An Examination of Stacks Protocol Performance Compared to Other Layer-One Blockchains

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ABSTRACT

The purpose of this paper is to survey the Stacks ecosystem and analyze its goal of creating a smart contract programming layer to augment Bitcoin's store-of-value properties. We begin by formally clarifying Bitcoin's history, comparing its price volatility to gold, and discussing its limitations as a blockchain protocol in enabling complex smart contracts. We then analyze the Stacks protocol and overview its Proof of Transfer mining consensus mechanism along with several applications that have been built on the Stacks blockchain so far, including AlexGo and CityCoins. We then transition to an assessment of Stacks' performance compared to other Layer 1 blockchains using metrics such as total developer count, average daily trading volume over the first 365 days of protocol operations, average daily trading volume over the past three months, and Ethereum/Stacks daily NFT trading volume ratio during the past three months.

The study finds that the volume of activity on Stacks is currently very small relative to competing blockchains, but it has some promising features that differentiate it from competitors such as a growing monthly developer count. We conclude by discussing several initiatives in the implementation stage to ensure Stacks' survival and ability to serve as an important element of the crypto universe. In particular, Stacks needs to execute on initiatives that achieve faster transaction speeds (one initiative currently in progress is called "Hyperchains"), a cross-chain bridge, and increased user adoption in order to fulfill its potential as a smart programming layer that augments Bitcoin's store-of-value properties.

OUTLINE

I. INTRODUCTION

Stacks is a cryptocurrency token founded by Mr. Muneeb Ali (Ph.D. Computer Science, Princeton University)[1] that seeks to expand the use cases for Bitcoin by designing smart contract capabilities that settle on the Bitcoin blockchain.[2] This can expand Bitcoin's potential by allowing users to lend, borrow and potentially earn Bitcoin through play-to-earn crypto gaming. In addition, Stacks enables yield farming using Bitcoin; yield farming is a mechanism to provide liquidity to cryptocurrency protocols and users (usually using pairs such as Stacks/Bitcoin) in order to earn interest. This is different from staking, which involves issuing collateral to a protocol to verify transactions, in exchange for block rewards. The collateral at "stake" is liable to be slashed in value if transactions are not verified correctly, whether due to malicious intentions or simply poor execution.[3] For example, in Section 3 of the paper we discuss staking Stacks tokens in order to earn block rewards denominated in Bitcoin.

Given the level of institutional investment Bitcoin has already seen to date, successful execution on the part of Stacks could lead to more institutional capital flowing into Bitcoin as well as capital flowing into Stacks. In fact, Mr. Ali recently raised $150 million in an initiative called Trust Machines in order to build applications that integrate Bitcoin more closely into the burgeoning Web 3.0 space, some of which will be built on Stacks.[4] Moreover, in March 2022 cryptocurrency exchange OkCoin partnered with several venture capital firms to raise $165 million towards growing the Stacks ecosystem. The plan is for venture capital firms to connect and fund promising project leaders seeking to launch applications on Stacks.[5]

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[1] https://www.linkedin.com/in/muneebali/
[2] https://blog.stacks.co/stacks-2-whitepaper
[3] https://www.blockchain-council.org/defi/staking-vs-yield-farming-vs-liquidity-mining/
[4] https://www.coindesk.com/business/2022/02/03/muneeb-alis-trust-machines-raises-150m/
[5] https://www.coindesk.com/business/2022/03/10/okcoin-stacks-launch-165m-pledge-to-support-bitcoin-related-projects/

The purpose of this paper is to analyze whether Stacks has the potential to become a dominant competitor in this highly contested space. In Section 2, we discuss Bitcoin's history and weaknesses that may limit its potential to grow in the cryptocurrency space in the years ahead. In Section 3, we provide an overview of how Stacks addresses Bitcoin's limitations and augments its capabilities on a conceptual level. Section 4 discusses areas for improvement in the Stacks protocol, while Section 5 analyzes developer data, average daily token trading volume, and daily NFT trading volume on Stacks compared to other blockchains. A discussion of Stacks' properties compared to other blockchains is presented in Section 6.

The study concludes that Stacks' developer base is greater than larger (in terms of market cap) protocols such as Fantom and Chainlink, but is lagging behind several other projects such as Avalanche and Terra. Stacks' average trading volume over its first 365 days and in a recent three-month analysis was lower than the other blockchains studied in this analysis, though Stacks' first 365-day trading volume of around $2M was not far behind Fantom's $7M and Ethereum's $14M.

The study also found that the Ethereum to Stacks NFT trading volume ratio averaged about 9,000 over the past 90 days. Our review suggests that Stacks needs to improve transaction speeds through its hyperchain initiative, build an Ethereum-Stacks digital bridge to onboard more users, and onboard more Bitcoin users to Stacks through marketing initiatives and word of mouth in order to grow as a protocol (discussed throughout sections 4, 5 and 6). Comparing Stacks NFT trading volume to Ethereum's is useful because the Ethereum blockchain generates nearly 90% of all NFT sales.[6] Thus, Ethereum NFT trading volume provides a benchmark to assess Stacks' current and future progress in NFT trading activity.

[6] https://cointelegraph.com/news/blockchains-vie-for-nft-market-but-ethereum-still-dominates-report

II. BITCOIN AND ITS LIMITATIONS

Bitcoin is a cryptocurrency created in January 2009 by anonymous software developer(s) going by the pseudonym Satoshi Nakamoto.[7] Bitcoin reached a market capitalization as high as $1T and as of April 2022 had a market cap of $730B.[8] Bitcoin was intended to be an alternative open-source currency immune to the effects of inflation and government control, evidenced by its hard supply cap of 21 million tokens. The coin is mined through a process called Proof of Work, in which miners expend electricity using advanced computational equipment to solve complicated math puzzles, in the process independently achieving consensus and verifying transactions. These transactions are organized into blocks which are linked together to comprise the blockchain.[9] Bitcoin can then be bought and sold on exchanges such as Coinbase and Gemini, as well as through decentralized mechanisms such as peer-to-peer transfers.[10] Though Bitcoin is highly touted for its similarities to gold as an inflation hedge and store of value (in fact, Bitcoin has often been referred to as "digital gold"), its price is much more volatile than gold, as shown in Figures 1 and 2 depicting the daily price volatility of gold versus Bitcoin from 2012-21.

[7] https://bitcoin.org/bitcoin.pdf
[8] https://www.coingecko.com/en/coins/bitcoin
[9] Ibid
[10] https://www.moneyunder30.com/how-do-you-buy-bitcoin-a-beginners-guide-to-buying-and-selling-bitcoin

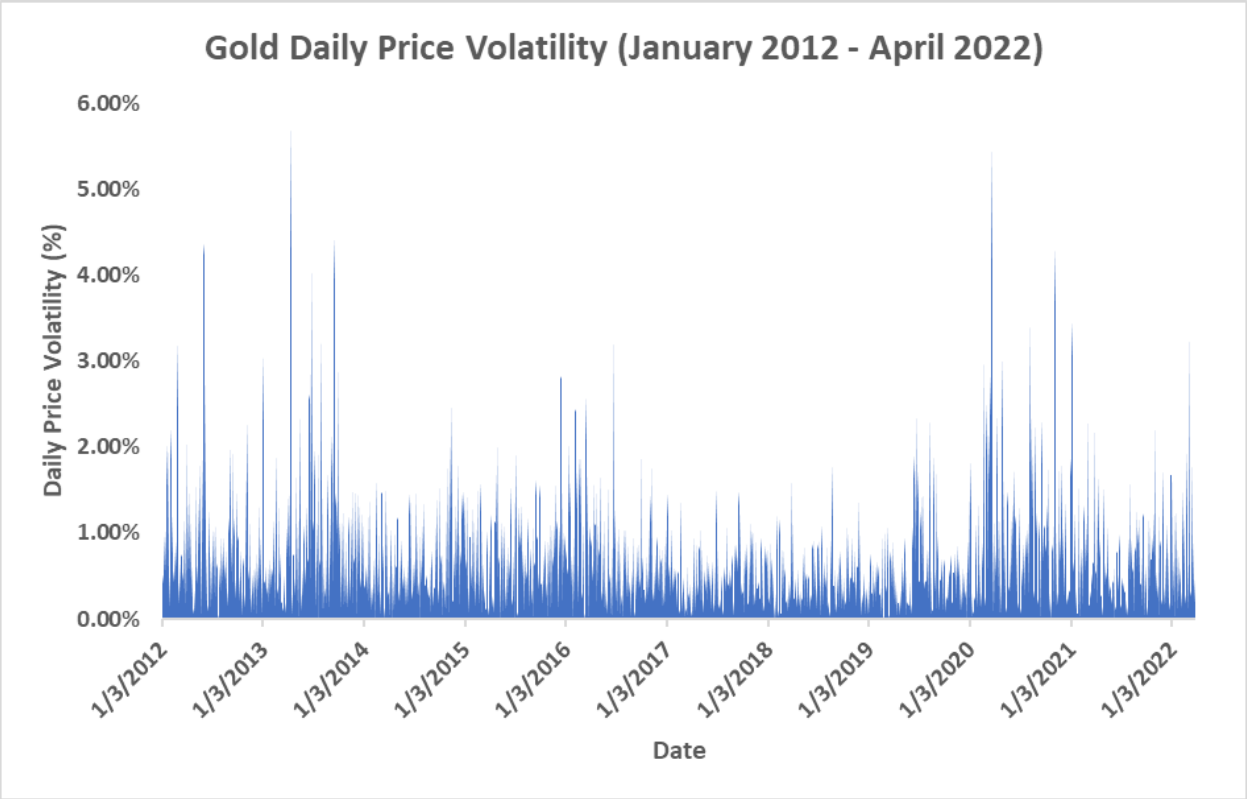

Figure 1. Gold Daily Volatility Chart from January 2012 - April 2022.[11]

[11] Ibid

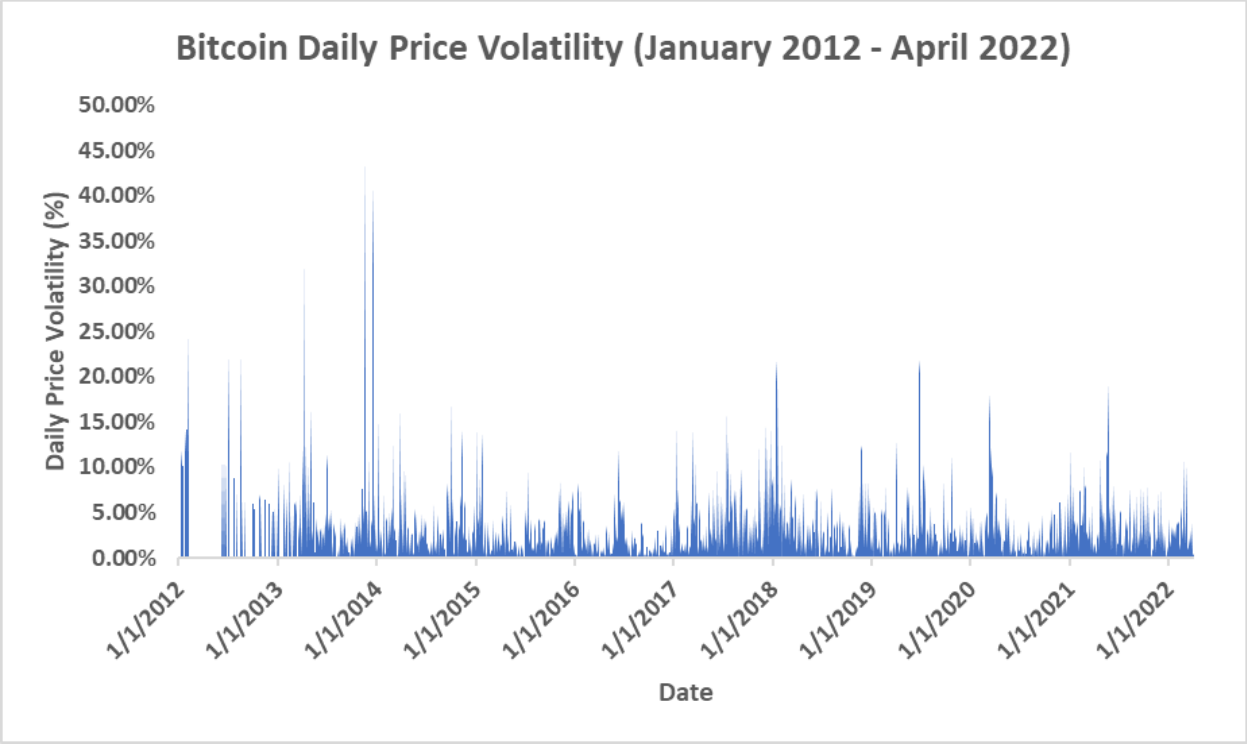

Figure 2. Bitcoin Daily Volatility Chart from January 2012 - April 2022.[12]

Gold's average daily price volatility during this period was 0.69%, while its maximum daily price volatility was 5.7%. Bitcoin's average price volatility during this period was 3.01%, while its maximum daily price volatility was 43.3%. This suggests that Bitcoin's price is significantly more volatile than that of gold on a day-to-day basis. Figure 3, analyzing Bitcoin versus gold price on an annual indexed basis, is shown on the next page.

[12] https://www.wsj.com/market-data/quotes/fx/BTCUSD/historical-prices

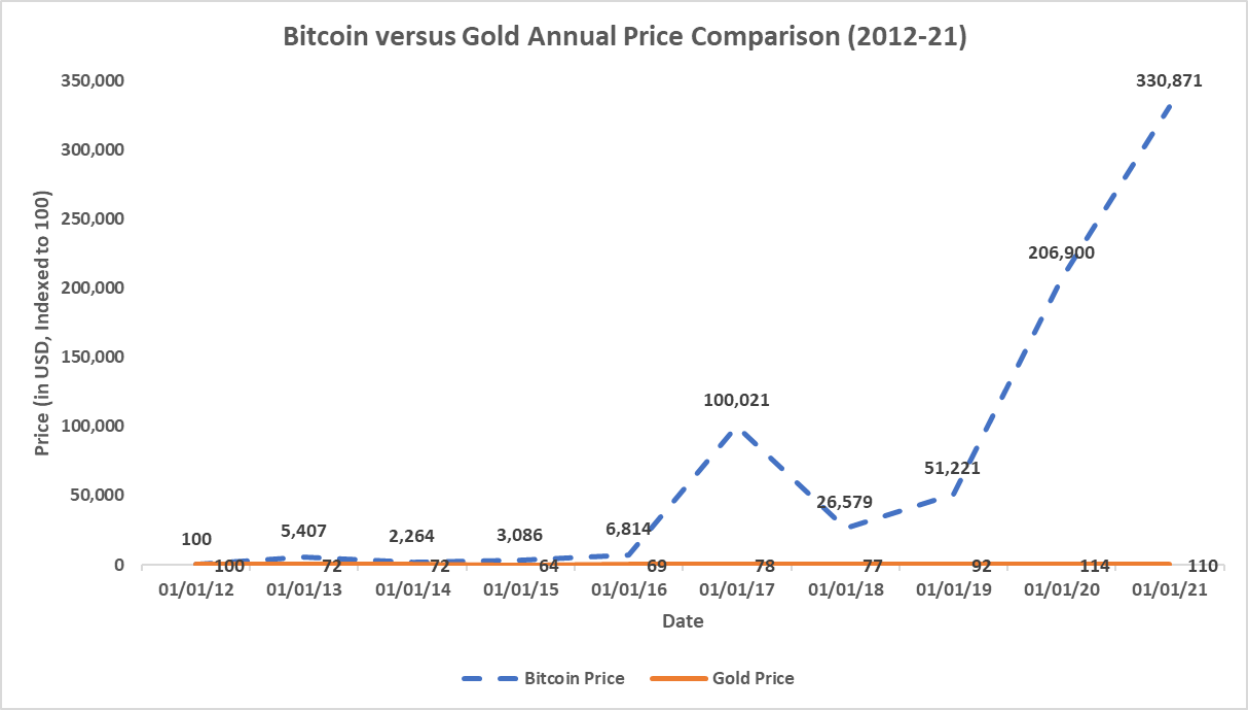

Figure 3. Bitcoin Versus Gold Annual Price Comparison (end of year 2012 to end of year 2021).[13] Bitcoin and Gold Year-Ending 2012 Prices Indexed to 100.

Both gold and Bitcoin prices are indexed to 100 using 2012 year-ending prices. The line depicting Bitcoin is dashed while gold's line is solid. The chart suggests that Bitcoin's price has fluctuated significantly on a daily basis between 2012-21, reaching a price-indexed high of over 100,000 by year-end 2017 before dropping to around 26,000 by year-end 2018. As of year-end 2021, the price of Bitcoin is at a new price-indexed high of over 330,000 compared to gold's 110, suggesting much greater variation in the price of Bitcoin in recent years compared to gold. This is confirmed by Figure 4 below, which analyzes price volatility on an annualized basis between Bitcoin and gold from year-end 2013 to year-end 2021.

[13] Ibid

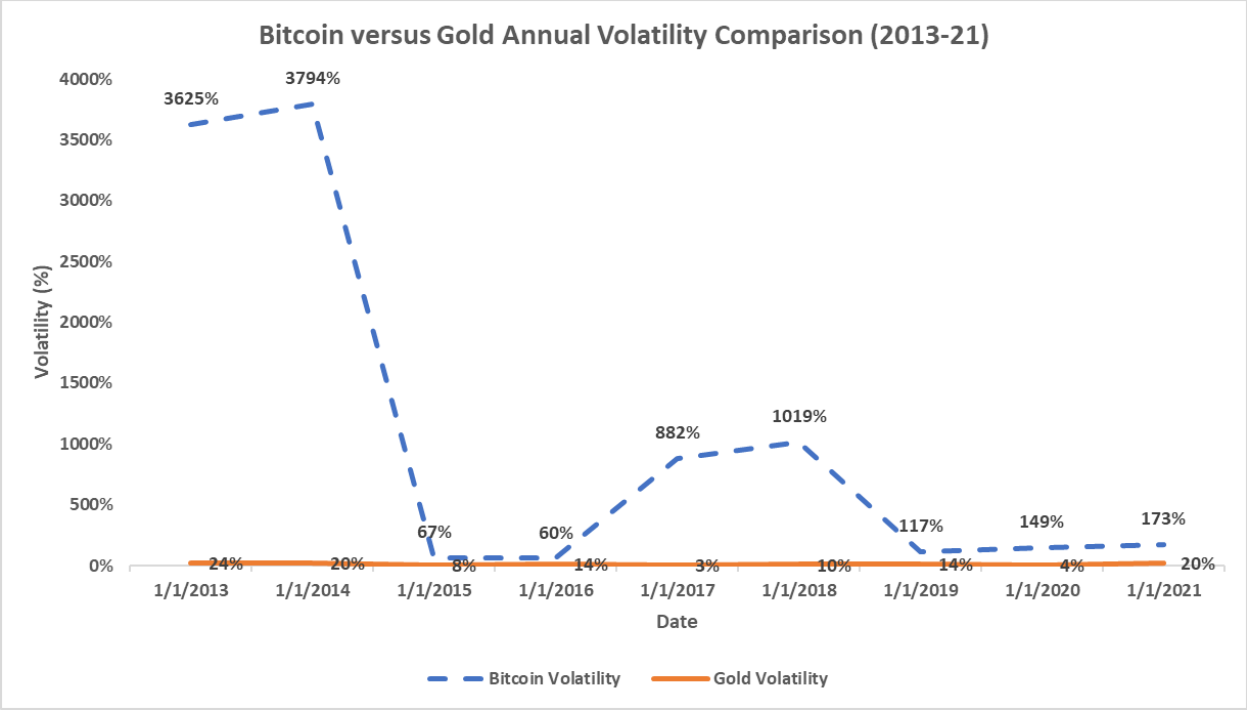

Figure 4. Bitcoin Versus Gold Annual Price Volatility Chart (end of year 2013 to end of year 2021).[14]

Bitcoin's price volatility has ranged from a high of 3794% at year-end 2014 to a low of 60% at year-end 2016, while gold's price volatility has ranged from a high of 24% at year-end 2013 to a low of 3% at year-end 2017. Interestingly, Bitcoin's price volatility has decreased substantially on an annualized basis (especially from year-end 2014 to year-end 2015) and its volatility trendline is beginning to resemble gold's, while gold's price volatility has fluctuated somewhat from year-to-year, though within a much narrower range. This suggests that Bitcoin is in the advanced stages of a growth phase that may eventually culminate in a mature period where its price movements are less volatile and match those of gold. This is supported by Bitcoin's daily price volatility chart in Figure 2, as price volatility in recent years is considerably lower than in Bitcoin's early years, particularly in 2013 and 2014. However, it is unclear whether

[14] Ibid

Bitcoin's maturation as a financial asset will unfold over several years, several decades, or several centuries, if indeed it does occur.

Despite Bitcoin's price volatility, it has grown substantially from its $1 price point on April 13, 2011.[15] Bitcoin has not only increased in price; institutional investors and nation-states are beginning to adopt the cryptocurrency. Asset manager Grayscale launched a Bitcoin trust in January 2020. More than 20 institutional investors held Bitcoin through the Grayscale Trust as of June 2020, including Ark Investment Management LLC, which held 20.2 million GBTC.[16] Tesla purchased $1.5 billion of Bitcoin in February 2021,[17] and Microstrategy has purchased 121,044 Bitcoin as of November 2021.[18] El Salvador passed legislation to make Bitcoin legal tender in September 2021, the first country in the world to do so.[19] Recently, the government of Ukraine created a set of cryptocurrency wallets for individuals wishing to support their resistance efforts in the midst of Russia's invasion, which reduced civilian and government access to traditional banking services. These wallets collected over 102,000 crypto asset donations totaling $54.7 million as of early March 2022. The contributions included $17.2 million in Bitcoin and $18.2 million in Ethereum.[20]

As a result, many observers in the cryptocurrency community have noted that Bitcoin and other cryptocurrencies can provide access to financial services to individuals who are either cut off from traditional banking services due to sanctions, war, or other causes or have traditionally been unbanked due to residence in a less developed country. Cryptocurrencies could assist those

[15] https://www.investopedia.com/articles/forex/121815/bitcoins-price-history.asp
[16] https://www.forbes.com/sites/michaeldelcastillo/2020/08/06/valuable-sec-data-on-20-institutional-bitcoin-investors-could-soon-disappear
[17] https://www.wsj.com/articles/tesla-buys-1-5-billion-in-bitcoin-11612791688
[18] https://fortune.com/2021/11/29/microstrategy-buys-more-bitcoin/
[19] https://www.newscientist.com/article/2306640-el-salvador-revamps-bitcoin-wallet-after-complaints-of-theft-and-fraud
[20] https://www.cnbc.com/2022/03/03/ukraine-raises-54-million-as-bitcoin-donations-surge-amid-russian-war.html

who are cut off from their bank accounts such that they can take care of their basic needs such as food, clothing, shelter, etc. in an emergency. It also ensures that those fleeing their countries due to war or impoverishment can easily transport their valuables without fear of search and seizure or having to leave valuables behind. In other words, it is much easier to carry $1 million worth of Bitcoin stored in an online or hardware wallet than it is to transport $1 million worth of gold in an emergency.

Over the past 12 years, Bitcoin has grown from a handful to 135 million users and is projected by one analyst to have 1 billion users by 2025.[21] This indicates that Bitcoin has a penetration rate of 2.88% of the 4.66 billion people worldwide with access to the Internet.[22] Moreover, the network has over one million miners verifying transactions.[23] While mining operations are becoming increasingly centralized, with a small number of mining pools employing a large number of miners,[24] Bitcoin has over 10,000 full nodes who are responsible for validating the token's entire blockchain history. In other words, miners verify transactions in real-time while full nodes verify the entire history of the Bitcoin blockchain.[25] This prevents malicious actors from rewriting the history of the Bitcoin blockchain to achieve a double spend.[26]

Bitcoin's node structure has helped the blockchain achieve a high degree of decentralization compared to other blockchains and payment systems. Exhibit 1 shows that the number of monthly active addresses on the Bitcoin network has increased from about 17 million

[21] https://bitcoinist.com/how-bitcoin-adoption-rate-is-beating-the-internet/
[22] Ibid
[23] Ibid
[24] https://bitcoinmagazine.com/business/is-bitcoin-mining-centralized
[25] https://www.sofi.com/learn/content/what-are-nodes/
[26] A double spend is when two payments are made with the same cryptocurrency. In other words, Person A sends one Bitcoin to Person B, then sends the same Bitcoin to person C. If a double spend were to occur, it would be catastrophic to the Bitcoin ecosystem. However, Bitcoin's 12-year history and resilience in the face of multiple hacking attacks suggests that it has solved the double spend problem.

in January 2017 to 30 million by December 2021.[27] It is estimated that over one million people mine Bitcoin,[28] while over 81 million people are Bitcoin wallet users.[29] Of those 81 million, there are around 633,000 users who own at least one Bitcoin.[30]

However, critics have pointed out that because Bitcoin is coded in limited script language, it lacks the ability to encode smart contracts like other blockchains such as Ethereum and Solana.[31] Smart contracts are agreements written in code that are managed by the nodes of a blockchain network. Whenever their conditions are met, they are guaranteed to execute without the need of a human intermediary to coordinate the transaction. This saves time, money and paperwork that would be required to execute and enforce an agreement in the real world.[32] One example of a smart contract is a bet placed between two individuals on the winner of next summer's NBA Finals. If the two parties agree that the winner of the Finals will receive $500 as a reward, they can enter into an agreement using code where the winner will receive an automatic payout if he or she wins the bet, leveraging oracle networks such as Chainlink to bring real-world data such as the championship winner onto the blockchain/smart contract agreement. This is faster and more efficient than a real-life transaction or bet where the loser may feign ignorance that the bet ever occurred in the absence or loss of a paper contract and lack of an intermediary.

Bitcoin's lack of smart contracts limits it to purely serving as a store of value instead of a platform to enable decentralized finance (DeFi), non-fungible tokens (NFTs), crypto gaming, and Decentralized Autonomous Organizations (DAOs), as smart contract-enabling blockchains

[27] https://studio.glassnode.com
[28] https://www.buybitcoinworldwide.com/how-many-bitcoins-are-there
[29] https://earthweb.com/how-many-people-own-bitcoin/
[30] https://bitcoinist.com/how-many-people-actually-have-at-least-1-bitcoin/
[31] https://due.com/blog/bitcoin-scripting-and-how-it-can-be-improved/
[32] https://blockgeeks.com/guides/smart-contracts/

facilitate. This also means that Bitcoin in its native form cannot be used in the rapidly developing metaverse. As a result, Bitcoin's current price forecast and growth potential is limited compared to other cryptocurrencies. Bitcoin's limitations have been referred to as the blockchain trilemma, similar to the Impossible Trinity in economic theory. The blockchain trilemma states that there are three pillars which blockchain projects aim to satisfy: decentralization, security, and scalability. However, they can only achieve two of these three pillars at any given time. Bitcoin has adapted to solve for decentralization and security at the expense of scalability.[33] Exhibit 2 is a diagram illustrating the three poles comprising the blockchain trilemma and the challenges involved with satisfying all three pillars.

Each Bitcoin block size is set to one megabyte, and the average transaction size is 380.04 bytes. Given that Bitcoin is coded to generate a new block once every 10 minutes, this means that Bitcoin can only process 4.6 transactions per second. In contrast, Visa, a popular credit card company with 182 million cardholders,[34] can process around 1,700 transactions per second.[35] This feature of Bitcoin, along with its limited script programming language, optimizes for security since it is extraordinarily difficult for malicious actors to reverse the chain of transactions that comprise the Bitcoin blockchain and achieve a transaction double spend. However, it also means that it is difficult for Bitcoin to adjust to increasing user (and institutional) adoption, and that it is virtually impossible to build smart contract capabilities directly on the Bitcoin network that enable real-world functions to be offloaded and customized to the blockchain.

[33] https://pramodv.ece.illinois.edu/pubs/Whitepaper2019-9.pdf
[34] https://wallethub.com/edu/cc/number-of-credit-cards/25532
[35] https://towardsdatascience.com/the-blockchain-scalability-problem-the-race-for-visa-like-transaction-speed-5cce48f9d44

As Web 3.0 and the metaverse continue to develop, another cryptocurrency, such as Ethereum, that enables complex smart contracts may overtake Bitcoin's market capitalization and diminish its stature in the crypto space. Web 3.0 is a concept related to the next iteration of the Internet that is expected to roll out over the next decade or so. According to this framework, Web 1.0 relates to the original, more decentralized version of the Internet that launched in the late 1990s, Web 2.0 relates to the version of the Internet dominated by a few centralized "Big Tech" firms starting in the early 2000s, and Web 3.0 is defined as a more decentralized version of the Internet centered on blockchains such as Bitcoin and Ethereum.[36] Though Bitcoin developers have created layer-two scaling platforms such as Lightning to process Bitcoin transactions more quickly, such scaling solutions have not addressed Bitcoin's lack of smart contract capabilities. In particular, the Lightning network simply moves smaller-ticket Bitcoin transactions off-chain in order to decongest the Bitcoin blockchain and allow for faster transaction speeds.[37] There is a real possibility that Bitcoin will be left behind as the cryptocurrency space matures.

III. HOW STACKS CAN EXPAND THE ADOPTION OF BITCOIN

Stacks (STX) is a blockchain that is attempting the ambitious task of building a smart contract layer around Bitcoin in order to expand Bitcoin's usability beyond its current role as simply a store of value.[38] Its original iteration, Blockstack, was registered with the SEC and

[36] https://www.singlegrain.com/web3/web-3-0/
[37] https://www.investopedia.com/news/lightning-network-what-it-and-can-it-solve-bitcoins-scaling-problem/
[38] https://jicnews.com/bitcoin-nfts-are-emerging-on-stacks-can-they-thrive/

issued 295 million tokens in an initial coin offering in 2019.[39] However, the current version of Stacks (dubbed Stacks 2.0) is no longer treated as a US security.[40]

Stacks is backed by Union Square Ventures and Winklevoss Capital, among other investors.[41] Union Square Ventures in particular owns over 5% of outstanding Stacks tokens. The protocol has over $506M in Total Value Locked (TVL). TVL is a metric that assesses the overall value of crypto assets deposited in a blockchain protocol.[42] As a result, TVL is a useful tool for measuring the amount of investment occurring within a blockchain protocol.

Mr. Muneeb Ali, one of the founders of Stacks, has referred to Stacks as a "Layer 1.5" blockchain, in comparison to traditional Layer 1 blockchains specializing in smart contracts such as Ethereum, Solana, and Avalanche. Layer 1 blockchains can be thought of as peer-to-peer networks with nodes that independently verify transactions occurring on the blockchain. Some, such as Solana, have a high degree of centralization, while others, such as Bitcoin and Ethereum, have achieved a high degree of decentralization. While Bitcoin does not enable smart contract capabilities due to its limited script, other Layer 1 blockchains such as Ethereum and Solana do. Solana in particular has solved for security and scalability at the expense of decentralization, enabling fast transaction speeds and strong network security with the caveat that one of the three main nodes comprising the blockchain can alter blockchain history at any time.

The smart contracts enabled by most Layer 1 blockchains are digital, automated, and immutable sources of computer code that remove the need for a mediator when two parties want to exchange digital or physical assets or services.[43] Thus, smart contract-enabling Layer 1

[39] https://www.sec.gov/Archives/edgar/data/1719379/000110465919020748/a18-15736_1partiiandiii.htm
[40] https://blog.blockstack.org/stacks-cryptocurrency-securities-filing/
[41] https://www.stacks.co/
[42] https://www.coindesk.com/learn/why-tvl-matters-in-defi-total-value-locked-explained/
[43] https://research.aimultiple.com/smart-contracts/

networks provide a base layer for Layer 2 protocols to build applications such as decentralized finance (DeFi), non-fungible tokens (NFTs), and decentralized insurance protocols that provide for faster and more efficient transactions between individuals. Stacks is not building on top of Bitcoin per se, as a Layer 2 application would, but is instead seeking to make as many connections as it possibly can with the Bitcoin network in order to bring complex smart contract functionality to Bitcoin.[44]

Stacks does this via a Proof of Transfer (PoX) mechanism, which involves miners spending Bitcoin in an effort to win Stacks mining blocks. Winners of each mining block are decided by a verifiable random function. The more Bitcoin that miners spend, the more likely they are to win a mining block. Bitcoin invested into the protocol by miners is awarded to individuals who choose to stake Stacks in a process called "Stacking." The way Stacking works is that individuals lock their STX in a two-week reward cycle, run or support a full node, and send useful information to the network as STX transactions.[45] Users need a minimum of 120,000 STX in order to "Stack" independently. Otherwise, they can use exchanges such as OkCoin or the native Stacks online wallet, Hiro Wallet, to join stacking pools where they can deposit STX and earn up to 30% yield in Bitcoin over the course of a stacking cycle.[46] It is for this reason that Proof of Transfer has been referred to as "recycled Proof of Work," as Bitcoin that has already been mined in previous blocks is used to support the Stacks protocol and incentivize staking.[47] This also accrues value to the Stacks blockchain, in the sense that miners must sacrifice their Bitcoin tokens in order to verify Stacks transactions and potentially win mining blocks. This means that miners are incurring a cost in order to mine in the expectation that they will achieve a

[44] Ibid
[45] Ibid
[46] https://stacking.club/learn
[47] https://www.citycoins.co/post/why-citycoins-is-powered-by-stacks

profit from earning Stacks through mining (and potentially staking Stacks tokens afterwards for Bitcoin rewards). Stacks blocks occur with every Bitcoin block and settle on the Bitcoin blockchain.[48]

Since Bitcoin expended in order to mine Stacks is issued to users who stake their Stacks tokens, Stacks can be considered to provide a "Bitcoin yield" to its users.[49] If Bitcoin continues to appreciate in price and grow institutional adoption, this provides an incentive for users to join the Stacks ecosystem by purchasing Stacks tokens. This may also incentivize institutions to adopt Stacks, since the token provides an established method to earn yield in Bitcoin to augment their existing holdings. In this sense, Stacks can be compared to a dividend stock, except users must take action in staking their tokens on OkCoin, through their Hiro Wallet, or by running a Stacks node in order to receive a dividend.

STX's strategy to bolster Bitcoin's long-term value is to facilitate the development of Layer 2 applications on its protocol that enable users to lend, borrow, stake, and swap Bitcoin for other cryptocurrency tokens without needing to first "wrap" Bitcoin.[50] Currently, users can only use Bitcoin on other Layer 1 blockchains if they "wrap" it into a form compatible with those chains. Wrapping Bitcoin involves creating a synthetic version of Bitcoin that can be used on other blockchains such as Ethereum. Users must store their Bitcoin in a digital vault in order to mint wrapped Bitcoin, whose token value is pegged to Bitcoin. Wrapped Bitcoin can then be used on other blockchains to earn interest through staking, use as collateral to borrow other cryptocurrency tokens, or swap for other cryptocurrencies. When the user is ready to convert their wrapped Bitcoin to native Bitcoin, they must burn their wrapped Bitcoin so that their native

[48] Ibid
[49] https://blockworks.co/stacking-stacks-is-the-latest-way-to-earn-passive-yield-in-bitcoin/
[50] Ibid

Bitcoin can be released from the digital vault to be returned to the user.[51] The burning process involves sending tokens to a wallet address from which they cannot be retrieved, thus removing them from circulation as they can no longer be used.[52]

There are several protocols that enable wrapping; Alameda facilitates the conversion of Bitcoin to Wrapped Bitcoin (WBTC),[53] while REN enables the conversion of Bitcoin to renBTC.[54] However, it remains unclear whether wrapped Bitcoin has the same value as the actual Bitcoin token, and most wrapping protocols are centralized[55] and employ Know Your Customer (KYC) protocols, which may discourage some users from using wrapped Bitcoin.[56] On the other hand, as Stacks matures and becomes more liquid as a blockchain, it may enable users to use Bitcoin in its native form on Layer 2 applications. Eventually, developers hope to create bridges between Stacks and other blockchains that will enable the lending, borrowing, staking, and swapping of many cryptocurrencies. Much like physical gold is used as in electronics and computers, in dentistry and medicine, and in jewelry, in addition to its use as a store of monetary value,[57] Stacks (if properly executed) enables Bitcoin to gain true functionality in the cryptocurrency space and potentially compete with other layer-ones as a smart contract-enabling blockchain.

Though the Stacks protocol has been in existence for only about one year, developers are already building and releasing DeFi apps on Stacks. One recently released app, AlexGo, allows users to lend, borrow, and stake Bitcoin, as well as engage in derivative transactions such as

[51] https://academy.shrimpy.io/lesson/what-are-wrapped-tokens
[52] https://www.coindesk.com/learn/what-does-it-mean-to-burn-crypto
[53] https://www.coindesk.com/markets/2020/09/04/alameda-research-claimed-nearly-70-of-wrapped-bitcoin-minted-in-august/
[54] https://www.coindesk.com/markets/2021/02/02/interoperability-project-ren-joining-alameda-research/
[55] https://threebody.capital/blog/2021/12/3/stacks-enhancing-bitcoin
[56] https://www.publish0x.com/the-part-time-economist/how-and-why-to-wrap-a-cryptocurrency-xdnqypp
[57] https://www.businessinsider.com/many-uses-of-gold-2012-9#gold-is-not-toxic-3

opening up long or short positions in Bitcoin futures contracts on its decentralized exchange (DEX). Bitcoin can be wrapped into xBTC and farmed in liquidity pools with Stacks in order to earn yield. What sets xBTC apart compared to other forms of wrapped Bitcoin is that since it is native to Stacks, it technically never leaves the Bitcoin ecosystem.[58] This is the first step towards eventually enabling native Bitcoin yield farms on Stacks-enabled applications. AlexGo raised $5.8 million in a recent funding round and launched in January 2022.[59] CEO and co-founder of AlexGo, Chiente Hsu, previously served as Managing Director and Global Head of Quantitative Strategy Research at Morgan Stanley, indicating she brings a strong quantitative background and understanding of traditional financial markets to the role.[60]

One of the most interesting opportunities in the Stacks ecosystem involves the CityCoins initiative. MiamiCoin was launched in August 2021 in order to provide a decentralized alternative to traditional fiat currencies. The conventional thinking is that cities extract revenue from their citizens via taxation of their income and assets, allowing them to fund budgetary expenses such as police services, waste management, and recreation and culture. CityCoins are an attempt to raise money through incentivized crowdfunding mechanisms to fund city services, lessening the need for taxation. Miners invest Stacks tokens in order to win CityCoin mining blocks, of which 30% is allocated to the city treasury associated with the coin (for example, if a miner allocates 100 STX towards winning a MiamiCoin block, 30 STX is deposited into the City of Miami's treasury while the remaining 70 STX is used to reward MiamiCoin stakers).[61]

Three months after launch, the City of Miami had already earned $21 million from MiamiCoin. If this amount were annualized, it would equal one-fifth of Miami's total annual tax

[58] https://medium.com/wrapped/wrapped-btc-xbtc-is-headed-to-stacks-4c58793a5dca
[59] https://www.coindesk.com/business/2021/11/15/alex-raises-58m-to-bring-defi-to-the-bitcoin-ecosystem/
[60] https://www.linkedin.com/in/chiente-hsu/
[61] https://www.citycoins.co/miamicoin

revenue of $400 million.[62] The main issue that CityCoins are running into right now is determining appropriate use cases. Some have speculated that residents can earn CityCoins for positive behaviors such as recycling, taking part in community initiatives such as building public housing or waste removal, or using electric cars as opposed to internal combustion engine vehicles. Those CityCoins can potentially be used to rent office spaces or purchase coffee or groceries at participating shops and retailers, potentially at a discount to fiat currency transactions to incentivize residents to adopt CityCoins. The initiative is still in early stages, so developers, early Stacks/CityCoin adopters, and city leaders are continuing to work together to determine viable uses for the cryptocurrency.

That being said, CityCoins have the potential to develop into an ecosystem that rewards people for moving to their respective cities, creating a world where cities compete for talent as opposed to talent competing to move to the most desirable cities. In November 2021, NYCCoin launched on the Stacks Protocol. Like MiamiCoin, NYCCoin is mined by investing Stacks tokens, with 30% of the proceeds allocated to New York City.[63] Although NYC mayor Eric Adams has come out in favor of NYCCoin, the city has not officially partnered with NYCCoin, nor have they accepted the Stacks tokens that have been allocated towards the city through mining.[64] Though the coin was launched nearly three months after the launch of MiamiCoin, as of May 2022 the NYCCoin wallet currently holds about $14M (15M STX),[65] while the MiamiCoin wallet holds around $11M (12M STX).[66] The value of each CityCoin wallet is subject to price fluctuations in the STX token.

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[62] https://www.coindesk.com/business/2021/11/11/miami-to-give-bitcoin-yield-from-miamicoin-to-its-citizens/
[63] https://www.citycoins.co/nyccoin
[64] https://www.coindesk.com/business/2021/11/09/citycoins-plan-for-nyccoin-is-welcomed-by-mayor-elect-adams/
[65] https://mining.nyc/wallet
[66] https://miamining.com/mia

In addition to CityCoins, Stacks enables Bitcoin-powered NFTs. This may help drive user adoption as "Bitcoin Maxis" and other Bitcoin supporters come to understand the value add that Stacks provides to the Bitcoin blockchain. "Bitcoin Maxi" refers to Bitcoin Maximalism, a school of thought that believes Bitcoin is the only viable cryptocurrency and will eventually hold a monopoly position in the cryptocurrency space.[67] Given the interactive and memetic nature of the NFT space, Bitcoin Maxis may eventually be drawn to the Stacks ecosystem since all NFT transactions ultimately settle on the Bitcoin blockchain.

One collection of Stacks NFTs, the Megapont Ape Club, has a floor price of around 2,700 STX as of May 2022.[68] Another collection, Satoshibles, recently built a bridge connecting its NFT collection with the Ethereum blockchain. Users can transfer their NFT from Stacks to the Ethereum blockchain and vice versa at any given time, meaning the NFT gives users access to a collection on Stacks and a collection on Ethereum. They can sell their NFT on Stacks NFT marketplaces for Stacks tokens or Ethereum NFT marketplaces for Ethereum tokens at any time.[69] This mechanism may be used to build a cross-chain bridge connecting Stacks to the Ethereum blockchain in the future, which may help grow Stacks' TVL, daily trading volume, and market cap.

In addition, with crypto gaming looming on the horizon, Stacks is facilitating the development of the video game Moonray, which users can earn Bitcoin to play.[70] This has the potential to make a significant impact on the gaming landscape, as in the past users had to pay to play popular video games and purchase video game systems. Bitcoin earned while playing Moonray can be used on platforms such as AlexGo to earn interest or use as collateral, creating

[67] https://blog.liquid.com/what-is-bitcoin-maximalism
[68] https://stxnft.com/marketplace/megapont-ape-club-nft
[69] https://decrypt.co/92537/satoshibles-first-nft-collection-bridge-ethereum-bitcoin-stacks
[70] https://moonray.game/

the potential for a Stacks ecosystem centered on the largest coin in the cryptocurrency space. The game recently raised a $3.5 million seed round led by Animoca Brands and is expected to launch in Q2 2022.[71]

IV. SUGGESTIONS FOR IMPROVEMENT IN STACKS PROTOCOL

The main challenges associated with the Stacks protocol at this time include slow transaction speeds (Stacks faces the same blockchain trilemma as Bitcoin, as it is optimized for decentralization and security), limited application buildout on the protocol, and the lack of a first mover advantage relative to blockchains such as Ethereum, which has achieved tremendous name recognition and a $554B market cap. While Stacks cannot change the fact that Ethereum is the first mover, it can mitigate some of Ethereum's success and capture some of its market share by virtue of the fact that it is connected with the ultimate first mover in the cryptocurrency space, Bitcoin. This will require a targeted advertising campaign and continued growth of "CityCoins," as they are a proven method of bringing eyes and ears to the protocol.

As for current transaction speeds, Stacks developers are working on an initiative called "Hyperchains," which are open-source scalability layers that are optimized for fast transaction speeds. This means that certain functions currently carried out on Stacks, such as NFT launches, DEXs, and collectible games can be offloaded to a hyperchain in order to relieve congestion on the main Stacks blockchain.[72] If successful, this would solve not only a major challenge for the Stacks protocol but also a wider challenge in the crypto community regarding scaling Layer 1 blockchains and solving the blockchain trilemma. Hyperchains are expected to be up and running by June 2022.

[71] https://decrypt.co/88230/first-bitcoin-metaverse-game-stacks-moonray-raises-3-5m
[72] https://www.hiro.so/blog/introducing-hyperchains-by-hiro

V. DATA ANALYTICS ON STACKS AND MAJOR COMPETITORS

V. 1. ANALYSIS OF DEVELOPERS ON STACKS COMPARED TO OTHER BLOCKCHAINS

An analysis of developers on Stacks compared to other major Layer 1 blockchains shows that Stacks has more developers working within its ecosystem than other currently larger (in terms of market cap) protocols such as Fantom, Harmony, and Chainlink. Stacks has over 120 monthly developers, while Fantom and Chainlink have around 90-100 monthly developers and Harmony has around 60. Stacks' monthly developer count is also not far from Terra, a $27B blockchain protocol[73] with around 150 monthly developers. In fact, Bitcoin itself has around 680 developers, which means Stacks has achieved about 18% of Bitcoin's monthly developer count in its first full year of operations. While Solana has around 900 monthly developers, the Solana blockchain has experienced network outages in recent months, which has led developers to focus their efforts on building out the Solana blockchain and rendering it more resistant to future network outages as opposed to building decentralized Layer 2 applications on top of the blockchain.[74] This is a tradeoff to Solana's secure and scalability-focused blockchain architecture and could leave Solana at a disadvantage compared to more decentralized blockchains like Stacks in terms of future app development. In fact, one NFT collection, Tiger Force, decided to migrate its NFT launch from the Solana blockchain to Stacks in February 2022 because lead developers were drawn to Stacks' relationship with Bitcoin, the strength of the

[73] https://www.coingecko.com/en/coins/terra-luna

[74] https://www.cryptoglobe.com/latest/2022/01/sol-ftx-ceo-defends-solana-against-criticisms-of-its-network-performance/

Stacks community promoting the protocol, and Stacks network security compared to Solana's.[75] This is only one example but may become a trend if Stacks continues to develop.

In ecosystems between 51-300 developers, Stacks was among a handful of protocols that gained developers from December 2020 to December 2021. In fact, Stacks is the only Bitcoin-focused Web 3.0 project gaining traction in terms of developers despite only being in existence for slightly over one year. Assuming continued growth, this could mean that Stacks will be a major competitor to alternative (non-Ethereum) Layer 1 blockchains in the years to come. This is because developers are responsible for designing the smart contracts and applications that incentivize users to adopt a particular blockchain. Thus, developer presence can be thought of as a proxy for future app growth. It is unlikely that users would have adopted Ethereum to the degree that they have, were it not for the decentralized applications enabling financial marketplaces, NFTs, and gaming in its ecosystem.

That being said, Stacks' developer growth was not as strong as other blockchains such as Avalanche, Algorand, and Terra. This may be due to differences in the code underpinning Stacks compared to other protocols. Ethereum uses a coding language called Solidity, and given its size other blockchain developers have also turned to using Solidity code in order to ensure compatibility with Ethereum. For example, Avalanche and Terra's networks are compatible with Solidity code, which may incentivize Ethereum developers to code applications on those blockchains.[76]

On the other hand, Stacks uses Clarity code, which has some important differences compared to Solidity. For example, Clarity code is Turing-incomplete and decidable, which means all smart contract codes can be reliably verified. This ensures that transaction fees are

[75] https://twitter.com/tigerforcenft
[76] https://docs.avax.network/

fixed when transacting on the Stacks network. On the other hand, Solidity code is Turing-complete and undecidable, which means developer smart contract output cannot be reliably verified. This results in variable transaction fees when using the Ethereum network.[77] While Clarity code's decidability reduces the amount of time spent writing code compared to undecidable coding languages, Ethereum has a first-mover advantage that incentivizes other protocols to adopt Solidity or at least ensure Solidity compatibility in order to motivate Ethereum users to use their blockchain as well. Thus, while Clarity is not as difficult to learn as Solidity, learning this coding language may be a barrier of entry for prospective developers.

One way to address this is by issuing grants to developers to learn Clarity code using a portion of Trust Machine and OkCoin grant funds. Trevor Owens, Managing Partner at Stacks Ventures (a venture capital arm of the Stacks protocol that provides capital to promising projects), recently affirmed that he and other Stacks project leaders are working on a grant to provide to developers who are interested in learning Clarity code.[78]

Figure 5 lays out the data discussed above. It is important to note that Solana was founded in 2017 and Avalanche was created in 2019, though the tokens associated with the respective blockchains did not launch until 2020. The Ethereum whitepaper was issued in 2013, but the first Ethereum block did not execute until 2015. Thus, Stacks' developer growth in its first year is substantial relative to other more seasoned competitors, but far behind several others due to its recent entry into the cryptocurrency space, lack of awareness of the protocol, and the need to learn the Clarity programming language.

[77] https://mobile.twitter.com/TO/status/1423848799122821122?s=20&t=Dz7LyMCPCgM6efQIlq5txQ
[78] https://twitter.com/TO/status/1511012397552701442

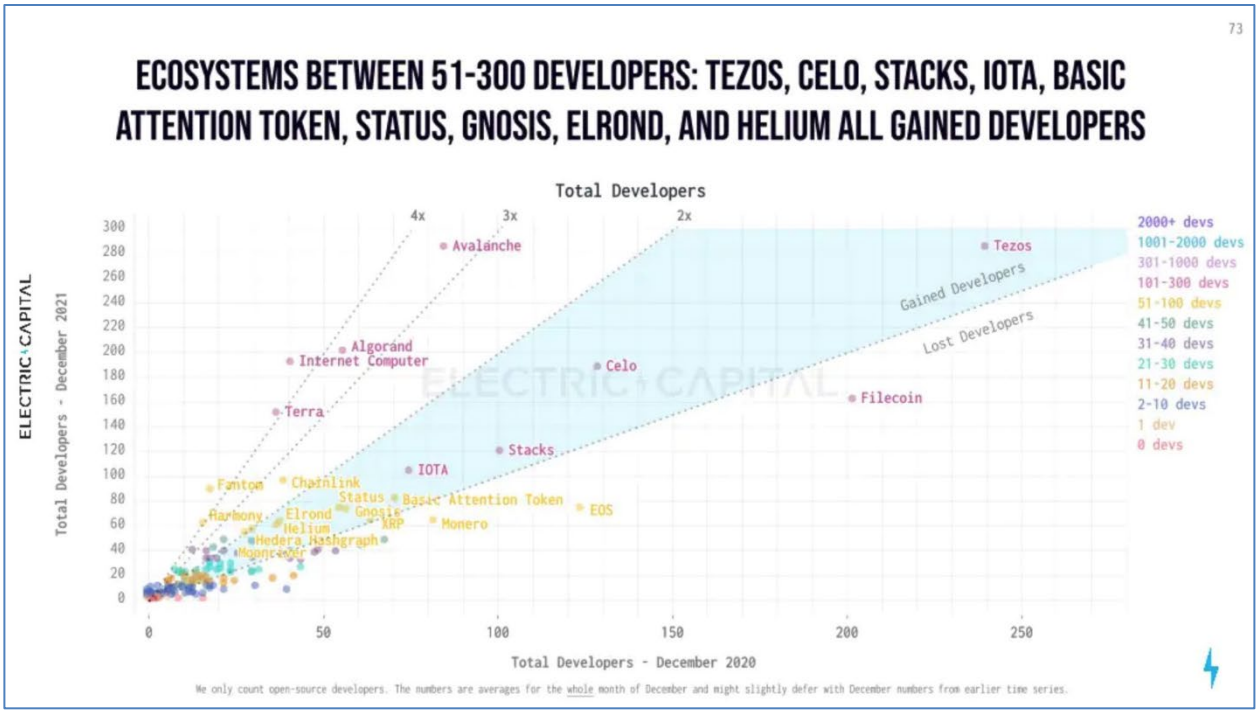


Figure 5. Monthly Developer Count on Stacks Compared to Other Blockchains, December 2020 - December 2021.[79]

V. 2. ANALYSIS OF STACKS TRADING VOLUME COMPARED TO OTHER BLOCKCHAINS

a) TRADING VOLUME DURING FIRST YEAR OF PROTOCOL OPERATIONS

An analysis of Stacks' average daily trading volume in its first 365 days of trading compared to other major Layer 1 blockchains in their first 365 trading days is shown in Figure 6 on the next page. The protocols were analyzed according to their first 365 days of trading in order to reduce the potential bias that could result from analyzing the protocols at different stages in their growth and development. Stacks had an average daily trading volume of $2M, which was the smallest of the blockchains studied. In fact, the next-smallest competitor, Fantom, had an average daily trading volume of $7M in its first 365 days of operations.

[79] https://twitter.com/muneeb/status/1478806871091855362/photo/1

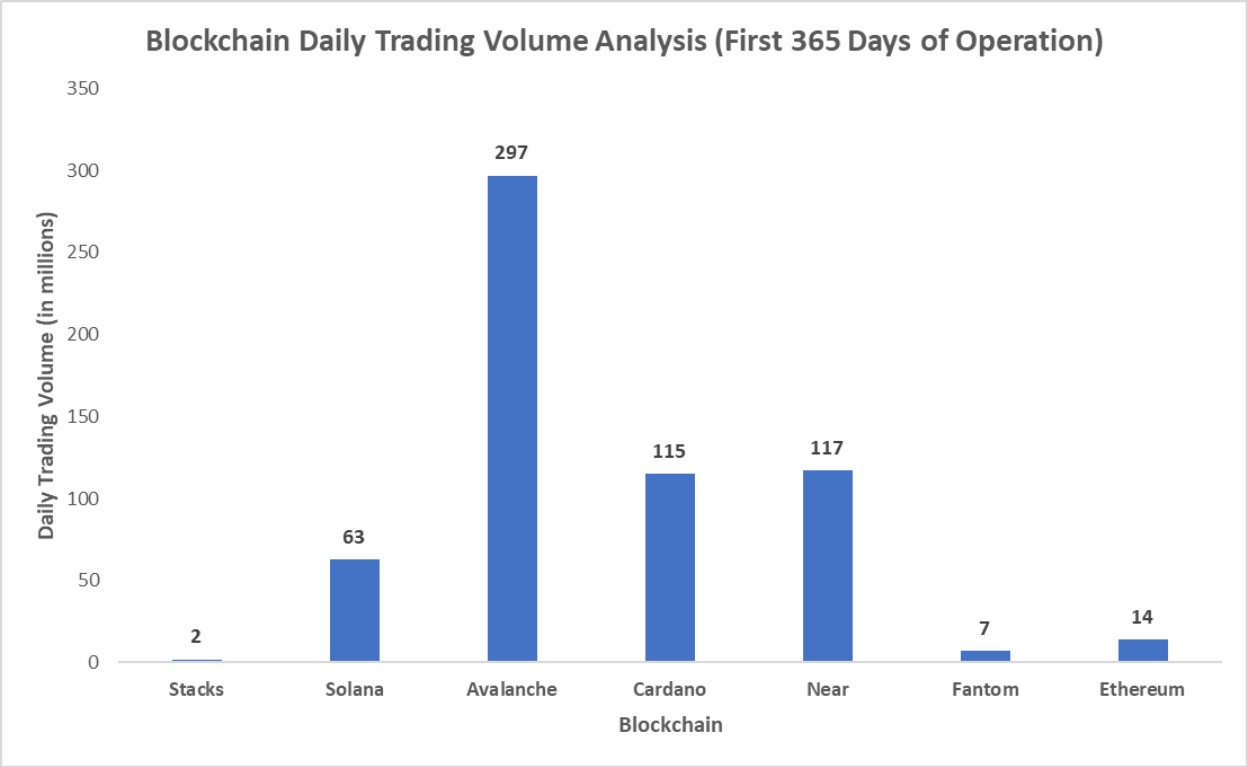


Figure 6. Average Daily Trading Volume over First 365 Days Across a Selection of Layer 1 Blockchains.[80]

One of the reasons Stacks may experience low trading volume relative to its peers is the amount of time it takes to process transactions. Because every Stacks block must ultimately settle on the limited-script Bitcoin protocol, transaction speeds are quite slow compared to other Layer 1 blockchains like Solana and Avalanche that have achieved tremendous growth and adoption over the past year. Another reason is that Stacks may be overshadowed by Bitcoin, meaning cryptocurrency users may not be aware of the value add that Stacks provides due to the hype and media attention surrounding Bitcoin. In addition, Stacks lost a significant amount of development time by initially registering as a security in 2019 before launching Stacks 2.0 (the current iteration of Stacks) in 2021. It is also important to note that 365-day daily trading volume

[80] Data sourced from https://www.coingecko.com/.

is only a snapshot in time and may not be a good indicator of which blockchain will achieve the most growth moving forward. Ethereum only achieved $13.4M in daily trading volume in its first 365 days of operations, while Cardano achieved $114.4M.

However, to this point Cardano has achieved very little application growth on its protocol and has largely achieved its market cap and trading volume based on its narrative as an "Ethereum killer," while Ethereum is the clear-cut smart contract leader in the cryptocurrency space.[81] While the data may not favor Stacks for the time being, it is always subject to change. Stacks will need to leverage the $150M Trust Machines grant and $165M OkCoin grant to further build out applications that convince users to use the blockchain instead of competitors like Solana and Avalanche.

b) RECENT THREE-MONTH TRADING VOLUME ANALYSIS

An analysis of average daily trading volume on Stacks compared to other Layer 1 blockchains over a three-month period ranging from January 5, 2022 to April 4, 2022, is provided in Figure 7 below. Stacks had a recent three-month average daily trading volume of $66M, which was the smallest among the blockchain competitors studied. While it is clear that Stacks' daily trading volume has grown significantly from its early days, it is still struggling to catch up to other competitors in the space.

[81] https://wccftech.com/is-cardano-ada-really-the-next-ethereum-killer/

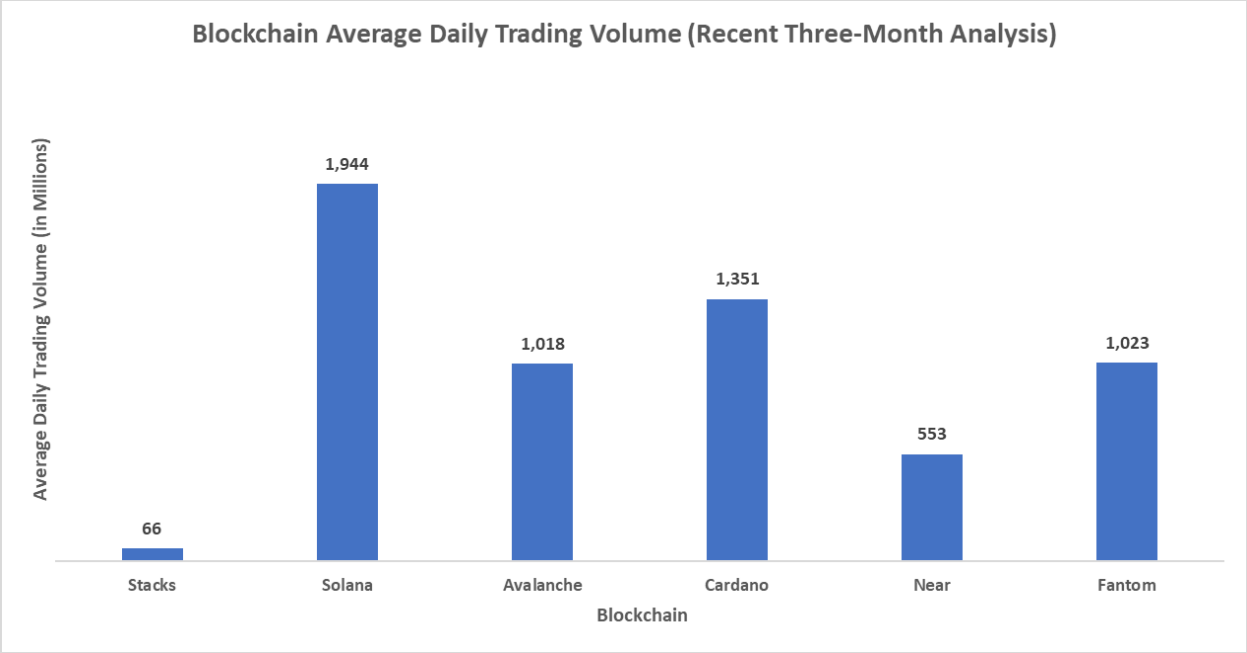


Figure 7. Daily Trading Volume Across a Selection of Layer 1 Blockchains: January 5, 2022 to April 4, 2022.[82]

Stacks' low trading volume relative to its competitors raises the question as to whether it may make more sense to evaluate Stacks as a Layer 2 scaling solution to Bitcoin, similar to the role that Layer 2 scaling solutions such as Arbitrum play in the Ethereum ecosystem.[83] The counter to this argument is that Stacks is intended to be more than purely a scaling solution meant to offload transaction volume from one blockchain to another in order to increase transaction speeds on the main chain, as Arbitrum is currently doing with Ethereum. Stacks' goal is to build smart contract capabilities alongside Bitcoin's store of value capabilities. One possible next step for Stacks could be to leverage the $150M Trust Machines grant to build DeFi and crypto gaming applications on par with its NFT marketplace in order to fully mature as a protocol and prove a stronger competitor to alternative Layer 1 blockchains.

[82] Data sourced from https://www.coingecko.com/.
[83] https://coinmarketcap.com/alexandria/article/what-is-arbitrum

V. 3. STACKS NFT TRADING VOLUME COMPARED TO ETHEREUM NFT TRADING VOLUME

Figure 8 showcases daily NFT trading volume on Stacks (in Stacks tokens) from December 6, 2021 to April 4, 2022, with data courtesy of the data analytics site StacksOnChain. The y-axis denotes trading volume in STX. The figure shows that Stacks has had an average daily trading volume of 18,377 STX over the past four months, with a peak trading day of 160,799 STX on April 1, 2022. The peak trading day was driven by a 105,000 STX sale of a Megapont NFT.[84]

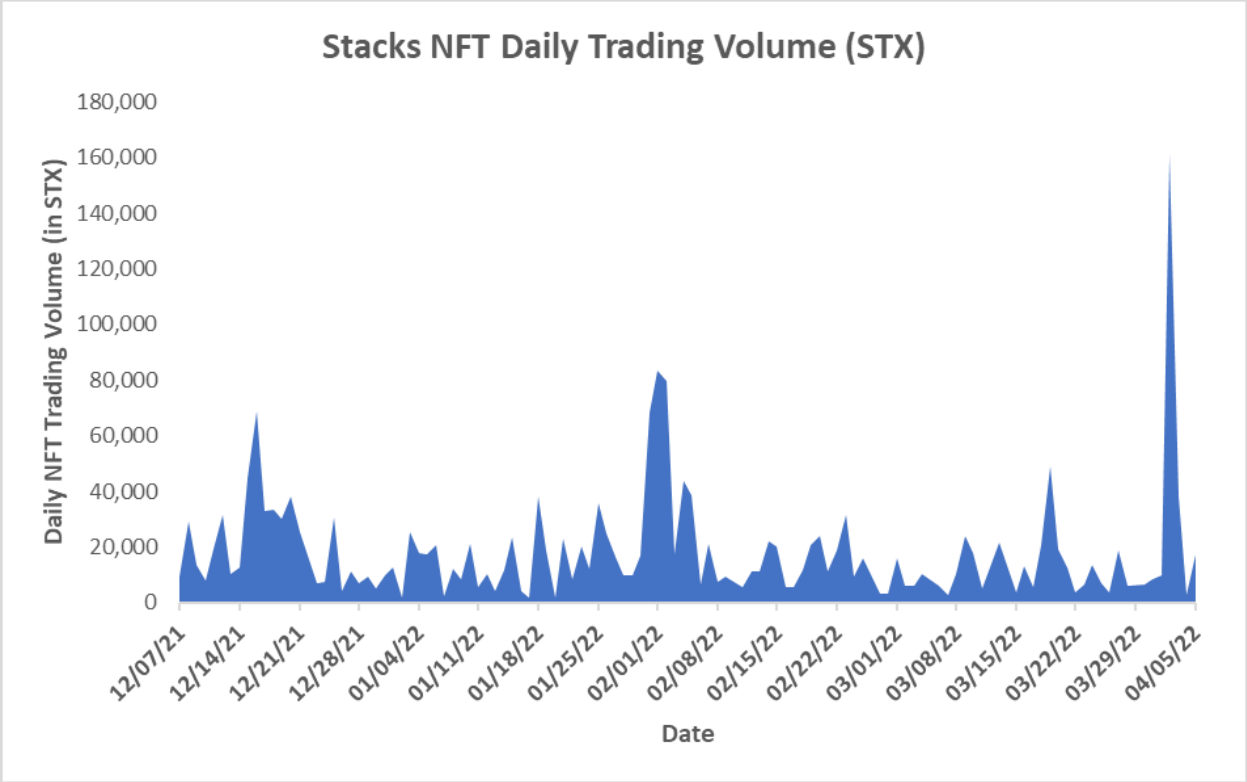


Figure 8. Stacks NFT Daily Trading Volume (in STX), December 6, 2021 to April 4, 2022.[85]

[84] https://twitter.com/MegapontBot/status/1509932928343679023
[85] https://stacksonchain.com/dashboards/nftstats

Stacks daily NFT trading volume was converted from STX to USD using the token's USD-denominated price from December 6, 2021 to April 4, 2022, as shown by Figure 9 below:

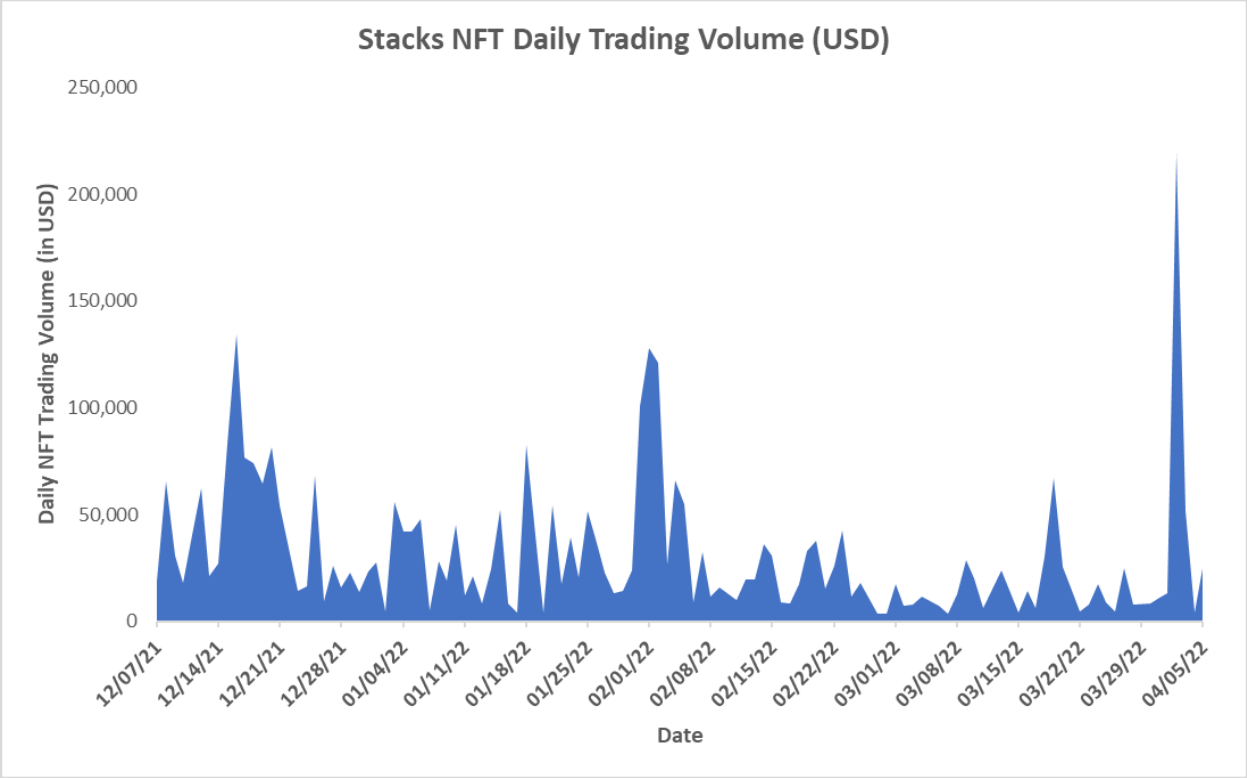


Figure 9. Stacks NFT Daily Trading Volume (in USD), December 6, 2021 to April 4, 2022.[86]

The protocol achieved an average NFT daily trading volume of $31,233 with a high of $219,386 on April 1, 2022 driven by the 105,000 STX Megapont NFT sale.

In comparison, Figure 10 shows daily NFT trading volume on Ethereum from January 5, 2022 to April 4, 2022, using the OpenSea NFT trading volume as a proxy.

[86] https://stacksonchain.com/dashboards/nftstats

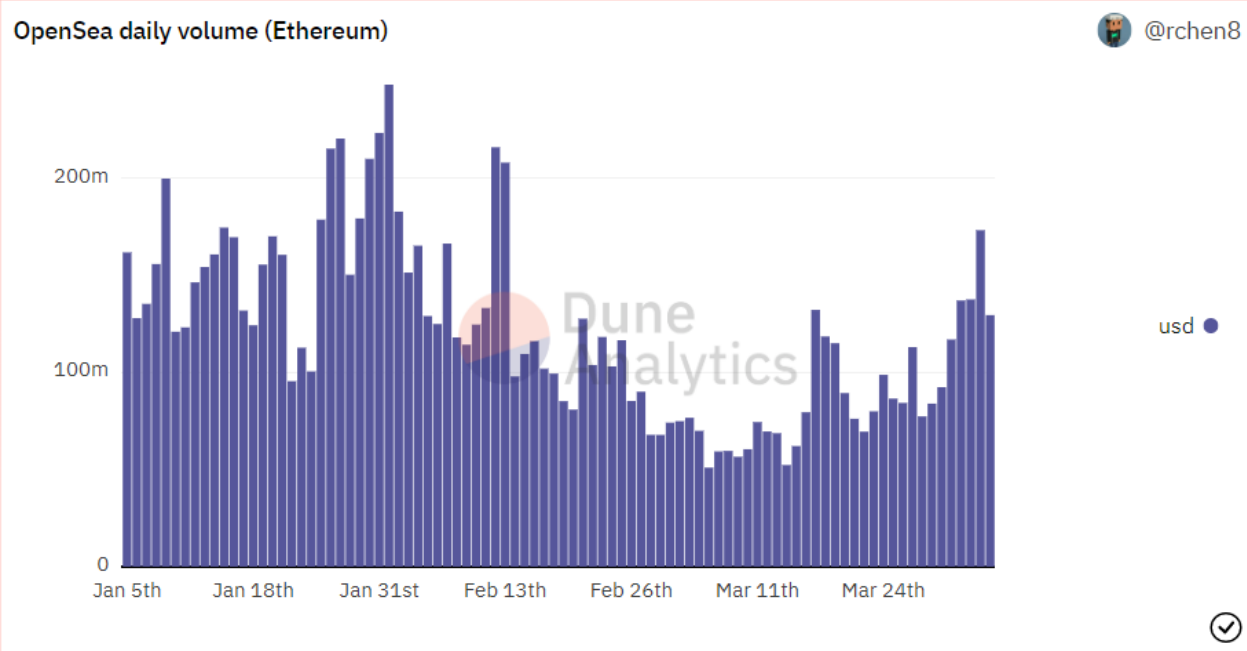


Figure 10. OpenSea Daily Trading Volume, Ethereum. This data is courtesy of a query on the data analytics platform DuneAnalytics. Daily trading volume is denoted in USD as opposed to Ethereum. [87]

These graphs were used to create Figure 11 analyzing the ratio of Ethereum NFT trading volume to that of Stacks over the past three months.

[87] https://dune.com/queries/11385/22601

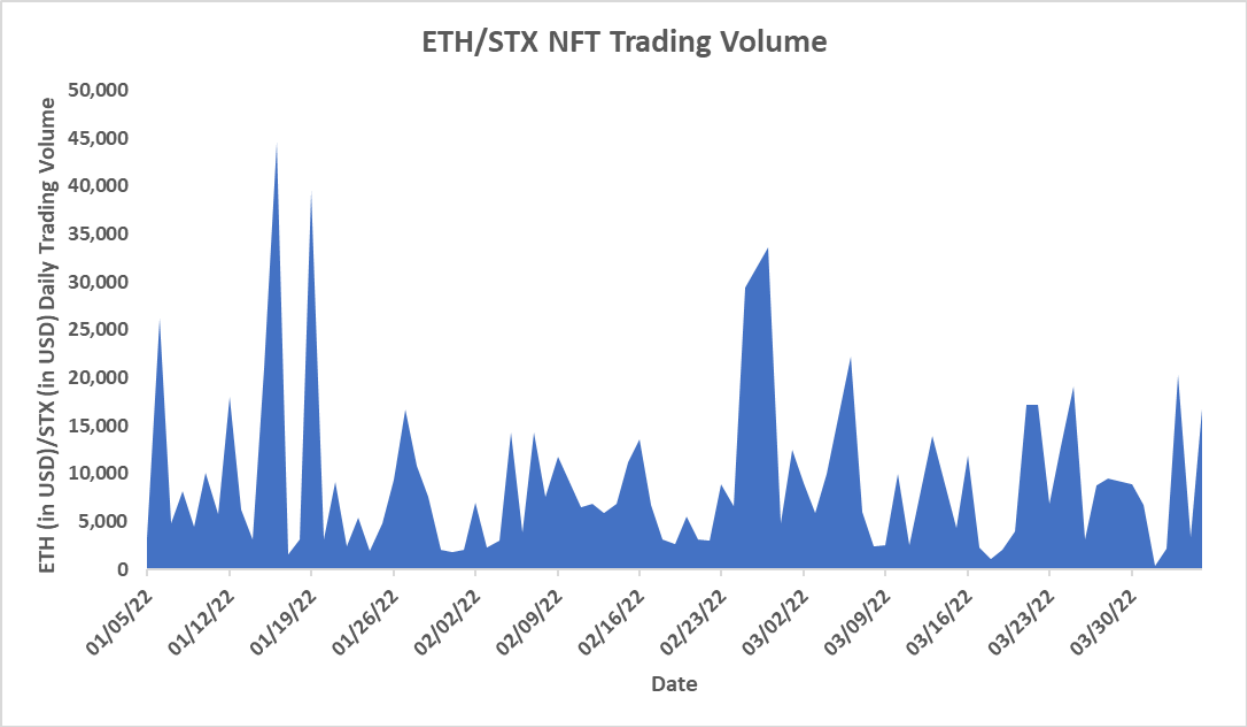


Figure 11. Ratio of Ethereum to Stacks Daily NFT Trading Volume: January 5 to April 4, 2022.

The average ETH/STX ratio of daily NFT trading volume was over 9,000, with a maximum ratio of 44,502 achieved on January 16, 2022 and a minimum ratio of 384 achieved on April 1, 2022. This indicates that the average Ethereum NFT trading volume is more than 9,000 times that of Stacks. That being said, Exhibit 3, which showcases OpenSea monthly fees in Ethereum dating back to August 2018, suggests that growth can happen quickly in the crypto/NFT space. If Stacks can achieve daily trading volumes in the millions or tens of millions within the next five years, which seems reasonable given the blockchain launched last year, it will likely enhance the valuation of Bitcoin while growing to a market cap comparable to that of Solana and Avalanche.

The biggest barrier to Stacks' growth in the NFT marketplace right now is slow transaction speeds. Because every Stacks transaction settles on the Bitcoin blockchain (based on

the Proof of Transfer mining mechanism discussed in Section 3), Stacks' transaction speeds are effectively pegged to Bitcoin's. Stacks is not a layer 2 scaling solution built on top of Bitcoin's network, like Lightning. Instead, it is a Bitcoin-adjacent blockchain that operates independently of Bitcoin yet is linked to Bitcoin through the mining process. Thus, it takes 10 minutes to mine a Stacks block, which is the same amount of time required to mine a Bitcoin block. This means Stacks can process about seven transactions per second, like Bitcoin.[88]

When AlexGo launched in January 2022, users reported that NFT transactions took several days to clear and required larger fees to process than usual. In fact, users reported spending up to 20 STX for transactions during that period, while normal transactions cost between 0.1-0.5 STX. Similar issues were reported when Megapont Ape Club launched a derivative NFT collection, Wasteland Apes, in collaboration with another NFT collection, Project Indigo, to celebrate Stacks' one-year anniversary in January 2022. The collection of 10,000 sold out within one day, but users reported slow transaction speeds, with transactions requiring 12 hours or more to process with similarly high fees.[89] As discussed in Sections 4 and 5, the main innovation likely to speed up transactions are hyperchains, which are expected to launch in June 2022.[90] If the hyperchains launch is successful, Stacks can offload its NFT and DeFi marketplaces to select hyperchains where users can transact quickly and efficiently before moving their funds back to the main Stacks chain if they wish to convert their Stacks tokens to fiat currency or stake their tokens to earn Bitcoin yield.

[88] Ibid
[89] https://twitter.com/Stacks/status/1482065095521980426
[90] Ibid

VI. COMPARISON OF BLOCKCHAIN PROPERTIES

Figure 12 provides a comparison of several blockchains, including Stacks, to determine why Stacks' trading volume may be lower than that of its competitors and how the protocol can grow moving forward:

Blockchain	Centralized/ Decentralized?	Mining Mechanism	Developer Count	Ethereum Bridge?
Stacks	Decentralized	Proof of Transfer (recycled Proof of Work)	120	In progress
Solana	Centralized	Proof of History	900	Yes
Avalanche	Centralized	Proof of Stake	280	Yes
Cardano	Centralized	Proof of Stake	375	In progress
Near	Centralized	Sharded Proof of Stake	400	Yes
Fantom	Centralized	Proof of Stake	90	Yes
Ethereum	Decentralized	Proof of Work (transitioning to Proof of Stake)	4,000	N/A
Bitcoin	Decentralized	Proof of Work	680	No
Harmony	Centralized	Effective Proof of Stake	60	Yes

Figure 12. Comparison of Blockchain Properties.

The main advantages that protocols such as Solana and Avalanche enjoy over Stacks is that miners achieve consensus through Proof of Stake instead of Stacks' Proof of Transfer (derived from Bitcoin's Proof of Work). This enables fast transaction speeds and low transaction fees for individuals to use the network. Transaction fees are commonly referred to as gas fees in the cryptocurrency space since they reflect the amount of computational effort required to

process transactions on the Ethereum network.[91] One of the reasons users are migrating from Ethereum to alternative Layer 1 blockchains is due to the rise in gas fees and slower transaction speeds over the past year, as Ethereum has appreciated in token price from less than $100 to over $4,700 at its peak.

In addition, many alternative Layer 1 blockchains have cross-chain bridges to Ethereum and other Layer 1 blockchains, enabling fast and efficient transfers of cryptocurrency from one blockchain to another. Stacks' lack of a cross-chain bridge may contribute to its comparatively low trading volume, as users may experience difficulty moving Stacks to other blockchains. Currently, a wrapped Stacks token does not exist, so the best way to move Stacks to a blockchain such as Ethereum is to swap Stacks to Bitcoin using Lightning Swap[92] and then wrap Bitcoin into WBTC or renBTC. From there, users can swap their wrapped Bitcoin to Ethereum or another Ethereum-based token on the Ethereum blockchain or lend their wrapped Bitcoin for interest rewards.

If Stacks can leverage a portion of its $150M Trust Machines grant to build a cross-chain bridge to Ethereum and other major Layer 1 blockchains such as Solana and Avalanche, it will likely drive higher TVL and higher daily trading volumes. In addition, it is quite important that Stacks' hyperchain initiative succeeds in the coming months so that current and prospective users can benefit from faster transaction speeds, as this will also incentivize users to transact more often on the network. One idea is to migrate the Stacks NFT marketplace and DeFi applications such as AlexGo and StacksSwap to a hyperchain to ensure fast and cheap transactions, then require users to move their cryptocurrency from a hyperchain back onto the

[91] https://support.opensea.io/hc/en-us/articles/1500006315941-What-are-gas-fees-on-Ethereum-
[92] https://www.lnswap.org/

Stacks blockchain in order to swap to Bitcoin or migrate to another blockchain, once Stacks has a cross-chain bridge in place.

VII. SUMMARY AND FUTURE OF STACKS

Stacks has achieved a significant amount of progress in its first year of operations as it has grown into a $1B protocol. It has a large and growing developer base that it can leverage to continue to build applications on the blockchain while improving existing areas such as its NFT marketplaces. While some observers may be inclined to group Stacks with Layer 2 scaling solutions for Ethereum such as Arbitrum and Plasma, Stacks is unique because it enables smart contract capabilities that settle on the Bitcoin blockchain. Unlike Arbitrum and Plasma, it does not serve as a source to offload transactions from the Bitcoin blockchain in order to relieve congestion and improve processing speeds. In that sense, Layer 2 scaling solutions on Ethereum may be better compared with protocols such as Lightning, which aims to improve processing speeds on Bitcoin. On the other hand, Stacks is more of an independent Layer 1 blockchain with a unique mining mechanism that tethers its transactions to the Bitcoin network.

Stacks enables users to lend, borrow, and stake Bitcoin, and has also facilitated the emergence of Bitcoin-powered NFTs through its NFT marketplaces (STXNFT and Byzantion). Stacks will have to execute on its hyperchain initiative in the coming months and from there offload certain functions such as its NFT marketplace onto hyperchains in order to improve transaction speeds. In addition, the Stacks-Ethereum bridge that enables Satoshibles NFTs to be transferred from one blockchain to another will also need to be expanded to comprise the entire Stacks network, so that assets on the Stacks blockchain can be exported to other blockchains efficiently. This is likely to drive higher Total Value Locked and daily trading volume on the

Stacks blockchain as users gradually understand the value added by the protocol as a secure and decentralized smart contract solution for Bitcoin.

Right now, Stacks' NFT marketplace is relatively mature compared to alternative Layer 1s, but its only major DeFi applications are AlexGo (a decentralized liquidity provider) and StacksSwap (a decentralized exchange for swapping and trading cryptocurrencies in the Stacks ecosystem).[93] It is possible that Stacks will cease operations if it fails to grow. The average lifespan of any blockchain project is 1.22 years, and only eight percent of the over 80,000 blockchain projects that have ever launched are still active today.[94] Most of these failed projects featured plagiarized investor documents and missing or fake executive teams, which has not been the case with Stacks. However, if Stacks' daily trading volume decreases even after utilizing the Trust Machines and OkCoin grants, it is conceivable that the protocol will fail to receive any more capital funding and developers and the core team (including Mr. Muneeb Ali) will move on to other blockchain projects.

If Stacks' daily trading volume does not change or does not exceed $100M, it will likely stagnate at its current $1.5B market cap and remain a fringe player in the blockchain ecosystem with a few features that are value accretive to Bitcoin. Stacks will likely need to grow daily trading volume to $250M, representing more than a 200 percent increase to current trading volume, in order to receive further funding and compete with other blockchains. Otherwise, another competitor enabling smart contract features on the Bitcoin network may emerge and take away market share from Stacks. Currently, no such competitor exists but that is subject to change given the rapid pace at which the cryptocurrency ecosystem continues to evolve.

[93] https://blockonomi.com/stackswap-raises-1-3-million-to-build-dex-on-bitcoin-network/
[94] https://bitcoinist.com/92-blockchain-projects-already-failed-average-lifespan-1-22-years/

Stacks can potentially grow by successfully launching hyperchains that process at least 4,500 transactions per second (equivalent to Avalanche's current processing speeds)[95] in order to incentivize users to transact on the blockchain. Currently, since Stacks is pegged to Bitcoin's network, the protocol can only process seven transactions per second.[96] Stacks developers will also need to build a bridge connecting Stacks to Ethereum to onboard users more effectively, like other blockchain projects have done. Stacks enthusiasts, network participants, and project leaders building on the Stacks protocol will also need to connect with Bitcoin maximalists and convince them of the utility that Stacks provides to the Bitcoin ecosystem by providing smart contract programming capabilities that complement Bitcoin's store-of-value properties. If Stacks can onboard 1% of the 81 million Bitcoin wallet users, that represents an exponential addition to the 50,000 users currently transacting on the Stacks network.[97] This would likely increase the likelihood that Stacks reaches a daily trading volume comparable to that of Near and Fantom, and potentially even Avalanche. Stacks has a fundraising arm called the Stacks Foundation comprising 13 employees and three board members, who will likely also need to invest time and energy into cultivating relationships with strong Bitcoin supporters and explaining to them the symbiotic relationship between Bitcoin and Stacks.[98]

While executing on these growth initiatives will be challenging, they are feasible. Layer 2 Ethereum scaling solutions such as Arbitrum process up to 40,000 transactions per second, while Ethereum can only process 14 per second.[99] Moreover, the Satoshibles NFT project has already demonstrated that it is possible to build a digital bridge connecting the Ethereum and Stacks

[95] https://www.investopedia.com/avalanche-avax-definition-5217374
[96] https://www.realvision.com/blog/what-is-stacks
[97] https://twitter.com/hirosystems/status/1484233766373453825
[98] https://stacks.org/about
[99] https://decrypt.co/resources/what-is-arbitrum-speeding-up-ethereum-using-optimistic-rollups

ecosystems, at least at the micro level. In addition, while convincing Bitcoin users, including maximalists, of Stacks' utility may not succeed at the macro level, it may achieve enough success at the micro level to compete with other layer 1 blockchains.

For now, Stacks is a growing ecosystem with promising indicators in developer count and ecosystem funding ($150M Trust Machines grant) that will need to achieve faster transaction speeds, a cross-chain bridge, and increased user adoption in order to compete with alternative Layer 1 blockchains such as Solana and Avalanche, as protocols compete to capture market share in the blockchain ecosystem. However, as only 8% of blockchain projects ever launched are still active, the odds for Stacks may be stacked against it unless many blocks fall into place.

EXHIBITS

Exhibit 1

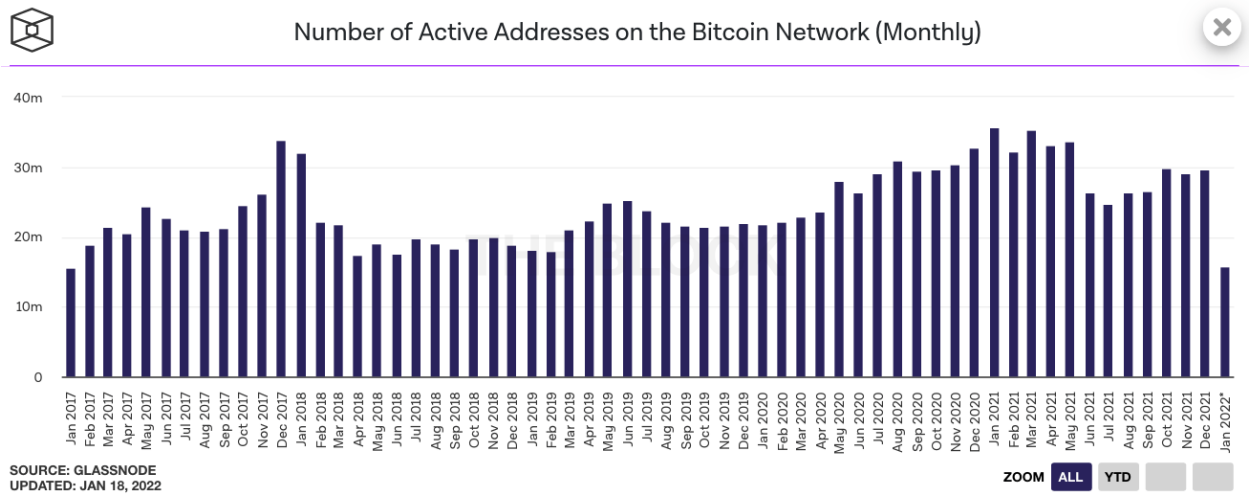


Exhibit 2

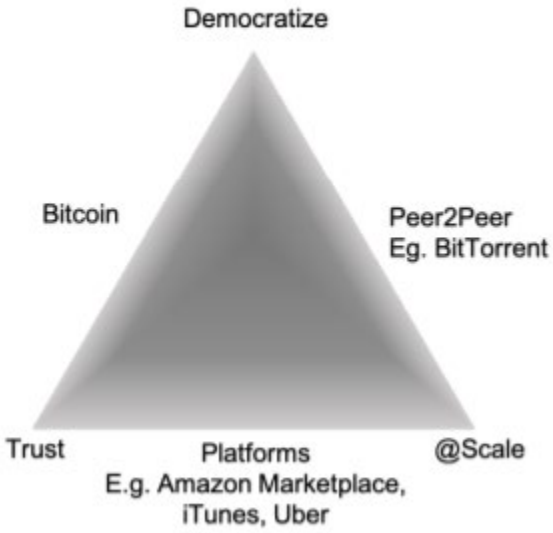
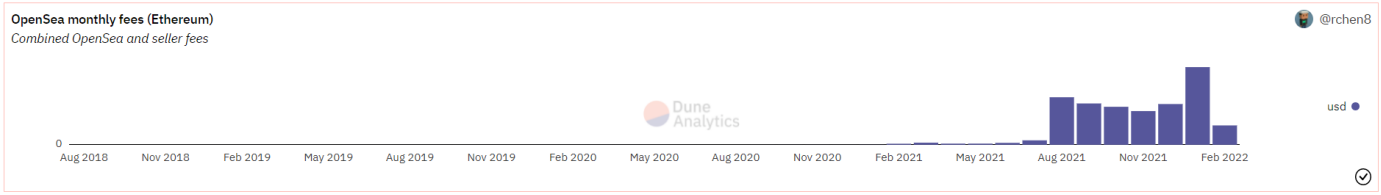


Exhibit 3



REFERENCES

Akhtar, Tanzeel. “CityCoin's Plan for NYCCOIN Is Welcomed by Mayor-Elect Adams.” *CoinDesk Latest Headlines RSS*, CoinDesk, 9 Nov. 2021, https://www.coindesk.com/business/2021/11/09/citycoins-plan-for-nyccoin-is-welcomed-by-mayor-elect-adams/.

Ali, Muneeb. *Stacks 2.0 Whitepaper*. Dec. 2020, https://gaia.blockstack.org/hub/1AxyPunHHAHiEffXWESKfbvmBpGQv138Fp/stacks.pdf.

Antonovici, Anatol. “How Many People Actually Have at Least 1 Bitcoin?” *Bitcoinist.com*, 13 Feb. 2020, https://bitcoinist.com/how-many-people-actually-have-at-least-1-bitcoin/.

Banerjee, Avinandan. “Staking vs Yield Farming vs Liquidity Mining- What's the Difference?” *Staking vs Yield Farming vs Liquidity Mining - What's The Difference?*, https://Blockchain-Council.org/Wp-Content/Uploads/2022/02/Logo-500x96-1.Png, 24 Mar. 2022, https://www.blockchain-council.org/defi/staking-vs-yield-farming-vs-liquidity-mining/.

Betz, Brandy. “Alex Raises $5.8M to Bring Defi to the Bitcoin Ecosystem.” *CoinDesk Latest Headlines RSS*, CoinDesk, 15 Nov. 2021, https://www.coindesk.com/business/2021/11/15/alex-raises-58m-to-bring-defi-to-the-bitcoin-ecosystem/.

Betz, Brandy. “OkCoin, Stacks Launch $165M Pledge to Support Bitcoin-Related Projects.” *CoinDesk Latest Headlines RSS*, CoinDesk, 10 Mar. 2022, https://www.coindesk.com/business/2022/03/10/okcoin-stacks-launch-165m-pledge-to-support-bitcoin-related-projects/.

Bhattacharya, Joydeep. “What Is Web 3.0? the Future of the Internet.” *Single Grain*, 7 Feb. 2022, https://www.singlegrain.com/web3/web-3-0/.

Blankstein, Aaron, and Sarala B. “Introducing Hyperchains by Hiro.” *Hiro*, https://www.hiro.so/blog/introducing-hyperchains-by-hiro.

“Blockstack SEC Filing, 2019.” *Sec.gov*, 11 Apr. 2019, https://www.sec.gov/Archives/edgar/data/1719379/000110465919020748/a18-15736_1partiiandiii.htm.

Borda, Mason. “Wrapped BTC (XBTC) Is Headed to Stacks.” *Medium*, Wrapped, 20 Apr. 2021, https://medium.com/wrapped/wrapped-btc-xbtc-is-headed-to-stacks-4c58793a5dca.

Braun, Helene. “Miami to Give 'Bitcoin Yield' from Miamicoin to Its Citizens.” *CoinDesk Latest Headlines RSS*, CoinDesk, 11 Nov. 2021, https://www.coindesk.com/business/2021/11/11/miami-to-give-bitcoin-yield-from-miamicoin-to-its-citizens/.

“BtcNews - Crypto News from around the World That Everyone Should Know.” *JIC News*, 7 Oct. 2021, https://jicnews.com/bitcoin-nfts-are-emerging-on-stacks-can-they-thrive/.

Castillo, Michael Del. “20 Institutional Bitcoin Investors Revealed, but Soon the List May Vanish.” *Forbes*, Forbes Magazine, 7 Aug. 2020, https://www.forbes.com/sites/michaeldelcastillo/2020/08/06/valuable-sec-data-on-20-institutional-bitcoin-investors-could-soon-disappear/.

Dilmegani, Cem. “Smart Contracts: What Are They & Why They Matter in 2022.” *AIMultiple*, 10 Feb. 2022, https://research.aimultiple.com/smart-contracts/.

CityCoins Community. “Why CityCoins Is Powered by Stacks - and How It All Works.” *CityCoins*, https://www.citycoins.co/post/why-citycoins-is-powered-by-stacks.

Costill, Albert. “Bitcoin Scripting and How It Can Be Improved.” *Due*, 17 Jan. 2022, https://due.com/blog/bitcoin-scripting-and-how-it-can-be-improved/.

Cuevas, Mitchell, and Muneeb Ali. “Stacks Cryptocurrency No Longer Treated as a US Security by Blockstack PBC.” *Stacks Blog - Apps and Smart Contracts for Bitcoin*, 21 Jan. 2021, https://blog.blockstack.org/stacks-cryptocurrency-securities-filing/.

Dale, Oliver. “StackSwap Raises $1.3 Million to Build Dex on Bitcoin Network.” *Blockonomi*, 8 Nov. 2021, https://blockonomi.com/stackswap-raises-1-3-million-to-build-dex-on-bitcoin-network/.

Economist, The Part Time. “How and Why to ‘Wrap’ a Cryptocurrency.” *Publish0x*, Publish0x, 2 Feb. 2021, https://www.publish0x.com/the-part-time-economist/how-and-why-to-wrap-a-cryptocurrency-xdnqypp.

Fantom Whitepaper. https://fantom.foundation/research/wp_fantom_v1.6.pdf.

Floyd, David. “Lightning Network: What Is It and Can It Solve Bitcoin's Scaling Problem?” *Investopedia*, Investopedia, 18 Feb. 2022, https://www.investopedia.com/news/lightning-network-what-it-and-can-it-solve-bitcoins-scaling-problem/.

Foxley, William. “Interoperability Project Ren 'Joining' Alameda Research.” *CoinDesk Latest Headlines RSS*, CoinDesk, 2 Feb. 2021, https://www.coindesk.com/markets/2021/02/02/interoperability-project-ren-joining-alameda-research/.

George, Benedict. “What Does It Mean to Burn Crypto?” *CoinDesk Latest Headlines RSS*, CoinDesk, 26 Jan. 2022, https://www.coindesk.com/learn/what-does-it-mean-to-burn-crypto/.

George, Benedict. “Why Tvl Matters in Defi: Total Value Locked Explained.” *CoinDesk Latest Headlines RSS*, CoinDesk, 26 Jan. 2022, https://www.coindesk.com/learn/why-tvl-matters-in-defi-total-value-locked-explained/.

Hayward, Andrew. “First Bitcoin Metaverse Game on Stacks, Moonray, Raises $3.5m.” *Decrypt*, Decrypt, 14 Dec. 2021, https://decrypt.co/88230/first-bitcoin-metaverse-game-stacks-moonray-raises-3-5m.

Hayward, Andrew. “Satoshibles Is First NFT Collection to Bridge between Ethereum and Bitcoin via Stacks.” *Decrypt*, Decrypt, 10 Feb. 2022, https://decrypt.co/92537/satoshibles-first-nft-collection-bridge-ethereum-bitcoin-stacks.

Hoskinson, Charles. “Cardano Whitepaper.” *Cardano Whitepaper*, 28 June 2017, https://whitepaper.io/document/581/cardano-whitepaper.

“How Many Bitcoins Are There?” *How Many Bitcoins Are There? (Circulating Supply - Live)*, https://www.buybitcoinworldwide.com/how-many-bitcoins-are-there/.

“How Many People Own Bitcoin in 2022?” *EarthWeb*, 22 Mar. 2022, https://earthweb.com/how-many-people-own-bitcoin/.

James, Adam. “92% Of Blockchain Projects Have Already Failed, Average Lifespan of 1.22 Years.” *Bitcoinist.com*, 29 May 2018, https://bitcoinist.com/92-blockchain-projects-already-failed-average-lifespan-1-22-years/.

L., Kenny. “The Blockchain Scalability Problem & the Race for Visa-like Transaction Speed.” *Medium*, Towards Data Science, 23 July 2019, https://towardsdatascience.com/the-blockchain-scalability-problem-the-race-for-visa-like-transaction-speed-5cce48f9d44.

LNSwap, https://www.lnswap.org/faq.

Macheel, Tanaya. “Stacking Stacks Is the Latest Way to Earn Passive Yield in Bitcoin.” *Blockworks*, 12 Aug. 2021, https://blockworks.co/stacking-stacks-is-the-latest-way-to-earn-passive-yield-in-bitcoin/.

Marquez, Reynaldo. “How Bitcoin Adoption Rate Is Beating the Internet.” *Bitcoinist.com*, 26 May 2021, https://bitcoinist.com/how-bitcoin-adoption-rate-is-beating-the-internet/.

Masnavi, Siamak. “$Sol: FTX CEO Defends Solana against Criticisms of Its Network Performance.” *CryptoGlobe*, CryptoGlobe, 25 Jan. 2022, https://www.cryptoglobe.com/latest/2022/01/sol-ftx-ceo-defends-solana-against-criticisms-of-its-network-performance/.

Mihajlovic, Marko. “What Are Wrapped Tokens?” *A Beginner's Guide to Decentralized Finance (DeFi)*, https://academy.shrimpy.io/lesson/what-are-wrapped-tokens.

Morris, Chris. “Microstrategy Has Added to Its Bitcoin Holdings, According to Latest SEC Filings.” *Fortune*, Fortune, 29 Nov. 2021, https://fortune.com/2021/11/29/microstrategy-buys-more-bitcoin/.

Muller, Chris. “How to Buy Bitcoin: A Beginner's Guide to Buying and Selling Bitcoin.” *Moneyunder30.Com*, 7 Dec. 2021, https://www.moneyunder30.com/how-do-you-buy-bitcoin-a-beginners-guide-to-buying-and-selling-bitcoin.

Nakamoto, Satoshi. *Bitcoin: A Peer-to-Peer Electronic Cash System*. 31 Oct. 2008, https://bitcoin.org/bitcoin.pdf.

Nibley, Brian. “What Are Nodes? 7 Types of Blockchain Nodes.” *SoFi*, SoFi, 8 Mar. 2022, https://www.sofi.com/learn/content/what-are-nodes/.

Number of Credit Cards and Credit Card Holders - Wallethub. https://wallethub.com/edu/cc/number-of-credit-cards/25532.

Ostroff, Caitlin, and Rebecca Elliott. “Tesla Buys $1.5 Billion in Bitcoin.” *The Wall Street Journal*, Dow Jones & Company, 8 Feb. 2021, https://www.wsj.com/articles/tesla-buys-1-5-billion-in-bitcoin-11612791688.

Phillips, Daniel. “What Is Arbitrum?” *CoinMarketCap* , CoinMarketCap, 6 Dec. 2021, https://coinmarketcap.com/alexandria/article/what-is-arbitrum.

Playfair, Edward. “Stacks: Enhancing Bitcoin.” *Three Body Capital*, Three Body Capital, 3 Dec. 2021, https://threebody.capital/blog/2021/12/3/stacks-enhancing-bitcoin.

Qureshi, Haseeb. “Blockchains Are Cities.” *Medium*, Dragonfly Research, 18 Jan. 2022, https://medium.com/dragonfly-research/blockchains-are-cities-564327013f86.

Real Vision. “What Is Stacks and How Does It Work?” *Real Vision*, 27 Jan. 2022, https://www.realvision.com/blog/what-is-stacks.

Ro, Sam. “Here Are Some of the Practical Uses for Gold.” *Business Insider*, Business Insider, 18 Sept. 2012, https://www.businessinsider.com/many-uses-of-gold-2012-9#gold-is-not-toxic-3.

Rosic, Ameer, et al. “Smart Contracts: The Blockchain Technology That Will Replace Lawyers.” *Blockgeeks*, 25 Nov. 2020, https://blockgeeks.com/guides/smart-contracts/.

Saleem, Rohail. “Is Cardano (ADA) Really the next ‘Ethereum Killer’?” *Wccftech*, Wccftech, 13 Aug. 2021, https://wccftech.com/is-cardano-ada-really-the-next-ethereum-killer/.

Sekniqi, Kevin, et al. “Avalanche Whitepaper.” *Avalanche Platform*, 30 June 2020, https://assets.website-files.com/5d80307810123f5ffbb34d6e/6008d7bbf8b10d1eb01e7e16_Avalanche%20Platform%20Whitepaper.pdf.

Shen, Maria. “Electric Capital Developer Report (2021).” *Medium*, Electric Capital, 28 Jan. 2022, https://medium.com/electric-capital/electric-capital-developer-report-2021-f37874efea6d.

Shinobi. “How Centralized Is Bitcoin Mining Really?” *Bitcoin Magazine: Bitcoin News, Articles, Charts, and Guides*, Bitcoin Magazine: Bitcoin News, Articles, Charts, and Guides, 6 Dec. 2021, https://bitcoinmagazine.com/business/is-bitcoin-mining-centralized.

Sigalos, MacKenzie. “Ukraine Has Raised More than $54 Million as Bitcoin Donations Pour in to Support the War against Russia.” *CNBC*, CNBC, 3 Mar. 2022, https://www.cnbc.com/2022/03/03/ukraine-raises-54-million-as-bitcoin-donations-surge-amid-russian-war.html.

Sparkes, Matthew. “El Salvador Revamps Bitcoin Wallet after Complaints of Theft and Fraud.” *New Scientist*, New Scientist, 10 Feb. 2022, https://www.newscientist.com/article/2306640-el-salvador-revamps-bitcoin-wallet-after-complaints-of-theft-and-fraud/.

Stevens, Robert. “What Is Arbitrum? Speeding up Ethereum Using Optimistic Rollups.” *Decrypt*, Decrypt, 29 Mar. 2022, https://decrypt.co/resources/what-is-arbitrum-speeding-up-ethereum-using-optimistic-rollups.

Trifecta Blockchain Team. *Trifecta: The Blockchain Trilemma Solved*. Oct. 2019, https://pramodv.ece.illinois.edu/pubs/Whitepaper2019-9.pdf.

Tse, Stephen, et al. “Harmony Whitepaper.” *Harmony*, https://harmony.one/whitepaper.pdf.

Voell, Zack, and William Foxley. “Alameda Research Claimed Nearly 70% of Wrapped Bitcoin Minted in August.” *CoinDesk Latest Headlines RSS*, CoinDesk, 4 Sept. 2020, https://www.coindesk.com/markets/2020/09/04/alameda-research-claimed-nearly-70-of-wrapped-bitcoin-minted-in-august/.

“What Is Bitcoin Maximalism?” *Liquid.png*, https://blog.liquid.com/what-is-bitcoin-maximalism.

Yakovenko, Anatoly. “How Solana's Proof of History Is a Huge Advancement for Block Time.” *Medium*, Solana, 23 Feb. 2020, https://medium.com/solana-labs/how-solanas-proof-of-history-is-a-huge-advancement-for-block-time-178899c89723.

Yakovenko, Anatoly. *Solana Whitepaper*. https://solana.com/solana-whitepaper.pdf.