aside from the base layer protocols, the next level in the stack also saw quite a bit of development and adoption, particularly in the Ethereum ecosystem. This includes L2 solutions and sidechains. Figure 44 details a quick rundown of some of the most notable developments in 2021 for each project.

Figure 44

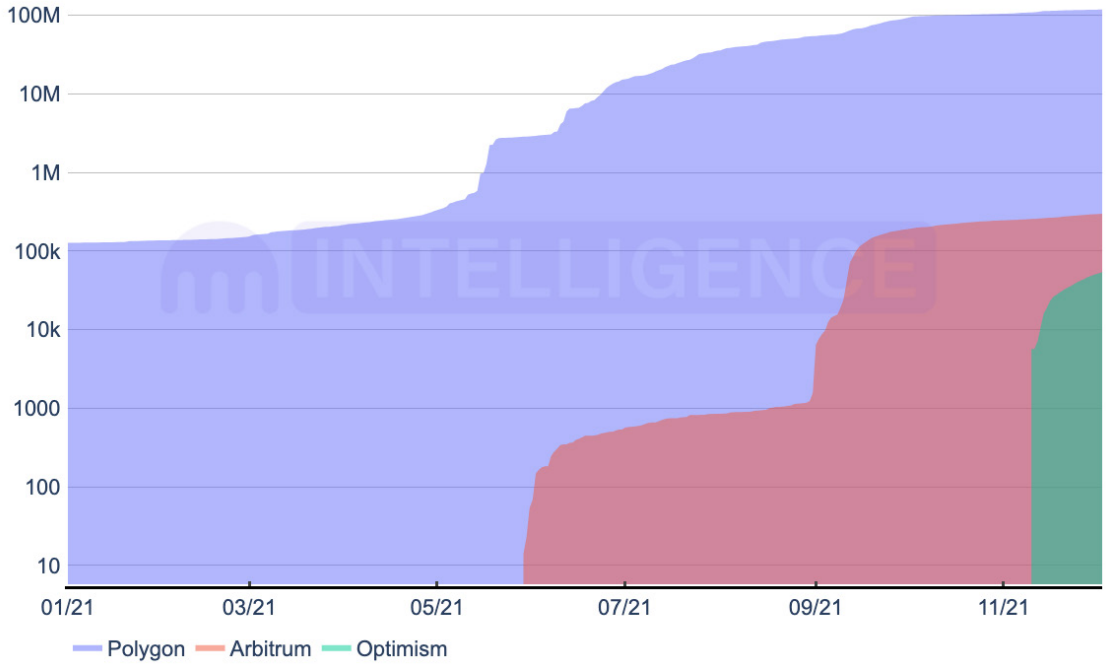
Ethereum Layer-2 Scaling Solutions

Polygon	▪ Originally launched in 2017 as Matic, rebranded to Polygon in February of this year. Originally launched in 2017 as Matic, rebranded to Polygon in February of 2021. ▪ Describes itself as a Swiss army knife of Ethereum scaling solutions with an EVM compatible PoS sidechain, zk-rollups, optimistic rollups, and more.[145] ▪ User growth on its PoS chain took off in June of this year with now almost 120M unique addresses and over 400k daily active users, although it should be noted many of these are likely zombie addresses.[146] ▪ Nearly $5B TVL in DeFi with popular dApps such as Aave and Sushiswap.[147] ▪ Polygon's PoS sidechain incurs transaction fees less than 1% of your typical fee on Ethereum.[148] ▪ Currently the network of choice for Ethereum-based metaverses such as Decentraland, Sandbox, Aavegotchi, and more. ▪ Integrated with Wormhole token bridge such that users can port their assets to Solana, Binance Smart Chain, and Terra.[149]
Arbitrum	▪ Layer-2 solution using optimistic rollups. ▪ Inherits security of Ethereum. ▪ Enables high-throughput, low-cost, smart contracts. ▪ User growth took off in September and now reaching almost 300k unique addresses.[150] ▪ Wide ecosystem of dApps such as DeFi dApps 1inch and Curve already live.[151]
Optimism	▪ EVM compatible optimistic rollup chain. ▪ Inherits security of Ethereum. ▪ Was initially supposed to launch in early 2021, but postponed to provide a more coordinated launch with projects.[152] ▪ Popular DeFi apps such as Uniswap and 1inch already live.[153]

Source: Kraken Intelligence

Figure 45

Ethereum Layer-2 Address Growth 2021



Source: Polygonscan, Arbiscan.io, Etherscan (Optimism)

Blockchain Agnostic Supporting Infrastructure

Aside from settlement layer platforms, blockchain agnostic supporting infrastructure solutions also saw high development, adoption, and utility throughout the year. Some of the top supporting infrastructure solutions include:

- **Chainlink**—decentralized oracle network that provides smart contracts with reliable data feeds for off-chain data.
- **The Graph**—decentralized solution for indexing and querying blockchain data which has integrated with several networks such as Ethereum, Polygon, Solana, and Moonriver.

- **Filecoin**—decentralized storage solution that uses IPFS and saw large growth in utilization with NFTs this year.
- **Arweave**—decentralized storage solution similar to IPFS which saw large growth in adoption from NFTs this year as well. The project also partnered with Solana to archive copies of the Solana blockchain.[154]

Of these solutions, Chainlink is one in particular which rose to prominence with respect to integrations and developments within its own sector. Chainlink is the largest decentralized oracle network (DON) in the world and this year surpassed $75B of value locked in smart contracts which the DON services.[155] Chainlink's adoption rate has outpaced other oracle network solutions, reflected in the increasing difficulty finding an application that requires an oracle and hasn't integrated Chainlink's solutions. Chainlink's network of node operators also expanded over the year with one of the more notable additions being the Associated Press.[156]

Chainlink distinguishes itself further through a broader focus on blockchain-agnostic interoperability for off-chain communication and interaction. This might include communication with another blockchain, data feed, or external API. During 2021, Chainlink released the Chainlink 2.0 whitepaper and expanded its services to include its Keepers, Verifiable Randomness Function, and Proof of Reserve products.[157] Further, Chainlink is working to develop an open standard for cross-chain applications and bridges with their Cross-Chain Interoperability Protocol (CCIP) that has the potential to revolutionize interoperability across the industry by enabling blockchains to securely send both assets and smart contracts to external networks.[158] While the DON's cryptoasset, LINK, did not perform exceedingly well relative to the broader market, the developments made over the year secured its footing as a critical piece of Web3 infrastructure.

Outlook on Infrastructure

2021 was the year of L1's as most of them were released into the wild and saw some of their first wave of mass popularity and adoption. While it was an exciting year for these platforms, almost all of them remain in somewhat of a beta phase—they either have yet to prove their technology works without training wheels or still have critical features to implement before they are considered to be in their final form. Upcoming developments for 2022 include:

- Ethereum is expected to see its long awaited upgrade to the Beacon Chain, "the merge", which is slated for 1H2022 and transitions Ethereum to a PoS-based consensus. Further, the project anticipates a migration of activity to L2 solutions to help decongest the base layer.
- Solana may drop the beta suffix from its name in 2022, so long as the team can confirm the long term stability of the network and that they are satisfied with the quality of their product.[159]
- Cardano expects to see the rollout of dApps and the Plutus dApp Store as well as further development of its L2 scaling solution Hydra.
- Polkadot and its canary network, Kusama, expect to see the continuation of parachain slot auctions and further development of parachains on both networks. A bridge which will connect the two relay chains could also see its launch in 2022.
- Cosmos expects to see the launch of its Interchain Security solution, a long anticipated upgrade to the Cosmos Hub. The team also teased a canary network of its own called Sagan, but the team has yet to release many details on this project.[160]

Overall, all L1's are expected to see further development and adoption of their ecosystems. Additionally, the L1 sector expands far past the projects mentioned herein; while we only have time to cover the detail of the developments and performance of a select few, there are many other projects that saw high development and adoption in 2021 including Algorand, Tezos, Fantom, Internet Computer Protocol, Flow, Elrond, and more. Depending how the crypto dice roll, 2022 could produce a whole new cohort of top L1's.

7.

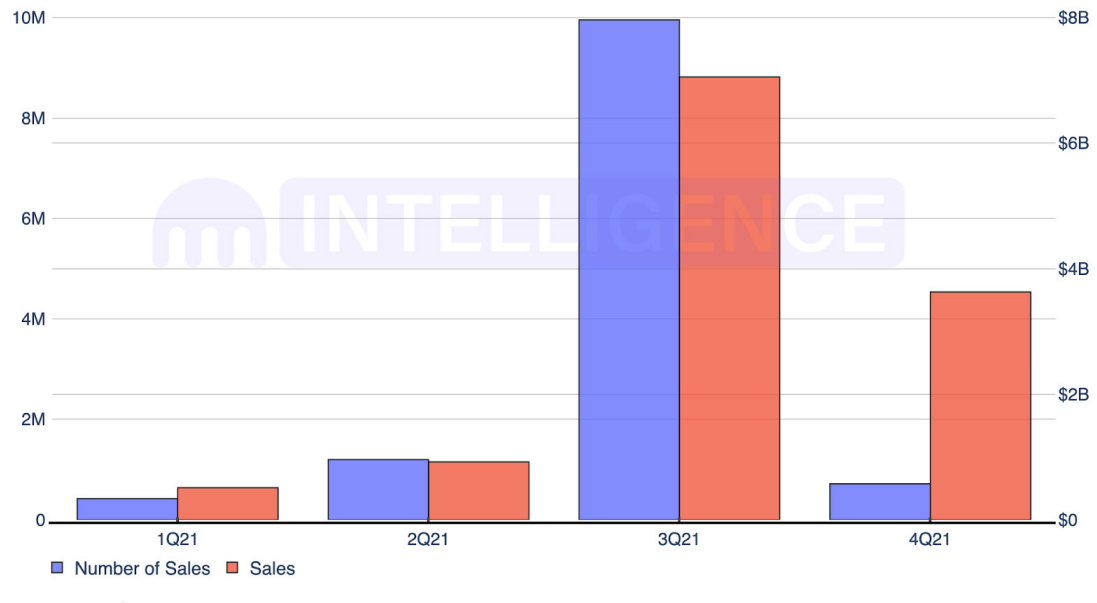
NFTs: Word of the Year

NFTs were certainly a hot topic and major theme of 2021, leaving a deep imprint on the crypto industry. From everyday artists to billionaires and celebrities, NFTs stoked a fire and brought many first-time crypto explorers to the industry. The industry saw continuous growth with new collections and applications of NFTs throughout the year. Its popularity was notable even outside the realms of the crypto community, so much so that "NFTs" was chosen as Collins Dictionary's word of the year.[161]

NFTs are tokens that allow an individual to prove ownership of a non-fungible asset stored on the blockchain like digital art, for example. They do preserve some level of fungibility in the form of collections, meaning multiple tokens that look the same will have different properties that make them completely unique. While a majority of the current NFTs come in the form of JPEGs or GIFs, the sector is evolving such that an NFT itself becomes a key to accessing exclusive privileges. For example, the ownership of an NFT can grant the owner the right and avenue to access data or a community directly. In 2021, NFTs reportedly recorded over $12B in sales on the Ethereum blockchain alone. This marks a +17,864% year-on-year growth when compared to the $67M of sales recorded in 2020.[162] While NFTs primarily trade on the Ethereum blockchain, notable NFT collections, such as Solana Monkey Business on the Solana blockchain, drew users to explore alternative platforms.

Figure 46

Quarterly Sales Count and Sales Value (USD)



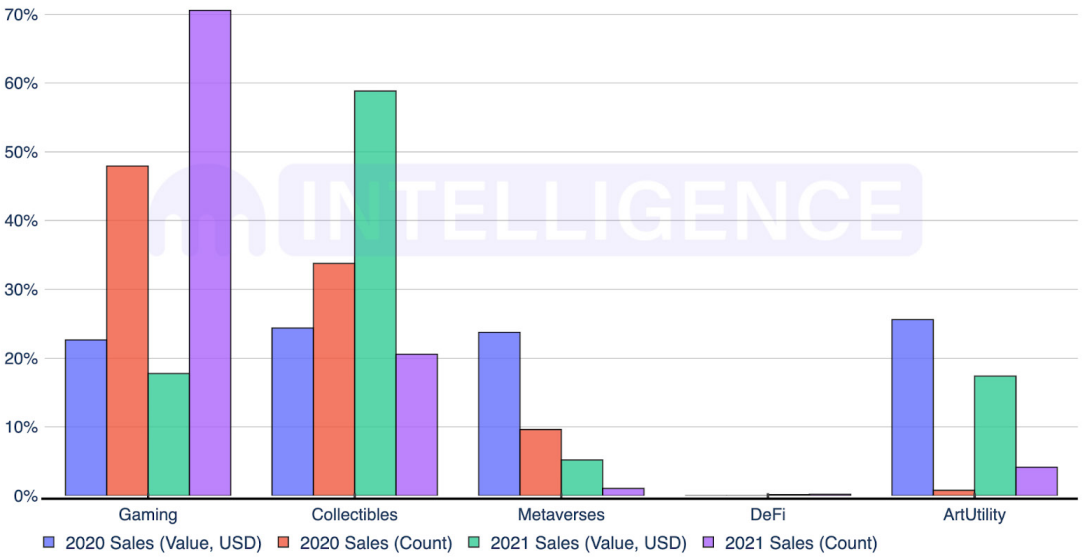
Source: Kraken Intelligence, Nonfungible.com

The initial wave of NFTs took off in 1Q2021 with arts and collectibles, as celebrities, digital artists, and traditional art auction houses like Christie's and Sotheby's leveraged the power of NFTs to expand their reach and offerings. By 3Q2021, adoption bled into in-game NFTs, following a broader macro trend into metaverses, as well as the music industry and beyond. By the end of 2021, the NFT market boasted a diverse audience and made waves in several sectors, namely in art, collectibles, DeFi, gaming, metaverse, and utility-driven NFTs. Many NFT collections, such as Cyber Kongz and Anonymice, introduced staking mechanics, where holders can lock their tokens in smart contracts to generate native currencies that provide additional utility, like fusing two NFTs to create a child NFT.

In figure 47, we examine the explosive growth witnessed in each sector this year.

Figure 47

Top NFT Sectors



Sources: Nonfungible.com

When sorted by sales count, gaming, DeFi, art and collectibles NFTs saw rapid growth in 1Q2021 through 3Q2021, with the market seeing a broader cool-off in number of sales towards the end of the year. In terms of sales value, gaming NFTs saw the greatest growth from 1Q2021 to 3Q2021 at 7,302%, while collectibles saw the highest sales recording over $3.7B in 3Q2021 alone. While most sectors cooled-off, metaverse and utility NFTs continued to grow in sales value in 4Q2021. This illustrates the level of interest in art and collectibles in the beginning of the year, and a gradual shift towards the metaverse and utility NFTs by the end of the year. Regardless of the sector, these metrics showcase undeniable growth and participation that happened in the realm of NFTs this year. Furthermore, across all sectors, there were notable creators, platforms, and collections that rose to the top and further popularized NFTs, as seen in figures 48 and 49.

Figure 48

Top NFT Art Creators

Creator	Highest Value Sale	Total Artworks Sold	Estimated Total Artwork Value
pak	$1,852,376	66,319	$291,836,198
beeple	$69,346,250	1,351	$174,643,678
tylerxhobbs	$256,327	1,008	$141,883,429
dmitricherniak	$3,030,472	856	$117,867,818
mattdesl	$47,413	2,019	$70,147,926
xcopy	$6,174,587	1,917	$60,968,727
hackatao	$947,023	4,582	$39,463,017
rich_lord	$37,193	1,396	$39,214,045
monicarizzolli	$38,139	1,026	$39,057,007
golid	$44,283	3,244	$33,241,717

Source: Cryptoart.io
Note: Data as of Jan. 2022. Art sales and value are subject to change.

Figure 49

Top 10 NFT Collections and Platforms by Sector

Art	Collectible	DeFi	Gaming	Metaverse	Utility
Art Blocks	Bored Ape Yacht Club	Cometh	Rumble Kong League	The Sandbox	Ethereum Name Service
SuperRare	CryptoPunks		Loot	Decentraland	NFT Boxes
Foundation	Doodles		Voxies	CryptoVoxels	Zora
PUNKS Comic	CyberKongz		League of Kingdoms	Somnium Space	Fortune Teller
Portion	Cool Cats		Plasma Bears	SuperWorld	Unstoppable Domains
MakersPlace	FLUF World		Warriors of Aradena	Arcona	Aetheria
Known Origin	Meebits		MegaCube	OVR	Urbit ID
Deafbeef	The Doge Pound		Influence	Vegas City	MethodNFT
Josie	VeeFriends		Luchadores	nØshot	Radi.Cards
CryptoArte	Lazy Lions		Neon District	Landemic	Ripio Credit Network

Source: NonFungible.com
Note: This only includes sales on the Ethereum blockchain, which accounts for the majority of NFT sales. Data does not include sales which took place off-chain (e.g. Sotheby's). Data as of Jan. 2022, subject to change.

The initial NFT art frenzy kick-started a growing level of mainstream adoption, as infrastructure platforms, marketplaces, and wallets began integrating NFT-related services and features to accommodate newer trends and user needs. NFT art was transformative in that it brought down the barriers to the traditional art industry. Individuals are going toe-to-toe with established artists and art auction houses. Digital creators made a name and fortune for themselves, much like the artist Beeple, selling an NFT for over $69M by auction house Christie's. Shortly thereafter, well-known celebrities, athletes, and companies joined in on this trade and began minting NFTs, with some even opening up their own NFT marketplace or services.

Figure 50

Celebrity and Athlete NFT Collections

Creator	Name of Collection	NFT Included	Sale Price
Snoop Dogg	"A Jorney with the Dogg"	Artwork, music	over $100K
Lindsay Lohan	"Lullaby"	Music with visuals	over $85K
Kings of Leon	"When You See Yourself"	Music, concert tickets	over $2M
Paris Hilton	"Hummingbird in My Metaverse" "Legend of Love" "Iconic Crypto Queen"	Artwork	over $1M
Grimes	"WarNymph"	Artwork, music	around $6M
Doja Cat	"Need to Know"	Access token	over $188K
Emily Ratajkowski	"Buying Myself Back"	Composite photo	around $175K
Jay Z	"Heir to the Throne"	Artwork	around $138K
Ellen DeGeneres	"Woman With Stick Cat"	Photo, video monologue	over $33K
Naomi Osaka	Naomi Osaka Preseason Access Pass	Access token	between $12–$100
Naomi & Mari Osaka	"The Colors of Naomi Osaka"	Artwork	around $600,000
Lionel Messi	"The Messiverse"	Artwork	over $9M
Andy Murray	"moments"-Andy Murray Wins Wimbledon 2013	Video	around $178K

Source: Sotheby's, Christie's, L'officiel, Crypto.com, afrotech.com, The Verge, Reuters, Wenew, cryptonews.com, one37pm.com

Towards 2H2021, NFTs saw a further expansion into the gaming and metaverse sector. From consumer brands like Nike and Adidas to luxury brands such as Louis Vuitton, fashion and luxury retail embraced NFTs. In addition, brands launched NFT-games or metaverses to connect their physical products to virtual NFTs, and further engage users with their brand.

Figure 51

Fashion brands' NFT initiatives

Company	Initiative
Nike	*Cryptokick:* patent for footwear. Buyers can link their NFT to their physical shoe and store a digital version of their shoes in a "virtual locker." *Nikeland:* a Nike metaverse in partnership with Roblox.
Louis Vuitton	*Louis the Game*: adventure-based NFT collecting game. Players can collect 30 NFTs, designed by artist Beeple.
Adidas	Digital token: rare NFTs owned by Adidas. Specific use-case to be announced.

Source: Nike, Adidas, Louis Vuitton

In a similar vein, individuals in the music industry utilized NFTs as a means to disseminate their content. Everything from music albums to concert experiences (access passes) were tokenized and sold through NFT marketplaces. For instance, rock band Kings of Leon released three types of NFTs: one token provided the buyer access to their album package, the second token offered live show perks including front row seats, and the third token represented audiovisual art NFTs. The unique NFT version of their album included a moving album cover, digital download of the music, and a limited-edition vinyl.[163] The evolution of NFTs took the application far beyond art and made its way into industries often controlled by middlemen with a higher share of profits and control over the dissemination of content. Since NFTs can be programmed to return a commission to the original creator in every secondary sale, artists are empowered to earn fees from their communities and fanbase without relying on a third-party.

Empowering creators on an individual level and eliminating barriers to entry stirs a greater conversation around the transformative power of NFTs. While current applications alone seem revolutionary, the developments of this year suggest to us

that we have only scratched the surface. Any physical product or experience could be programmed into an NFT, both in its current static form or eventually as dynamic NFTs.[164] NFTs will bring access to communities, services, content, experiences, products, and more. They may also act as a virtual representation of physical objects and assets and simplify the concept of provable ownership. As the industry continues to break ground and mainstream companies adopt their product offerings to accommodate NFTs, we believe continued demand will result in the upending of industries that fail to catch up, such as entertainment, event management, real estate, and more.

Outlook on NFTs

Towards the end of 2021, the NFT market entered a cool-down period. Some even argued that the lack of excitement or engagement came from a broader sentiment that many NFTs were massive PR scams. Despite these opinions, critical areas of the NFT market continued to see growth, as evidenced by multiple NFT platforms successfully completing funding rounds and investing into the future growth of NFT platforms. Looking forward, we believe there are notable issues on the horizon that need to be addressed in order for the NFT industry to proliferate.

NFTs and its surrounding ecosystem went mainstream this year because it tapped into the concept of digital identity and verifiable scarcity, where individuals could represent themselves online with the NFTs they held. Whether it was an art piece that showcased one's personality and wealth or a virtual item that held utility in online games, NFTs accelerated the migration into metaverses and the online world. Correspondingly, we experienced the setbacks, including hacks, counterfeits, and more, which shed light on the lack of maturity of NFTs and areas for improvement over the long-run. For example, there is a growing need for the ability to securely hold NFTs without risk of theft or reproduction without consent. Most platforms and collections today use data storage solutions that rely on third parties to house NFT data, which can expose the collector or creator to the risk of NFT obsolescence. Finding and utilizing storage solutions that do not rely on third parties would allow for more robust security for users maintaining their NFTs.

Furthermore, the issue of counterfeit NFTs or duplicated NFTs will need to be tackled for the longevity of the industry. For instance, verification systems that can identify similar NFTs, ones that are unique but a clear counterfeit, by checking NFTs against others living in the ecosystem could set the foundation for a safer expansion of the industry. As an example, verifying access passes or concert ticket NFTs before purchasing, would prevent the sale of any counterfeit or illegally reproduced NFTs. NFTs can revolutionize the way we live and function in society yet there are still gaps in the ecosystem that require fortification and development. However, that's not to discredit the growth we have witnessed in 2021. NFTs created a space where creators could envision more agency and control over their work and directly profit off of their sales. If the space continues to develop security measures and risk mitigation solutions to protect creators and collectors alike, such as NFT storage solutions that remove external dependencies while lessening user maintenance or platforms that can detect counterfeit NFTs, there may be greater adoption and awareness of methods to safeguard one's NFTs. This would shape the way we approach and maintain NFTs and NFTs then may begin to play a bigger role in representing ownership, social and business interactions, and even the way we enjoy games, art, and music.

Metaverse & Gaming

The metaverse, while not a new concept, took over the mainstream crypto narrative toward the end of the year, thanks largely to Facebook's rebranding to Meta and newfound commitment to the metaverse. Other tech giants such as Microsoft and NVIDIA asserted their commitment to the future in the metaverse as well.

The tech giants' implementations thus far seem to be a general application of augmented reality (AR) and virtual reality (VR) technology to social, professional, and industrial experiences. On the other hand, *blockchain-based metaverses* such as Decentraland and The Sandbox, are more oriented on building virtual universes with virtual real estate and economies for gaming and social experiences, leveraging the power of blockchain

networks, NFTs, and DeFi protocols. Blockchain-based metaverses can, and likely will, integrate AR and VR into their platforms, but currently most are limited to desktop applications.

Blockchain gaming platforms such as Axie Infinity and Star Atlas adopt a similar paradigm of NFT-based virtual real estate and *true ownership* whereby users own the in-game assets, which are represented as NFTs, and can sell them directly to other players on open markets for crypto. This broad overlap makes it difficult to distinguish blockchain metaverses from blockchain gaming—ultimately the question comes down to "what defines a game?" If The SIMs and Roller Coaster Tycoon are considered games, then so too should metaverses; fundamentally, the only difference is "true ownership."

Nonetheless through true ownership, blockchain-based metaverses and blockchain gaming unlock a seemingly endless amount of economic opportunity as each metaverse consequently props up a virtual economy consisting of various roles such as landowners, asset owners, game developers, digital creators, event hosting, performing, and more. Further, it enables a Play-to-Earn (P2E) gaming model which has taken the sector by storm, and some have argued it may have the potential to make a significant impact not just on gaming but also in broader society as an alternative to universal basic income, as P2E can serve as an efficient medium of providing low-skilled workers with a livable income through true ownership and in-game rewards.

Play-to-Earn

An intriguing aspect of the blockchain-based metaverse paradigm and blockchain gaming P2E model. P2E is somewhat of a buzzword getting thrown around with the new emerging projects in these fields, so the concept of what P2E actually looks like can be somewhat vague and mean different things in different applications However, it is rooted in the model of "true ownership" enabled by blockchain. The implications resulting from this model are revolutionary for gaming, particularly in an age where users spend real money on in-game assets such as in *Fortnite* which has generated billions in revenue. Not bad for a so-called "free-to-play" game.[165]

P2E mechanics arguably apply to any role within the metaverse, but is generally associated with the user/player role (i.e. roles that don't require investment). Other roles also exist along the lines of an "invest-to-earn" model (i.e. landowners, asset traders). P2E can take shape in the following forms:

- **P2P Battles**—players battle head-to-head with in-game assets on the line or compete for prizes in tournaments.
- **Quests & Achievements**—players receive valuable NFTs by completing campaign modes or add more value to an in-game asset leveling-up and gaining experience points, etc.
- **Responsibilities**—players have a role in the metaverse with a set of responsibilities in which they are paid a wage in some form of asset or currency in return for their work. This could be in-game maintenance such as working as a crew member on a spaceship, hosting/managing a concert in the metaverse, or performing within the metaverse whether as a musical artist at the concert.
- **Sponsorships**—players are sponsored to wear a certain in-game clothing with a company's logo or use and promote a company's in-game asset (or a real-world product or service). Additionally, skilled gamers may be paid to play and promote a new upcoming game.
- **Attention & Participation**—players are rewarded for the cumulative time spent on a platform while consuming advertisements. This incentive model can be used to bootstrap a community as players' participation in a metaverse follows Metcalfe's Law which suggests the value of a network is, to some degree, proportional to the size of that community. Rewards to users in this model may be funded through advertisers or through a tax-based economy as suggested by Ed Castranova, a professor at Indiana University, in his book *Virtual Economies: Design and Analysis.*[166]

The P2E model has already been life-changing for many, such as the users of Axie Infinity who are reportedly earning nearly $500/month from in-game rewards.[167] Looking ahead, it is possible many will make a career out of being in the metaverse, architecting digital buildings, hosting events, and playing via P2E game mechanics as the industry grows and commercial involvement increases.

Overall, the metaverse has the potential to build new virtual world economies and provide a plethora of economic opportunities for players, investors, creators, and more. The concept of true ownership is revolutionary for gaming and will undoubtedly accelerate the industry's booming growth by attracting new users intrigued by the model. Based on the sentiment surrounding the metaverse late in the year and announcements coming from companies and projects both inside and outside of crypto, it is likely we've only seen the tip of the iceberg of what's to come in these virtual worlds.

8.

DeFi Economy: Disrupting TradFi

2021 proved yet another exponential year of growth for the DeFi sector. Total value locked (TVL) across DeFi protocols increased +13,000% from $21B in January 2021 to $320B as of December 2021. Before 2021, the majority of DeFi apps were built on top of the Ethereum network. But by the end of 2021, the network's dominance dipped slightly as users fled from high gas fees and flocked to other chains with lower fees, including Binance Smart Chain, Polygon, Avalanche, and Solana. "Yield farming," also known as "liquidity mining," remained a driving factor in TVL growth across DEXs.

From six-figure yields to six-figure token airdrops, crypto market participants across the board eagerly ran to every opportunity. While legacy DeFi projects, such as Yearn Finance and Aave, maintained their rankings among the top-200 cryptoassets by market capitalization, a plethora of new "DeFi 2.0" projects stole the spotlight in 2021 by offering innovative products, such as decentralized reserve assets, decentralized autonomous organizations (DAOs), and reward-bearing token collateralization. Needless to say, the trends and growth of DEXs, cross-chain DeFi protocols, DAOs, and airdrops were a pivotal part of DeFi in 2021 and have set the stage for what to expect in the new year.

What is DeFi?

Decentralized finance (DeFi) is an ecosystem of dApps that perform financial functions on a blockchain. Instead of processing and confirming transactions through a centralized intermediary, such as a bank, transactions are programmatically executed directly between participants by smart contracts. Smart contracts represent a collection of computer-programmed terms or rules that automatically execute when triggering conditions are met. For example, when a user deposits ETH to an asset vault on Yearn Finance the protocol immediately begins to accrue yield to the user's claimable rewards account.

Many dApps can connect and work together to create complex financial services. For instance, BTC holders can tokenize their holdings on the ethereum blockchain by locking BTC in a smart contract that automatically creates an ERC-20 token equivalent, pegged 1:1 with the user's locked bitcoin. This "wrapped" BTC (WBTC) is then available to commit to a liquidity pool smart contract, or peer-to-peer lending platforms that borrowers can use by contributing their own collateral. The protocol automatically adjusts rates according to the demand for the asset and its value on a real-time basis.

Yield farming, a process whereby market participants lock up funds across DeFi protocols to earn token rewards, is another popular mechanic utilized by many dApps. Through yield farming, liquidity providers (LPs), or yield farmers, provide liquidity to liquidity pools in return for fixed or variable interest, paid out in a protocol's respective token, and a percentage of generated fees. Through yield farming, lending and borrowing, and decentralized trading, 2021's DeFi ecosystem continued to grow in total value locked (TVL) as more participants sought to multiply their returns.

DEX Activity

Broad market momentum for cryptoassets was only one driving factor for ETH's surge from $730 to an all-time high of $4,800 during 2021. Improved decentralized exchange (DEX) mechanics through greater capital efficiency, cross-chain integrations, and improved oracles led the charge in rapid DeFi growth.

On August 10, 2021, the CFTC and FINCEN cracked down on leverage trading and levied fines to a number of centralized exchanges (CEXs) over the following months.[168] With an appetite for leverage and long-tail assets while maintaining custody of their own assets, traders flocked to DEXs like Solana-based Mango Markets, ETH-based dYdX, and SushiSwap. DEXs, which source their order book liquidity from protocol investments and yield farmers, provide a haven for crypto users where they can permissionlessly swap tokens across markets. DEXs found immediate market-fit through crypto traders who are willing to bear the risk of trading smaller token markets before CEXs offer the assets.

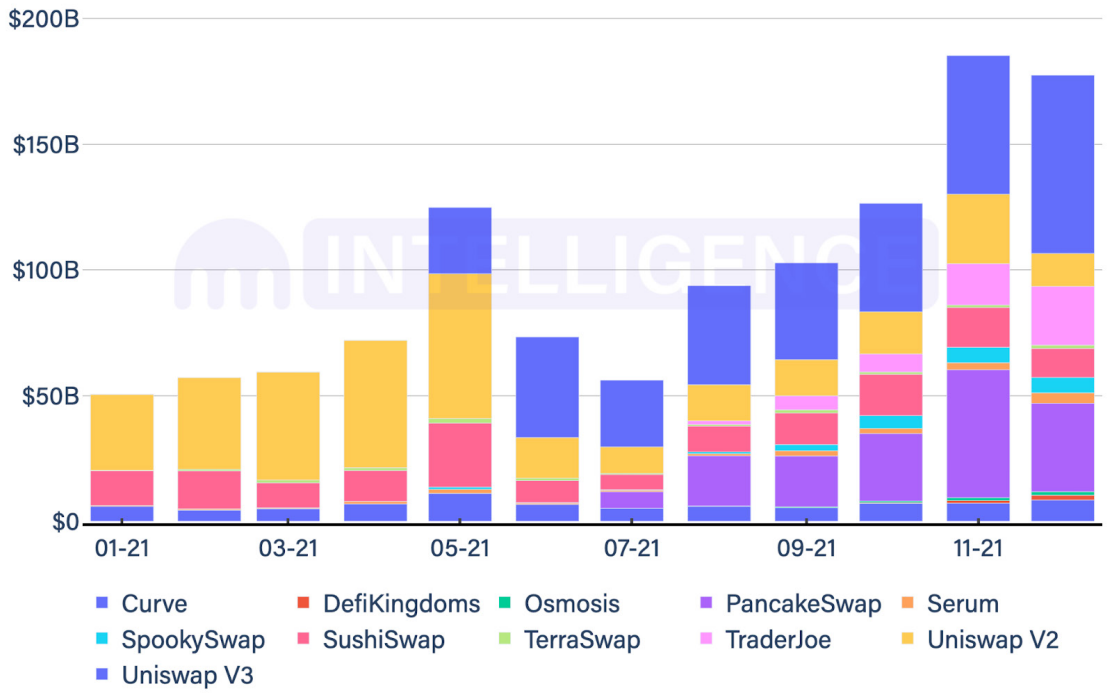
Of the DEXs that led the scene in 2021, Uniswap and SushiSwap stood out among their peers; TVL across the DEX giants rose from $2.1B and $1.19B TVL to $11B (+424% YoY) and $6B (+404% YoY), respectively.[169] Uniswap's first-mover advantage locked in its seat as the leading DEX in 2021. SushiSwap distinguished itself by enabling swaps on chains beyond Ethereum with its Polygon integration in May, followed by Moonriver, Avalanche, Harmony, Fantom, and Arbitrum integrations. Uniswap launched its long-awaited v3 in May, introducing concentrated liquidity and multiple fee tiers.[170] Concentrated liquidity gives individual liquidity providers (LPs) granular control over what price ranges their capital is allocated to. This means individual positions are now aggregated into a single pool, forming one combined curve for users to trade against. Concentrated liquidity gives traders deeper liquidity and benefits LPs by offering up to 4,000x more capital efficiency when compared to v2.[171] Uniswap also implemented the tokenization of LP positions as NFTs, in contrast to the prior ERC20-denominated LP positions. Further, the DEX upgraded its oracles to time weighted average price (TWAP) oracles. Oracles are a critical piece of DeFi infrastructure for leading projects, including Compound, Reflexer, and Curve, by making it possible to calculate any TWAP within the past nine days via a single on-chain call, reducing gas costs across the board for traders and developers.

While Ethereum DEXs laid the groundwork for general decentralized market structures, many users opted to use low-fee marketplaces across the Solana and Avalanche blockchains, among others. These DEXs offer similar models where users can provide liquidity to receive fees and governance voting rights in the form of their native currencies. These governance rights provide users engaged in the platform the ability to dictate future development decisions and exchange policies. In March 2021, the Solana ecosystem launched its Raydium DEX, which taps Project Serum's decentralized on-chain orderbook.[172] Serum is the backbone of Solana's DeFi ecosystem as it integrates all Solana DEXes to share liquidity in one orderbook. Raydium DEX also acted as a launchpad for initial decentralized offerings (IDOs) of many Solana tokens, such as the play-to-earn (P2E) project Star Atlas. Together, Raydium and Serum were paramount to the expansion of the Solana ecosystem. In August 2021, the Avalanche ecosystem saw its own DEX contender, Trader Joe, which serves as the cornerstone of Avalanche's DeFi ecosystem. Trader Joe saw so much demand that its TVL rose from $25M to $3B in only

four months.[173] DEXs on other blockchain platforms built on the initial Ethereum DEX architectures piloted by SushiSwap and Uniswap grew to become one-stop shops with full suites of DeFi services, such as lending, borrowing, and staking. While Ethereum still reigns in terms of DEX trading volumes, Raydium and Trader Joe signaled a notable shift in asset migration to other chains, capturing 0.7% and 3.7% of total DEX trading volumes, respectively. Last year brought explosive DEX growth to the crypto space, and as adoption continues, we can expect to see a similar trend throughout 2022 as new users begin to leverage passive staking yields and seek high-risk small market cap assets before they are available to the masses on CEXs.

Figure 52

2021 DEX Trading Volumes



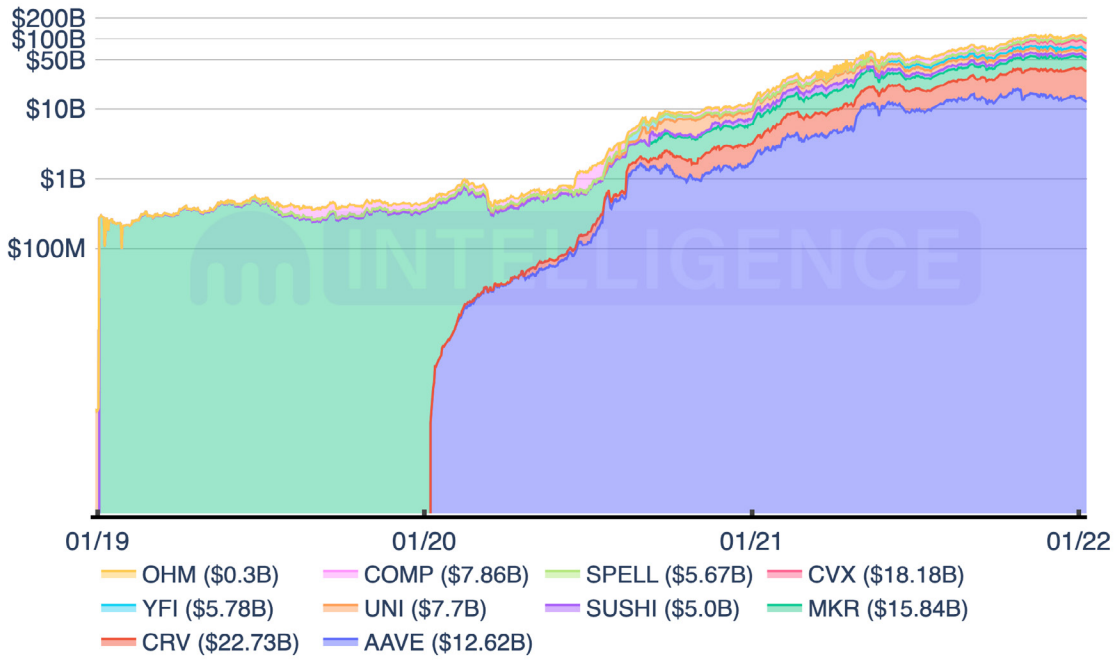
Source: Kraken Intelligence, CoinGecko

Protocol Growth

While DEXs enabled participants to trade most cryptoassets, DeFi protocol growth drove unprecedented demand to exchange these tokens. To date, at least 740 DeFi protocols exist, with many of the larger projects, such as Curve Finance, Aave, and Abracadabra functioning across multiple chains.[174] While blue chip DeFi protocols, such as Yearn Finance, posted sizable growth, an emerging trend of "DeFi 2.0" protocols stole the spotlight.[175] This new wave of protocols, dubbed "DeFi 2.0," such as decentralized reserve currency OlympusDAO, Curve yield maximizer Convex Finance, liquidity-as-a-service provider Tokemak, and reward-bearing collateral protocol Abracadabra, captured exponential growth during the year, outperforming most older DeFi protocols. They innovate further on the blue-chip protocols before them by offering services that stretch beyond simply lending, borrowing, or providing liquidity for an asset, such as protocol-owned liquidity and inter-protocol reward-boosting.

Figure 53

TVL Among Major DeFi Protocols



Source: Kraken Intelligence, DeFi Llama

Abracadabra, with its native stablecoin Magic Internet Money (MIM), started in June 2021 with less than $100M TVL. Abracadabra allows holders of interest bearing tokens from Yearn, Sushi, and Curve to collateralize their yield-generating assets to mint MIM. This allows users to continue accruing interest on their collateral while they borrow MIM to freely spend. With the offering of decentralized leverage trading, collateralized reward-bearing token vaults, and multi-protocol synergistic collaborations across the FTM, AVAX, and ETH chains, its governance token SPELL posted a +17,000% annual return from its launch in June.[176] Comparing this performance to YFI's +36% annual return, DeFi 2.0 is clearly a new narrative to follow.

OlympusDAO, another DeFi 2.0 project founded by a pseudonymous developer known as Zeus, started in March 2021 with a market cap of roughly $200,000 and has surged to a market cap of $3B by December 2021.[177] OlympusDAO participants have historically staked about 90% of the cryptoassets's circulating token supply to receive exorbitant annual returns, currently at ~5,000% APY, automatically compounded every eight hours. Common critics state that this annual return is unsustainable, but with OlympusDAO's unique bonding mechanism and protocol-owned liquidity, the protocol can maintain this return runway for at least another 360 days. Only time can tell if this annual yield will continue. OlympusDAO's bonding mechanism generates revenue for the protocol by selling OHM at a discount in exchange for assets, such as ETH, DAI, FRAX, and USDT, to add to its treasury.

In 2021, OlympusDAO popularized the concept of protocol-owned liquidity, where the product itself issues liquidity provider (LP) bonds that vest native tokens proportionately over seven days. As a result, proceeds from LP bonds ensure the longevity of a liquidity pool, unless the protocol votes to utilize the LP positions elsewhere, or a rogue party exploits the protocol.

DeFi bonds function as follows:

1. DeFi protocols provide vested bonds that provide a 5–10% market price discount on their respective tokens to gain ownership of their DEX liquidity or expand their treasuries.
2. In exchange, a participant pays via LP tokens, stablecoins, or any other tokens that a protocol accepts.

3. The protocol locks the bond proceeds into its treasury and pays out its native token over a 5 to 7 day vesting period to the bond purchaser.

Many other DeFi protocols adopted protocol-owned liquidity and bonding mechanisms to capture value for their stakeholders, signaling a fundamental shift from DeFi protocols' norm of providing inflationary token rewards to incentivize liquidity. By owning their own liquidity, protocols generate fee revenue to feed into their treasuries. The treasuries can be utilized however the protocol deems fit, whether that be the incubation of a new protocol, a treasury swap with another protocol, or the accumulation of governance tokens to gain more voting power over reward yields for different token vaults. OlympusDAO ushered in a new era of forked protocols, such as Wonderland Finance, AnubisDAO, Temple DAO, and Snowbridge DAO, that fueled a new level of speculation in 2021's DeFi scene. All forks implemented different twists on OlympusDAO's mechanics but maintained fundamental concepts of treasuries, high staking returns, protocol owned liquidity, and bonding mechanisms.

The Curve Wars

While Abracadabra and Olympus brought entirely new product offerings in 2021, some protocols sought to leverage existing DeFi architecture to benefit holders through the usurping of control of pre-deployed funds. Through collective efforts, smaller protocols could attempt to gain governance control of other multi-billion dollar protocols and vote to influence decisions that direct large reward emissions. In May 2021, Convex Finance entered the DeFi scene and triggered the on-going "Curve Wars," a term used to describe the power-struggle between different protocols to gain a material share of Curve Finance's governance tokens. With Curve being the largest DeFi protocol in terms of TVL, its veCRV token grants voting power to influence the future issuance of CRV tokens. By accumulating large holdings of veCRV tokens, protocols like Convex Finance voted to allocate large CRV returns on pools of their choice and effectively control the $20B DeFi behemoth.[178] Through control over CRV allocations, different protocols engaged in governance warfare to attract pooled assets and bring in more revenue for their respective token holders.

In August 2021, Curve introduced "bribe" services whereby governance participants receive a payout from other protocols by voting in favor of their pools.[179] Another bribe mechanism, called Votium, allows users to use a more passive bribe system. Deposited tokens are automatically managed to vote for bribes. Abracadabra was one of the first successful bribers to utilize services and offered lucrative SPELL token payouts to receive CRV emissions. Convex's CVX token saw so much interest this year that it surged to an all-time high of $35 in November 2021 versus an exchange price of $5 in May.[180] Moreover, this does not take into account Convex's reward schedule, which reached upwards of 60% to 80%.[181] New governance protocols such as Lobis Finance and Redacted, both of which appear to have the intention of accumulating CVX and CVR tokens to influence governance, suggest that the Curve Wars will stretch beyond 2021.

Legacy DeFi

Although DeFi 2.0 stole the spotlight for the latter half of 2021, blue chip legacy DeFi protocols, like MakerDAO, Aave, and Yearn continued to grow throughout the year and had a number of developments and successes deemed worthy of checking in 2022. For instance, legacy DeFi saw a notable jump in demand from institutional investors. Asset managers, including Grayscale and BitWise, launched their own DeFi index funds that offer investors exposure to a variety of blue chip DeFi protocols like Uniswap, Aave, Compound, Curve, MakerDAO, and Yearn. Last year, consumer demand continued to grow and consequently led to an influx of funds into the older, more established DeFi protocols. The protocols demonstrated strength in their willingness to evolve with the entire crypto ecosystem.

MakerDAO, the protocol behind the DAI stablecoin, passed a proposal in April 2021 that allowed the Tinlake marketplace to serve as a bridge between real estate loan company New Silver and MakerDAO.[182] The protocol established two tranches of reward-bearing tokens, DROP and TIN, that were issued against real estate-backed NFTs based on individual deposits from New Silver. This marked the first time that real-world assets were collateralized in DeFi to issue debt. MakerDAO's TVL nearly doubled from $12B in January 2021 to $20B by the end of the year, likely indicating that demand for

DAI continues to grow. Lending protocol Aave posted an all-time high TVL of $22B this year, far up from its January 2021 TVL of $2B.[183] The protocol teased a new V3 upgrade in November that would introduce a Portal feature to allow borrowers and lenders to venture into cross-chain lending markets.

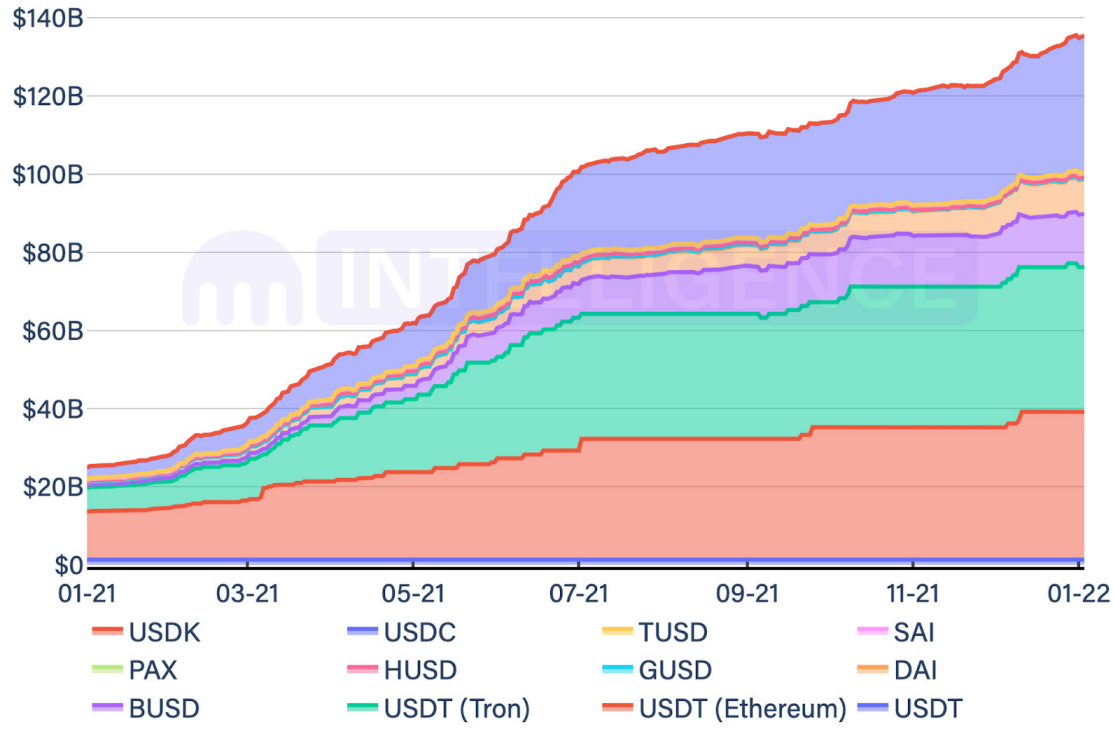
Yearn Finance started the year with $500M in TVL before attracting $6B of assets to its automated reward-bearing vaults. In September, the protocol released a beta V3 that boasted a new user interface and hinted towards a cross-chain future. Compound Finance's biggest event of the year involved a bug in its comptroller smart contract that erroneously disbursed 280,000 COMP ($90M) in early liquidity mining awards to users. With no methods to pursue legal action as a DAO, the protocol implored recipients to return their COMP tokens out of goodwill. The protocol's TVL remains unaffected and posted a gain from $2B TVL to nearly $14B TVL during 2021. All in all, 2021 brought massive growth and introduced a surge of institutional investors into the legacy DeFi sector. The longevity of these protocols and continual growth in TVL signals that they are likely here to stay and will continue to iterate on mechanics to add value and branding to the entire DeFi ecosystem.

Stablecoins

Growing demand for liquidity in DeFi protocols sparked a massive surge in stablecoin supply growth in 2021. Stablecoins, such as MakerDAO's DAI and Circle's USDC, power DeFi lending, trading, and farming protocols due to their common use as collateral. Throughout the year, the Biden administration raised concerns over the threat that stablecoins pose to the USD as a global reserve currency.[184] Total supply of stablecoins rose from $29B to $146B in 2021.[185] Tether continued to dominate the stablecoin market, composing 54% of total supply, but lost some of its share to USDC and Terra's UST, perhaps explained by ongoing controversy over the backing of its USDT reserves during 2021. In response, Tether disclosed quarterly audit reports showing collateralization in the form of cash, commercial paper, corporate bonds, and loans. In the midst of this debate, USDC's dominance rose significantly during 2021, now composing ~25% of total stablecoin supply. Circle voiced its support for regulators' proposal to require stablecoin issuers to register under the same license requirements that banks are held to.

Figure 54

Total Stablecoin Supply



Source: Kraken Intelligence, CoinMarketCap

DAOs

With billions of dollars locked in DeFi protocols, a fair and decentralized governance structure is essential to ensure the longevity and safety of participants. Decentralized autonomous organizations (DAOs) provide a structure that allows token holders to democratically control a number of mechanics in DeFi protocols, such as lending rates, supported assets, and new product offerings. A DAO is a collective with decisions influenced by a majority vote. All participants are given an equal entry opportunity to join the organization, often represented by their holding of a token.[186] These organizations primarily exist to govern a protocol or steer grantmaking to accomplish a stated mission.

The first DAO formed in 2017 as a venture capital fund where Ethereum contributors could seed funding and collectively act on potential investment opportunities. Shortly after inception, a smart contract exploit allowed a hacker to steal Ξ12.7M, or around $150M at the time, from the DAO. Since the DAO hack, these organizations reorganized with protective innovations, such as new models (Moloch, multisig wallets) to bloom into powerful forces that govern everything from lending dApps like AAVE to DEXs like Uniswap.

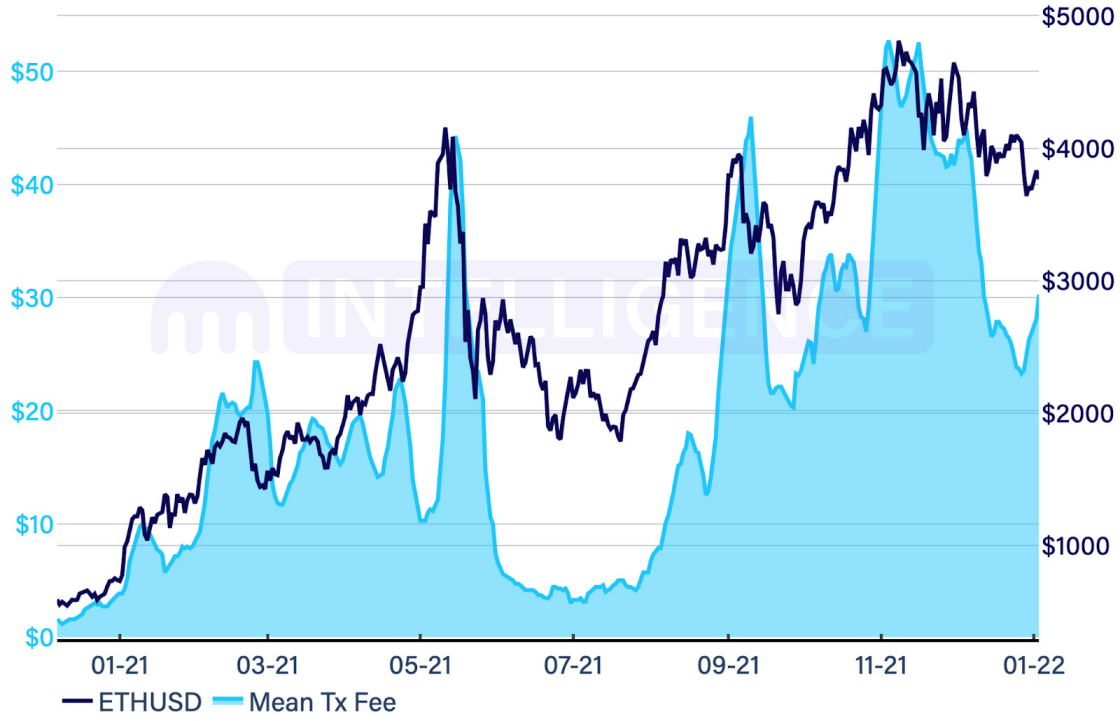
DAOs made waves through a number of initiatives in 2021. In April, Wyoming passed legislation that officially granted DAOs a formal registration option via a DAO LLC. Although the majority of the DeFi landscape we see today is a direct product of DAOs, these entities stretch far beyond DeFi governance alone. With backing from Ethereum founder Vitalik Buterin, CityDAO raised Ξ2,500 ($11M at the time) through the sale of 10,000 citizenship NFTs that grant governance rights for the organization.[187] In November, the DAO purchased 40 acres of land in Wyoming with the intention to tokenize the parcels on the blockchain.[188] ConstitutionDAO raised $40M in a week to purchase an original copy of the U.S. Constitution in a Sotheby's auction.[189] Although the DAO did not procure the document, the movement captured media attention and helped shape the narrative around DAOs, where global crypto organizations can coordinate to make noticeable impacts on the physical world around them. In October, NFT collective PleasrDAO revealed their purchase of the Wu-Tang Clan's 1/1 NFT album, "Once Upon a Time in Shaolin," for $4M.[190] The DAO also purchased NSA-whistleblower Edward Snowden's "Stay Free" NFT for $5M earlier this year.[191] The collective exists to further the decentralized ethos of crypto through the incubation and collection of digital art. As DAOs continue to captivate audiences worldwide, 2022 should generate traction for the movement, where decentralized governance and coordination among the Web 3 community enable these organizations to make impactful contributions to causes they care about.

Bridge-Mania: DeFi Goes Cross-Chain

Before 2021, DeFi protocols primarily nested on the Ethereum blockchain due to its first-mover advantage in the smart-contract realm. However, with increased usage from dApps and the NFT craze, the network's transaction fees, commonly called "gas fees," surged to all-time highs in 2021. Gas fees on Ethereum are priced in gwei, which is short for gigawei, and equivalent to one billionth of one Ether.[192] Many users felt excluded as any transaction of less than Ξ0.03 ($130) proved economically unfeasible with fees representing almost half of the total transaction value. As a result, Layer-2 scaling solutions such as Arbitrum, Optimism, and zkSync gained popularity as users searched for cheaper alternatives. Many users fled the Ethereum network altogether for alternative Layer-1 blockchains, such as Avalanche, Solana, Harmony, and Luna.

Figure 55

Annual Gas Cost per Transaction on Ethereum

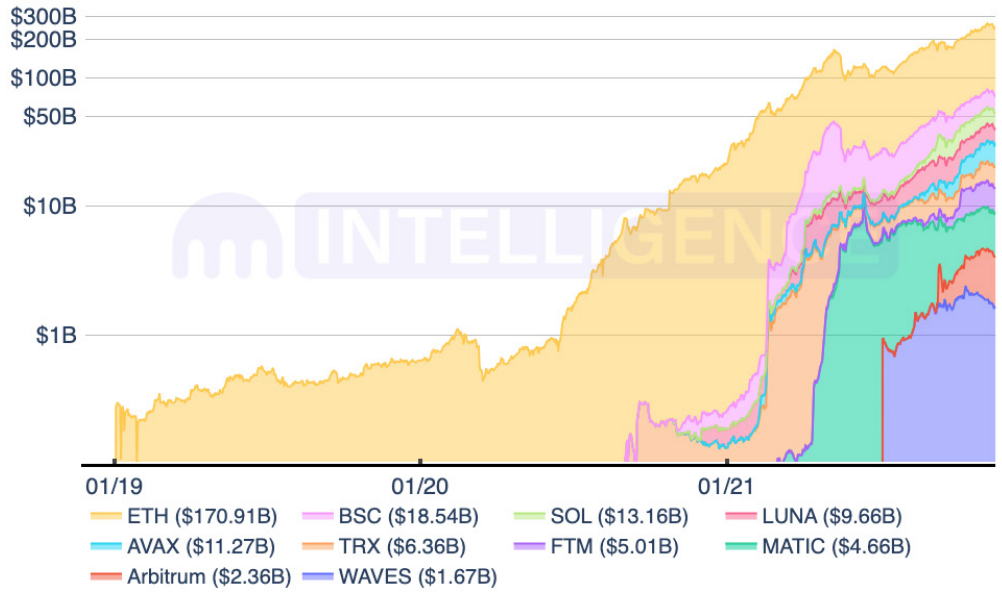


Source: Kraken Intelligence, Coin Metrics

Together, Layer 1 blockchains and Layer 2 solutions other than Ethereum attracted a notable $93B of TVL, composing a substantial ~40% of the entire DeFi ecosystem by December 3, 2021.[193] This movement emerged from the release of "bridge" protocols that allow users to quickly transfer Ethereum-native assets to other networks. With the release of bridges, users no longer required centralized exchanges to exchange or transfer assets between chains. Further, many blockchains launched ecosystem funds and hack-a-thons to attract dApp developers and liquidity to their networks. As mentioned earlier, DEXs on alternative blockchains created opportunities for users to leverage new markets and yield farming opportunities. Many protocols on other blockchains also offered airdrops to retroactive users, attracting hopeful airdrop farmers in masses. While Ethereum still remains king in terms of TVL in DeFi, bridges caused the network's dominance to slightly fall in 2021, leaving participants to wonder how dApp distribution will look by the end of 2022.

Figure 56

Top 10 TVL by Blockchain



Source: Kraken Intelligence, DeFi Llama

Airdrops

DeFi presents unparalleled opportunities that one can't find in the traditional finance world, such as airdrops that provide free tokens to early users of dApps, often equating to tens of thousands of dollars. Beyond monetary incentives, these airdrops provide opportunities for early users to own a stake in these platforms and grant them the ability to guide decision-making as the platforms grow. Since most airdrops happen without prior announcements, seasoned DeFi users are quick to test out every dApp imaginable. In turn, platforms rapidly gain large user bases that provide feedback to perfect and iterate on platform functionality, which helps accelerate the adoption and development of in-demand products. In 2021, we saw a number of airdrops, including Ethereum Name Service's ENS token, automated market maker (AMM) ParaSwap, and leverage DEX dYdX.

In September, leverage DEX dYdX kicked off a string of airdrops through the release of its dYdX governance token to early users based on their trading activity. Approximately 64,300 users received anywhere from 310 to 9,500 tokens depending on their volume tiers.[194] At the token's all-time high of $26 on September 29, 2021, recipients had the opportunity to sell their tokens for anywhere between $4,000 and $135,000.[195] The platform did not airdrop tokens to U.S.-based users due to SEC regulations. This raised a fundamental grievance among the broader crypto community where investors were outraged over the U.S.' archaic crypto policies that are meant to "protect" investors but endlessly cause them to lose out on rare opportunities.

In November, Ethereum Name Service airdropped 25M ENS governance tokens to all users who purchased Ethereum domain names, an alternative to the long strings of letters and numbers that compose a traditional Ethereum address. An additional 25M ENS tokens were distributed to core contributors, and the remaining 50M of the total ENS supply were sent to a multisig treasury wallet where they are governed by all ENS token holders.[196] The ENS DAO exists to map human-readable names to machine-readable identifiers, such as Ethereum addresses. This may sound familiar because the Internet Domain Name Service did this same thing in the 1990s to popularize URL addresses for early Internet architecture. On average, early users received 200 ENS tokens, with mid-level tier users receiving 500 ENS, and high-tier users receiving 1,000 ENS. The token peaked at an all-

time high of $85 on November 10, 2021 , allowing recipients to cash in their airdrops for $17,000 to $85,000, depending on how many ENS domains they owned.[197] However, the greater power lies in a recipient's ability to hold the token and continue to influence ENS' next moves. Decentralized bridge Hop Protocol and DEX aggregator ParaSwap also airdropped tokens to early users this year, agnostic of recipients' locations. With hundreds of thousands of dollars in potential airdrops on the line, 2022 brings the question—"Which protocols will airdrop funds next?" More importantly, airdrops incentivize early users of platforms with ownership in the protocols to continue building innovative, fair, and in-demand products.

Outlook on DeFi

Last year brought a new era of DeFi protocols that challenged the status quo of the giants before them. Total growth in the DeFi sector indicates that retail investors' risk appetites grew. With many protocols promoting anywhere from 10% to 250,000% annual rewards on dormant assets, TVL shot up drastically across all chains. However, pending DeFi and stablecoin regulation continues to be the elephant in the room. Last year's biggest game changer in DeFi was the introduction of protocol-owned liquidity. This concept provides potential to drastically reduce the common inflationary token models used in the past to incentivize deep liquidity pools for early DeFi protocols. Through DAO governance processes and the inception of treasuries, protocol stakeholders witnessed the power of coordination to truly take ownership of the future of their platforms. Further, lending protocols are actively working towards permissionless lending, where users can long or short virtually any asset, as long as someone sets up the market. We witnessed protocols begin to generate millions in revenues to continue the building of new solutions and programs. As DeFi continues to grow, at what point will some protocols eclipse public banks?

Looking forward, blue chip DeFi projects likely will still maintain their large TVL stats due to their brand names and proven resilience. However, DeFi 2.0 projects demonstrated how continual innovation creates opportunities for investors to outperform the legacy protocols. A paradigm shift in DeFi will likely emerge in 2022 where DEXes can aggregate liquidity across multiple blockchains and protocols, offering minimal price slippage and seamless non-custodial trading. With notable projects, such as Redacted, emerging to accumulate mass reserves of governance tokens like CRV, CVX, and OHM, 2022 will show participants just how far the governance wars can go. As institutional investors continue to dive down the rabbit hole, 2022 may bring their funds to yield-generating dApps, if they can stomach the risk.

9.

The Biggest Setbacks of 2021

NFT Scams and Hacks

While 2021 was certainly the year of NFTs in terms of development, adoption, sales, and community growth, we also witnessed a number of setbacks. From fake NFTs to insider trading on NFT marketplaces, the industry faced malicious actors. Despite the meteoric rise of NFTs this past year, the following events proved that the community, technology, and infrastructure surrounding NFTs still have room for growth.

Figure 57

NFT Scams and Hacks in 2021

Event	
Fake Banksy NFT	A fake Banksy NFT named the "Great Redistribution of the Climate Change Disaster" was linked to Banksy's website. The NFT was posted and traded on OpenSea's marketplace where it was sold for nearly Ξ100, worth around $336,000 at the time of sale. However, the NFT was soon removed from Banksy's website as the pseudonymous artist's agency confirmed that the NFT was not created by nor affiliated with Banksy. Many speculated that Banksy's website had been hacked, though none of this was confirmed. The event ended with the buyer of the inauthentic Banksy, known as Pranksy, having his money returned to him by the alleged "hacker."
Evolved Apes NFTs	The developers of the NFTs known as Evolved Apes vanished one week after the launch of the collection, after having promised the launch of a related NFT gaming project. The official Twitter account and website disappeared, alongside the Ξ798 ($2.7M equivalent) of the project's funds. The funds came from the sale of the NFTs and commissions on the secondary market, and were meant for expenses related to the project such as marketing.
Discord Bots and Phishy Links	On more than one occasion, Discord users were faced with scam accounts sharing malicious links in phishing attempts. For instance, in early November 2021, the admin account for digital artist Beeple's official Discord group was hacked overnight. The hacker conducted a fake NFT drop via Nifty Gateway, which led to an estimated collective loss of Ξ38 by users.

NFT Bay	An NFT "heist" took place when an individual named Geoffrey Huntley went to download 20 TB of NFTs on the Ethereum and Solana blockchains in an experimental effort to reveal the nature of NFTs. Huntley named this repository "NFT Bay" in homage to the infamous website Pirate Bay. The intention behind the act was exposing the public to the reality that most NFT images are not stored on blockchains but rather web 2.0 storage solutions, which could end up as 404 errors, and render the NFT obsolete.
Insider Trading	The CEO of NFT marketplace OpenSea confirmed that an employee purchased NFTs with insider knowledge of their addition to Opensea's front page, which generally invites interest. The employee has since resigned from Opensea.
Aurory Project NFT Drop Phishing Attack	A scammer cloned the Aurory Project's website right before it released an NFT drop. The fake address, named 'aurory.app,' resembled the real address 'app.aurory.io' and led unknowing individuals to link permissions to their Solana wallets, emptying their balances. At one point, the total amount stolen from user wallets amounted to over 10,600 SOL, roughly $1.1M.

Source: Cointelegraph, CNN, Vice, Digitalmusicnews, BBC, the Verge

DeFi Hacks

In 2021, DeFi attackers stole at least $1.5B across 44 protocols, a sharp 14x increase from the $134M in funds stolen during 2020.[198] However, this number is not comprehensive as plenty of smaller hacks occurred with minimal publicity. The biggest setback in 2021 for DeFi goes to cross-chain token swap platform Poly Network, which suffered a massive $611M compromise. The hacker exploited a vulnerability in the Poly Network contract to transfer funds to their own account. The Poly Network team wrote a message to the hacker to try to recover the funds, to which the hacker replied,

"IT WOULD HAVE BEEN A BILLION HACK IF I HAD MOVED REMAINING SHITCOINS! DID I JUST SAVE THE PROJECT? NOT SO INTERESTED IN MONEY, NOW CONSIDERING RETURNING SOME TOKENS OR JUST LEAVING THEM HERE."[199]

After having his wallet address blacklisted from major exchanges, the hacker returned $298M of the funds. The increase in total funds stolen in 2021 DeFi hacks reminds us that even with monumental growth, best practices for smart contract development are still evolving, despite the close examination of smart contract auditors and corresponding attestations.

Figure 58

DeFi Hacks in 2021

Date	Protocol	Amount
8/10/2021	Poly Network	$611M
9/29/2021	Compound	$147M
12/2/2021	BadgerDAO	$120M
4/19/2021	EasyFi	$59M
4/28/2021	Uranium Finance	$57.2M
11/5/2021	bZx	$55M
5/19/2021	PancakeBunny	$45M
2/13/2021	Alpha Finance	$37.5M
9/21/2021	Vee Finance	$34M
11/30/2021	MonoX	$31.4M
2021	Other	$332.8M
2021	**Total**	**$1.53B**

Source: Kraken Intelligence, Rekt News

10.

Conclusion

It goes without saying, 2021 truly brought crypto to the mainstream. Crypto grew partially thanks to institutional investors flooding the market more than ever before, as well as a surge in innovation thanks in part to large sums of capital flowing into the ecosystem. But, institutional investors weren't the only ones who got involved in 2021, as household names and retail market participants also tossed their hats in to draw more attention to the asset class. Accordingly, in this note we discussed several key topics that spoke broadley to the crypto trends of 2021.

In this note, we noted that bitcoin posted a remarkable return when compared to traditional financial assets, but underperformed its peers even on a risk-adjusted basis. We mentioned that much of the ecosystem's growth could be attributed to a number of big developments that turned the heads of those both in and outside of the ecosystem—including a number of big updates for Bitcoin in particular. We showed that Layer-1 and Layer-2 activity, in particular, saw abnormally astronomical growth with market participants opting to use dApp platforms other than Ethereum for the first time (e.g. Solana, Avalanche), thereby marking the beginning of what remains to be "the rise of crypto infrastructure." However, we also pointed out that much of the adoption and usage of Layer-1 and Layer-2 blockchains could be attributed to the rise of NFT and the metaverse, as well as the continued emergence of DeFi. We concluded our note by pointing out that while crypto saw lots of groundbreaking developments in 2021, there still were a number of setbacks that served as valuable learning lessons for both market participants, innovators, and platform users.

With increased regulatory and media attention, institutional investing, and massive levels of user-onboarding, it's safe to say that crypto has successfully cemented itself into history. However, 2021 was just the tip of the iceberg. Now that corporate players and regulators can no longer shrug off the industry, 2022 will surely bring a whole new spectrum of adoption, regardless of price action. Hold on to your hats, and don't forget to take a break from watching that one minute candle on the BTC chart because this roller coaster is just getting started.

11.

Appendix

Appendix A:

Assets Used to Construct Sector Indexes

DeFi	Dog Coins	Exchange	L1cSmart Contracts	Metaverse	Stablecoins
luna	doge	bnb	ada	axs	usdt
uni	shib	cro	dot	mana	usdc
lrc		ftt	sol	sand	dai
aave		leo	etc		busd
cake		kcs	vet		ust
rune		ht	trx		tusd
crv		okb	eos		
comp			algo		
yfi			atom		
sushi			neo		
			xtz		
			avax		
			waves		
			ksm		
			hbar		
			egld		
			xem		
			zil		
			near		
			celo		
			one		
			ont		
			ftm		

12.

KI Lookback: 2021

In the past year, Kraken Intelligence has published a number of reports that delve deeper into the themes discussed in this note, and more. In case you missed it, the reports are listed below.

Date	Report	Link
1/7/2021	December 2020 Market Recap & Outlook	https://kraken.docsend.com/view/fsw6qcg7cdjpun6x
1/20/2021	2020 Crypto-In-Review: The Year of The ₿ull	https://kraken.docsend.com/view/f5yrdazcjw6n3955
2/2/2021	Crypto Yields 2: The Deep Dive on DeFi	https://kraken.docsend.com/view/dg34s3izvsbfa9uh
2/8/2021	January 2021 Market Recap & Outlook	https://kraken.docsend.com/view/k72g8dnauuvd5zjs
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