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BITCOIN LAYERS

Tapestry of a Trustless Financial Era

Bitcoin Layers: A Tapestry of a Trustless Financial Era

is a research report on developments occurring throughout the Bitcoin Ecosystem. This report was authored by the team at The Spartan Group, Kyle Ellicott, and a number of experts who offered their feedback and insights and generously gave their time reviewing the final version you read today.

Authors / Contributors

Kyle Ellicott
Yan Ma
Darius Tan
Melody He

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Executive Summary

1. **Most of the $850+ Billion Capital in Bitcoin Remains Unproductive.** The stability and security of the Bitcoin network not only endow BTC with lasting value but also have enabled it to amass considerable capital, with an $850B+[1] market capitalization at the time of this report. Yet, the network faces significant challenges, in programmability, technical scalability, and cultural alignment within its developer community. These factors have historically hindered development efforts on the Bitcoin network, and underutilization has kept much of the capital remaining dormant.
2. **Significant Shift in the Bitcoin Landscape Can Unlock Its Massive Potential.** To activate this dormant capital, it's essential to harness the potential and capabilities of the Bitcoin network fully. Efforts have been made to build technologies on top of, or adjacent to, Bitcoin that provide the smart contracts and scalable, fast transactions that can enable new use cases. Consequently, Bitcoin is evolving beyond its presumed role as a mere Store of Value (SoV) and becoming a foundational technology platform for the trustless financial system it was envisioned to be. These approaches have each had significant limitations, however, be it in their flexibility, performance, or security model.
3. **Ordinals Brought a Renaissance of Bitcoin Builder Culture.** At the same time, the introduction of *Ordinals* marks a significant cultural shift towards using the Bitcoin Layer-1 for applications other than a SoV, including “NFTs on Bitcoin” as well as further innovations upon the Ordinals protocol, including recursive inscriptions, BRC-20, and more. This additional usage of the L1 has stressed its performance and scalability limitations and increased Bitcoin fees substantially.
4. **Bitcoin Layers Address Scalability.** The concept of "Bitcoin Layers," mirroring Ethereum's layered architecture, represents a strategic response to Bitcoin's limitations. These layers bring functionalities like programmability, increased transaction speeds, data availability, application functionality, and more. This approach leverages Bitcoin’s security and stability, while also unlocking Bitcoin’s vast capital. Lightning is already a type of Layer-2 protocol for fast payments, but other layers provide more sophisticated capabilities such as smart contracts in addition to fast transactions and scalability.

[1] *$855.0Bn market cap for Bitcoin as of time of writing - https://messari.io/project/bitcoin*

5. **The Strategic Imperative of Bitcoin Layer-2 Solutions.** The Bitcoin L1 will always---by design, for security and decentralization---have the limitations of lack of programmability via smart contracts, and slow transaction speeds. Significant past upgrades like SegWit and Taproot address some issues, but the need for smart contracts as well as the while rising gas fees (peaking at >280%[2] this year vs Ethereum at >160%[3]) and strong demand for Bitcoin blockspace highlight the need for more refined Layer-2 solutions like Stacks, which is releasing a significant upgrade (Nakamoto Release) in early Q2 2024. The Nakamoto Release promises to turn Stacks into the type of Bitcoin Layer-2 that is needed: one that supports smart contracts, allows applications to use BTC as their asset, inherits 100% of Bitcoin's reorg security and finality, and provides fast transactions. Strategically, growing the available Layer-2 options will help drive innovation and scalability through competition and developer interest.

6. **The Bitcoin Ecosystem is Well-positioned for Institutional Adoption.** Ahead of the 2024 halving event, Bitcoin's ongoing development of Layer-2s is producing a more scalable and secure ecosystem. Boosted by increased institutional interests, as shown in the anticipated approval of multiple Bitcoin Spot ETFs, Bitcoin is at the forefront of a new, trustless financial paradigm that blends traditional and decentralized systems.

[2] *YCharts, Dec. 1, 2023, Bitcoin Average Transaction Fee is at a current level of 6.469, down from 6.700 yesterday and up from 1.690 one year ago. This is a change of -3.46% from yesterday and 282.7% from one year ago." https://ycharts.com/indicators/bitcoin_average_transaction_fee*

[3] *YCharts, "Ethereum Average Transaction Fee is at a current level of 1.346, up from 1.314 yesterday and up from 0.513 one year ago. This is a change of 2.39% from yesterday and 162.3% from one year ago." https://ycharts.com/indicators/ethereum_average_transaction_fee*

I. Bitcoin Economy Awakened

The Evolving Bitcoin Thesis

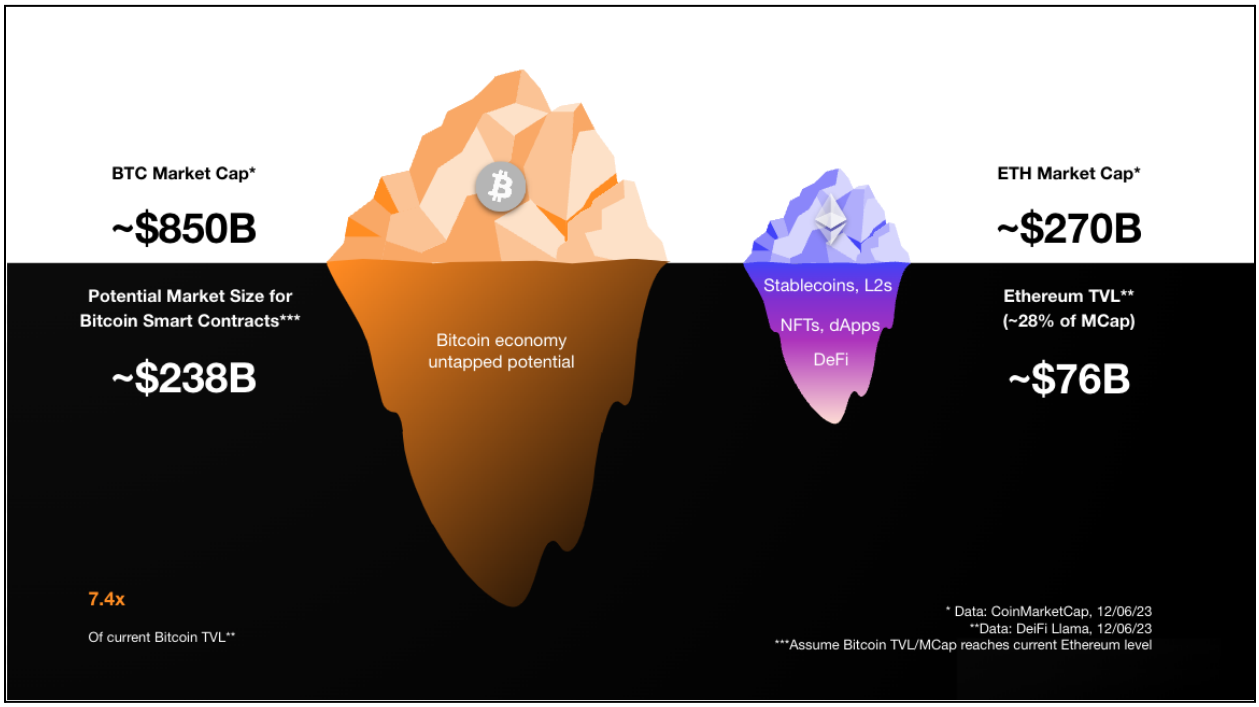
Since Bitcoin's inception in January 2009, its role and potential have significantly evolved. Many initially considered Bitcoin an inflationary hedge, a SoV, and a beacon of hope in democratizing financial systems. Its role in shaping the future of decentralized applications (dApps) has only recently become a focal point. By 2023, nearly fourteen years after its launch, this evolution became evident as Ethereum saw growing success with applications and Bitcoin's dominance as an asset grew over Ethereum, and developers introduced numerous infrastructure "layers" above the Bitcoin core network (Layer-1 or L1). These Bitcoin Layers, enhancing scalability and programmability, capitalize on Bitcoin's stability and security while tapping into its over $850B+ [4] and growing unproductive capital without altering the L1. We are now seeing significant advances in Bitcoin layers, allowing them to act on the BTC asset and inherit Bitcoin's reorg security and finality while overcoming its limitations in programmability and performance. Going forward, these additive infrastructure layers, unique to the Bitcoin Ecosystem, will become the cornerstone upon which many will look to build their applications.

Despite this progress, much of the necessary infrastructure remains in the development and experimental stages. The journey is not without precedent. In 2017, early NFT and token projects flooded the Ethereum network, resulting in slowed transactions and high transaction fees. This has reinvigorated the developer community's ambition to construct more robust infrastructure, providing the necessary scalability and flexibility for the network to support even a fraction of the potential applications' demands. The Ethereum community debated and experimented with several approaches and settled on a layered approach to performance and scalability, leading to well-utilized Ethereum (Layer-2 or L2) with billions in total value locked (TVL). The experience with Ethereum provides valuable insights for Bitcoin in scaling, growth, and decentralization for applications and their underlying networks.

Similar to Ethereum, Bitcoin experienced a pivotal moment with the introduction of Ordinals and a shift towards "Building on Bitcoin". Bitcoin recently had a comparable moment, almost six years later, thanks to the release of Ordinals (based on Ordinal Theory and the ability to inscribe data on the Bitcoin chain) and the newfound culture shift of "Building on Bitcoin". This shift has sparked a development revolution in infrastructure and scaling layers on top of Bitcoin's L1. We're now seeing not only new protocol & token standards (BRC-20, etc.) but also the development of new Bitcoin L2s that have begun to unlock the Bitcoin Economy and provide a sneak peek into the potential of unlocking $850B+ of dormant capital and the industry's most stable and trialed technology to date. As a result, the Bitcoin Thesis is being redefined: no longer just a SoV or an asset, Bitcoin is emerging as a fundamental infrastructure within its own expanding economy.

[4] *$855.0Bn market cap for Bitcoin as of time of writing - https://messari.io/project/bitcoin*

Drawing parallels to Ethereum's growth trajectory, the Bitcoin ecosystem will likely experience user adoption surges driven by viral use cases that kickstart the flywheel. This, in turn, will attract more developers and increase the ecosystem's application TVL. Considering Bitcoin's $850B market capitalization is about 3.1[5] times that of Ethereum's $270B, while its application TVL is currently only a tiny fraction at about $320 Million compared to Ethereum's $76B, this scenario presents a potential 7-fold[6] growth opportunity for the Bitcoin ecosystem to reach the similar level of maturity on the application front as Ethereum, not counting additional liquidity influxes once the ecosystem gains momentum.



Massive Market Potential of Bitcoin Smart Contracts

The Network vs the Asset

To understand the changing narrative, a distinction needs to be drawn between Bitcoin, the Network (i.e., Bitcoin Core, Bitcoin L1, Bitcoin Blockchain), and BTC, the digital asset. There has been constant confusion for many as the term "Bitcoin" itself can refer to both, which are vastly different while deeply related. To help avoid confusion, this report adopts the standard of capitalizing Bitcoin when referring to the network and using BTC for the token or digital asset.

- **Bitcoin the Network** went live shortly after the October 31st, 2008, release of the famed whitepaper[7] introducing a Peer-to-Peer Electronic Cash System. Its genesis block was then

[5] *Source: CoinMarketCap Market Capitalization data at the time of writing*
[6] *Source: DefiLlama TVL data at the time of writing*
[7] *Bitcoin: A Peer-to-Peer Electronic Cash System, Satoshi Nakamoto - https://bitcoin.org/bitcoin.pdf*

mined on January 3, 2009. Since its release, the network has remained stable, while other networks have experienced downtime, attacks, and more, proving its viability as the ultimate L1. Bitcoin has shown that it can provide trust without a centralized intermediary and act as the ultimate decentralized settlement layer for transactions, assets, and future applications. However, it has been difficult to develop applications other than the BTC asset itself on Bitcoin due to its lack of flexible programmability and the inability to write trustlessly to the network from outside it. Bitcoin is different from Ethereum in this important way: it does not natively support the smart contracts that enable decentralized applications to use BTC as the asset or settle their transactions on the Bitcoin L1.

- **BTC, the digital asset,** has traditionally been considered a SoV and an inflationary hedge against turbulent global financial markets. For the first time, its creation provided for a digital, permissionless, censorship-resistant, and scarce global asset. It has remained the top crypto-asset, with a market capitalization of more than $850B and $1.25 Trillion at its peak in November 2021[8]. Yet even today, more than a decade later, BTC remains largely a SoV with little other utility or ability to move beyond that without further developments.

Bitcoin layers provide a solution to this problem. BTC, the asset, is the initial use case of the Bitcoin L1. If Bitcoin layers, such as Bitcoin L2s, can run smart contracts that can use BTC as their asset, the Bitcoin L1 can retain its key benefits of security, durability, and decentralization while allowing infinite experiments to take place on other Bitcoin layers. Applications using BTC as their asset can run L2 rails and settle their transactions on L1. These L2 rails can also inherit an increasing amount of security from the L1 while providing much faster and more scalable transactions. This makes “Building on Bitcoin" possible and redefines the Bitcoin Thesis to make it an asset and a fundamental infrastructure for an expanding Bitcoin economy.

Building on Bitcoin

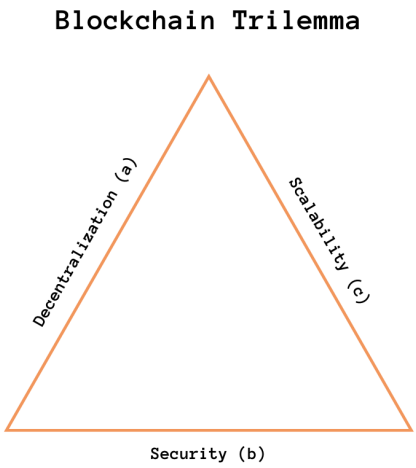
Building on the Bitcoin blockchain has presented unique opportunities and challenges over the years. Unlike other blockchains, Bitcoin began as an asset or ‘money,’ not as a platform for applications, while others began explicitly as application platforms. To grasp why Bitcoin's evolution into a mature ecosystem was delayed relative to other ecosystems, it's essential to look back at its beginnings:

- **The Bitcoin network welcomes all, regardless of background or technical knowledge**. Bitcoin’s code is open-source[9] and can be duplicated and modified. This openness has fostered a culture of experimentation without any single group or individual dictating the direction of the blockchain.

[8] *Bitcoin All-Time High reach on November 10, 2021 - https://www.coingecko.com/en/coins/bitcoin*
[9] *Bitcoin Github Repo - https://github.com/bitcoin/bitcoin*

- **Limited interoperability of the network resulted in distinctive derivatives.** The derivations of Bitcoin are entirely separate networks with their own separate assets and lack "backward compatibility" with the original Bitcoin network. Consequently, in its current state, BTC assets are confined to the Bitcoin network and cannot be directly removed or transferred to other blockchain networks.
- **Lack of programmability creates significant hurdles for building.** Bitcoin is not flexibly programmable since it does not provide smart contracts, which hinders its use as a development platform for applications. This, together with its severe performance limitations, is a key challenge when viewing Bitcoin as a platform to build upon.
- **Bitcoin L1 needs help with speed and scale.** The capability of the Bitcoin network to confirm transactions quickly or to handle large amounts of transaction data on its platform in a short span of time is very limited. Records (known as blocks) in the Bitcoin blockchain are necessarily limited in size and frequency by the critical desire to preserve decentralization. The on-chain transaction processing capacity of the Bitcoin network is limited by the average block creation time of 10 minutes and the original block size limit of 1 megabyte, with an average transaction confirmation time of 10 to 30+ minutes[10], none of which come close to sufficing for most applications.

Addressing these characteristics involves understanding the *Blockchain Trilemma*[11]. Applying it to Bitcoin's L1 reveals a network that is decentralized (a) and secure (b) but lacks direct scalability (c), processing only about 3 to 7.8 transactions per second (TPS)[12]. This limitation highlights the need for alternative solutions or additional layers to compensate for the network's inherent sacrifices.



The urgency for scalable solutions led to the early creation of the Ethereum network, which, despite lacking Bitcoin's security and decentralization, achieved significant growth by providing necessary scalability solutions for application developments like L2s (i.e., Arbitrum, OP Mainnet, etc.), Subnets (i.e., Avalanche's Evergreen), etc. Similar trade-offs have been made across the industry, sparking a wave of development focused on scaling solutions such as Sharding, Nested Blockchains, State Channels, Supernets (i.e., Polygon Edge), App-Chains, and L2s (or sidechains, as some prefer).

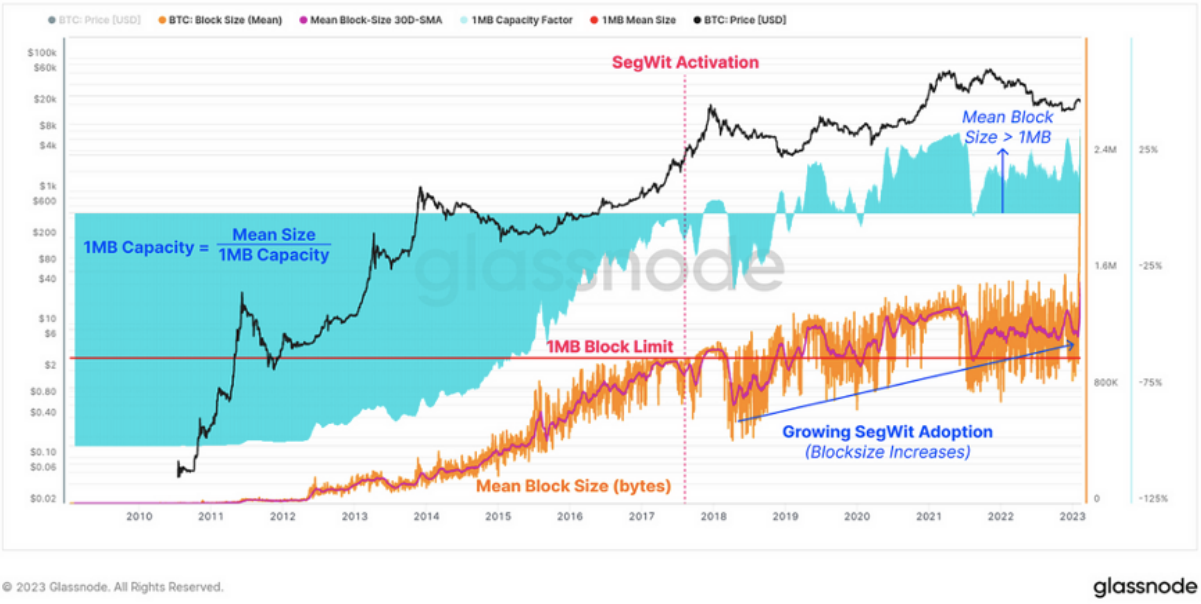
[10] *Median Bitcoin confirmation times - https://www.blockchain.com/explorer/charts/median-confirmation-time*
[11] *CAP theorem is a theory that was developed by computer scientist Eric Brewer that states that it is impossible for a distributed data network to at the same time provide more than 2 out of 3 guarantees: consistency, availability, and partition tolerance (which stands for the acronym CAP). The theory was used as the basis for the Blockchain Trilemma theory which states that it is impossible to build and operate a blockchain protocol that is: decentralized, scalable, and secure - https://www.gemini.com/cryptopedia/glossary#cap-theorem-cap*
[12] *TPS figure based on data sourced on Nov.5, 2023*
https://studio.glassnode.com/metrics?a=BTC&category=&m=transactions.Count&s=1695942000&u=1697093999&zoom=

For years, the focus has predominantly been on Ethereum and Ethereum Virtual Machine (EVM) compatible ecosystems. However, as of 2023, with recent upgrades to Bitcoin L1 and Ordinals, there's been a noticeable shift. Developers are increasingly shifting their attention back to Bitcoin, particularly to address its scalability – a vital component of the Trilemma specific to Bitcoin L1.

Scaling Bitcoin: Key L1 Upgrades

Significant advancements in Bitcoin's scalability began with the Segregated Witness[13] (SegWit) update in July 2017. This upgrade marked a pivotal change by segregating the unlocking code into a dedicated section of each Bitcoin transaction. This reduced transaction times and increased block capacity beyond the initial 1MB limit set by Satoshi Nakamoto in 2010[14].

SegWit introduced a revised block size measurement using Weight Units (wu)[15], later termed as vsize/vbyte, allowing a maximum of 4M weight units (4wu) per block, effectively expanding the block size to approximately 4MB. Designed for backward compatibility with all previous Bitcoin Core versions, this change improved transaction efficiency significantly.

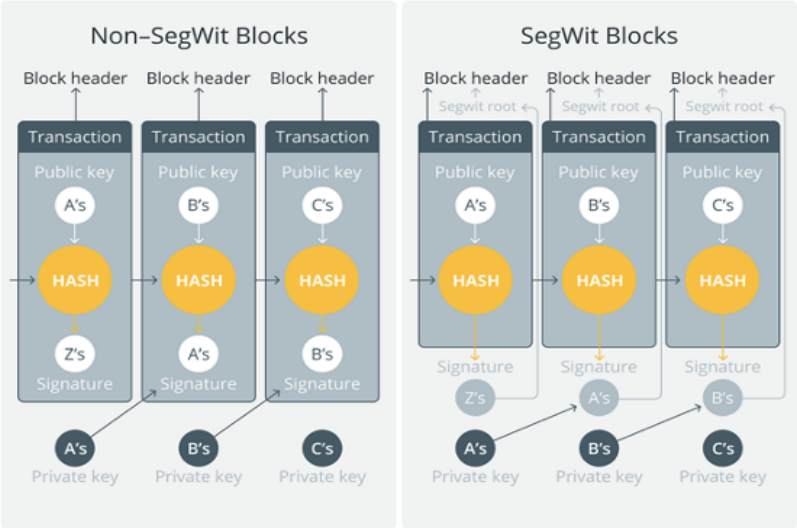


Bitcoin: 1MB Block Size Capacity Factor. Source: Glassnode

SegWit accomplished this via a split data structure separating the "witness" data within a transaction, including the signatures & scripts, to an entirely new part of a Bitcoin block, known as "transaction data," containing details of the sender, receiver, etc. The introductions of this structure split the new 4wu block size into:

[13] *BIP-0141 - https://github.com/bitcoin/bips/blob/master/bip-0141.mediawiki#cite_note-3*
[14] *Source - https://github.com/bitcoin/bitcoin/commit/8c9479c6bbbc38b897dc97de9d04e4d5a5a36730*
[15] *Source - https://en.bitcoin.it/wiki/Weight_units*

- *Witness data* with each vbyte of counting for 1wu or 25% of the weight per vbyte compared to Transaction data.
- *Transaction data* with each vbyte of counting for 4wu or four times the weight per vbyte compared to Witness data.



How is SegWit Different? Source: Cointelegraph

Following SegWit, the next major upgrade was activated in November 2021, known as *Taproot*[16]. It is a soft fork that removed limitations on maximums of per-transaction witness data footprints, leading to faster transactions, enhanced privacy through *Merkelized Alternative Script Trees* (MAST), and more efficient key signatures with *Schnorr*. Taproot also facilitated asset transactions on the Bitcoin L1, introducing protocols like *Pay-to-Taproot* (P2TR) and *Taproot Asset Representation Overlay* (Taro).

- **Taro**, powered by Taproot, is a proposed protocol for issuing, sending, and receiving assets on the Bitcoin L1 and Lighting Network, which in October 2023[17] activated its mainnet alpha launch.
- **Schnorr** signatures unlock key aggregation by introducing the ability to combine multiple public keys and signatures into one. Simply put, combining multiple signatures for verification rather than aggregating individually provides greater transaction efficiency.
- **MAST** hides any preset conditions tied to transactions. Unused outcomes are not published on-chain, giving added privacy and condensing the size of transactions, thus less data usage.
- **P2TR** adds a new method of spending Bitcoin with Taproot addresses.

[16] *Bitcoin Taproot Update Basic Breakdown - https://trustmachines.co/learn/bitcoin-taproot-upgrade-basic-breakdown/*
[17] *Lightning Labs Rolls Out Taproot Assets Mainnet Alpha - https://bitcoinmagazine.com/technical/lightning-labs-rolls-out-taproot-assets-mainnet-alpha*

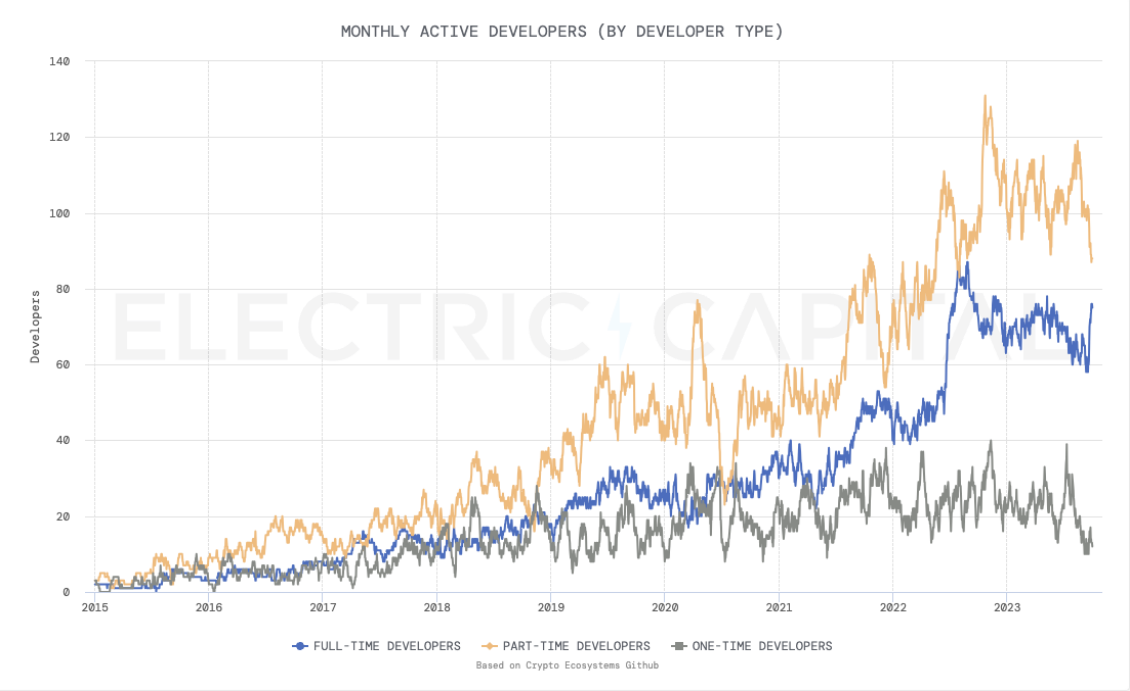
These L1 upgrades laid the groundwork for further development of Bitcoin Layers, which has been happening quietly in the background. It wasn't until the release of Ordinals that building on Bitcoin came under the spotlight again, marking a new era in Bitcoin's scalability and functionality.

Ordinals Revived the Bitcoin Builder Culture

Despite the L1 upgrades, Bitcoin's development activities experienced a period of stagnation following the conservative outcomes of the 2017 "Blocksize Wars"[18] **until 2022.** This relatively slow development pace was largely attributed to the predominant focus on maintaining the Bitcoin core L1, with less attention given to the development of broader infrastructure necessary for an expansive ecosystem. Among the limited development activities on Bitcoin, efforts are primarily concentrated in nascent ecosystems like Stacks (175+ monthly active developers[19]) and Lightning, which comprised a smaller segment of the industry's developers.

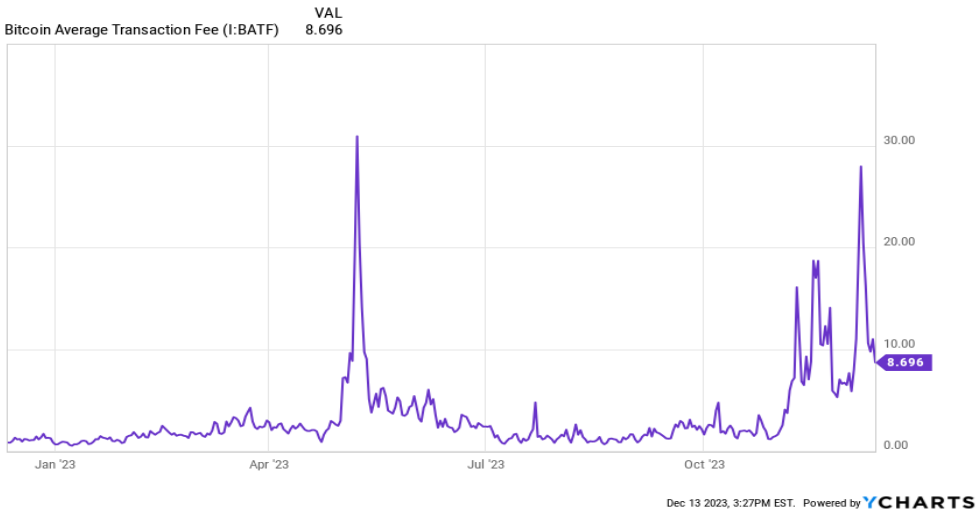
The Bitcoin development landscape has undergone a significant transformation with the advent of Ordinals in December 2022. Ordinals, enabling the creation of immutable on-chain digital artifacts, has not only revitalized the Bitcoin developer community but is also projected to evolve into a substantial $4.5B[20] market by 2025. A growing number of developers are moving beyond their exclusive focus on Ethereum. These developers are increasingly broadening their scope to include a framework for Bitcoin L2s. This pivotal development marks a resurgence in engagement and innovation within the Bitcoin ecosystem, setting the stage for a new era of growth and technological advancement.

[18] *The Blocksize Wars Revisited* - https://www.coindesk.com/consensus-magazine/2023/05/17/the-blocksize-wars-revisited-how-bitcoins-civil-war-still-resonates-today
[19] *Electric Capital's Developer Report Stacks Monthly Active Dev data as of October 1, 2023* - https://www.developerreport.com/ecosystems/stacks
[20] *Bitcoin Ordinals Inscriptions a $5BNFT Market* - *https://www.galaxy.com/research/whitepapers/bitcoin-ordinals-inscriptions-5-billion-nft-market/*



Monthly Active Developers on Bitcoin. Source: Electric Capital

The introduction of Ordinals has had a profound impact on the Bitcoin network, particularly in the increase of transaction fees. In stark contrast to the relatively modest fees of 1-3 sats/vB seen in 2022, there has been a meteoric rise to 20x - 500x in May 2023, when Ordinals first took center stage. Fees have continued going up as much as 280% YTD in December 2023. This increase in fees is a clear indicator of heightened activity and interest in the Bitcoin network, playing a crucial role in rejuvenating the Bitcoin builders' culture and ecosystem. While higher fees contribute positively to the long-term security budget of Bitcoin, surpassing current standards, they also reflect a growing demand for Bitcoin block space.



Bitcoin Average Transaction Fee Peaked in May 2023 Due to Ordinals. Source: ycharts

The surge in Bitcoin's network usage has led to an increased strain on its infrastructure, manifesting in higher transaction costs and posing challenges in terms of affordability and practicality. This trend is particularly evident in cases where users face disproportionately high fees relative to the transaction amount. For example, a Bitcoin transaction worth $100 might incur a fee as high as $50, significantly diminishing its economic viability. Such a scenario extends to Lightning Network channels, where closing a channel with a similar transaction value becomes impractical due to excessive costs. The network faces the risk of further complications if transaction fees reach exorbitant levels, as much as 1,000 sats/vB. This situation underscores the urgent need for scalable solutions within the Bitcoin ecosystem to accommodate growing demand while maintaining transaction feasibility.

The Ordinals phenomenon, while reigniting developer interest in Bitcoin, also amplifies these limitations. Notably, Ordinals' lack of support for fully expressive smart contracts has redirected developer focus towards other platforms. This underscores the need for more sophisticated scaling solutions within the Bitcoin ecosystem, ensuring its utility and relevance in the broader blockchain and financial sectors.

Strategic Imperative of L2 Solutions

As a result, L2 solutions are becoming increasingly essential for Bitcoin network's functionality and success. L2s operate on top of the L1, enhancing scalability and reducing transaction costs by facilitating off-chain transaction channels. Unlike Ethereum, where L1 autonomously supports smart contracts, Bitcoin’s L1 relies on L2s for this functionality, due to its original design prioritizing security and decentralization. This reliance highlights the crucial role of L2 solutions in expanding Bitcoin's utility beyond basic transactions, thereby bolstering its efficiency, scalability, and overall appeal in the digital asset landscape.

Bitcoin's L2 solutions, though still in the early stages of development, are poised for significant growth. Presently, Bitcoin L2s do not exhibit the same maturity level as the scaling solutions of established alternative L1 networks such as Ethereum and L2s like Polygon. These networks have benefited from extensive development efforts since 2017, equipping their platforms with advanced tools (i.e., Starknet, ZKSync, etc.) and capabilities, reflected in their TVL figures, which range approximately between 9.0% and 12.5%[21] of their market capitalizations. The expectation is that, over time and through continued innovation, Bitcoin's L2 solutions will achieve similar levels of development, unlocking a comparable or greater L2 economy. Estimates suggest that Bitcoin L2s are set to manage a substantial portion of all BTC transactions in the foreseeable future, potentially handling over 25% of all BTC transactions, a significant increase from their current minimal share compared to Bitcoin's L1 usage.

[21] *DeFiLlama - https://defillama.com/chain/Ethereum*

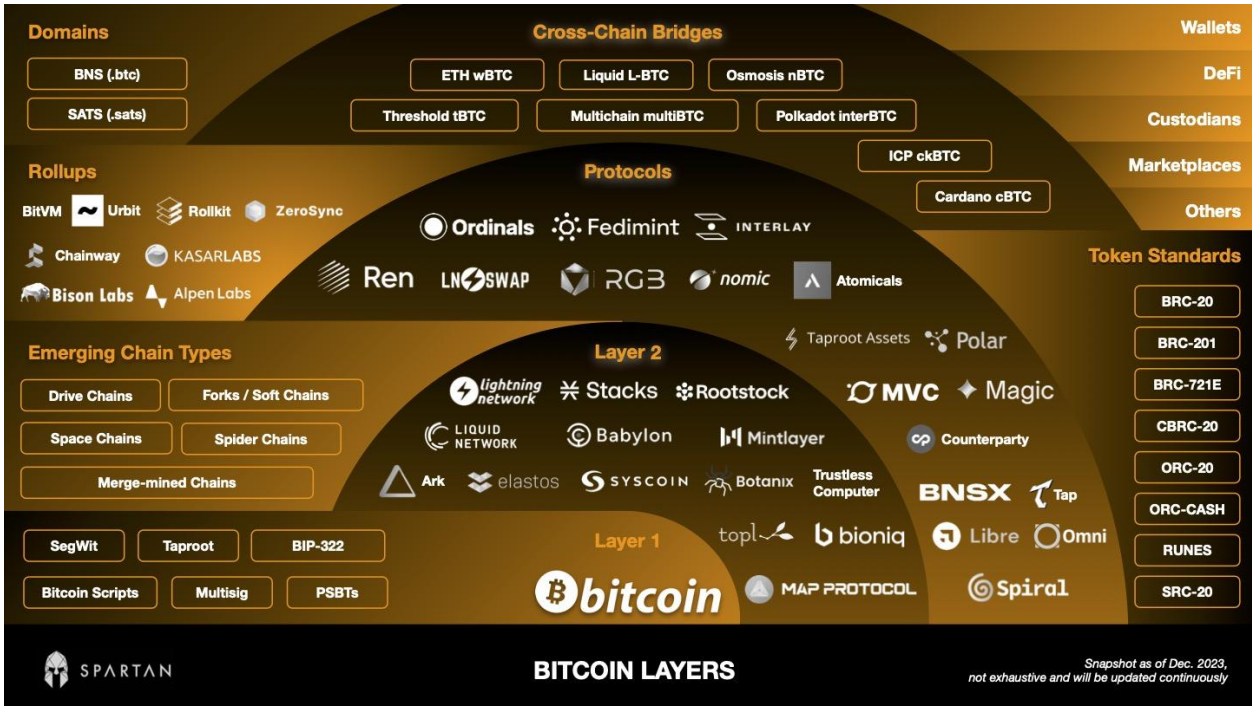
II. Bitcoin Layers: A Renaissance

The concept of "Bitcoin layers," introduced in 2018, represents a pivotal shift in Bitcoin's evolution, tackling its scalability challenges. Historically, various endeavors aimed to enhance Bitcoin's L1 have shared a common goal: facilitating off-chain transactions to improve the network's scalability. These efforts are anchored around the secure settlement layer provided by L1. Bitcoin layers have emerged as a suite of solutions encompassing L2, Layer-3 (L3), Data, and Application layers, etc., drawing insights from Ethereum's layered architecture. These innovations reflect the network's adaptive response to its inherent limitations, showcasing a progressive approach towards a more robust and versatile blockchain infrastructure.

The emerging Bitcoin layers introduce a multitude of functionalities, transforming the network's capabilities. These layers offer:

- **Smart Contract Programmability:** Enabling complex financial and contractual transactions directly on the Bitcoin network.
- **Increased Throughput Speeds:** Significantly reducing transaction processing times, with some layers achieving speeds of less than 30 seconds.
- **Trust-Minimized Movement of BTC to L2:** Facilitating the secure and efficient movement of BTC between layers, providing a solution to the centralization concerns of federated approaches.
- **Cost-Efficiency:** Lowering transaction costs, making Bitcoin transactions more accessible to a wider user base.
- **Asset Issuance and Rollups:** Offering new avenues for asset creation and transaction bundling for efficiency.
- **Interoperability and Privacy Measures:** Enhancing the network's ability to interact with other blockchain systems and protecting user privacy.
- **Virtual Machines (VMs) and Specific Features:** Supporting various applications, including gaming, finance, media, and decentralized science (DeSci).

Strategically built upon Bitcoin's L1, these layers leverage L1 as a foundational platform akin to 'cold storage' for the BTC asset. This layered structure not only allows seamless asset movement across different layers that unlocks Bitcoin’s $850B+ in idle capital. Consequently, applications leveraging these layers benefit from Bitcoin's renowned security and stability.



Bitcoin Layers Landscape (Dec. 2023) [22]

As of Q4 2023, significant strides have been made in Bitcoin layer development, with notable advancements in L2 solutions. The ecosystem has expanded to include Sidechains, Drivechains, Merge-Mined Chains, and Proof-of-Stake Chains. This period also marks the emergence of a diverse array of protocols, token standards, cross-chain bridges, rollups, and other innovative solutions.

These developments are not just technical enhancements; they represent a paradigm shift in Bitcoin's utility, opening new avenues for user adoption and application deployment. The layered approach underlines Bitcoin's ability to evolve and adapt, cementing its position in a rapidly evolving digital world. The following sections detail key innovations within these categories, illustrating the dynamic and forward-looking nature of Bitcoin's layered ecosystem.

Bitcoin L2s: The Big Four

The main Bitcoin Layers to exist have been led by the "Big Four" - *Stacks, Lightning, RSK & Liquid*. These four entities have collectively conducted the majority of L2 transactions, shaping the landscape of Bitcoin's scalable solutions. Each of these L2 solutions has distinct features and functionalities, contributing uniquely to the Bitcoin ecosystem's growth and scalability.

[22] *Snapshot as of Dec. 2023. The market map represents a snapshot of Bitcoin Layers. New experiments, projects, infrastructure, etc., are being created daily. If your project is not listed but would like to be included in future versions, please reach out!*

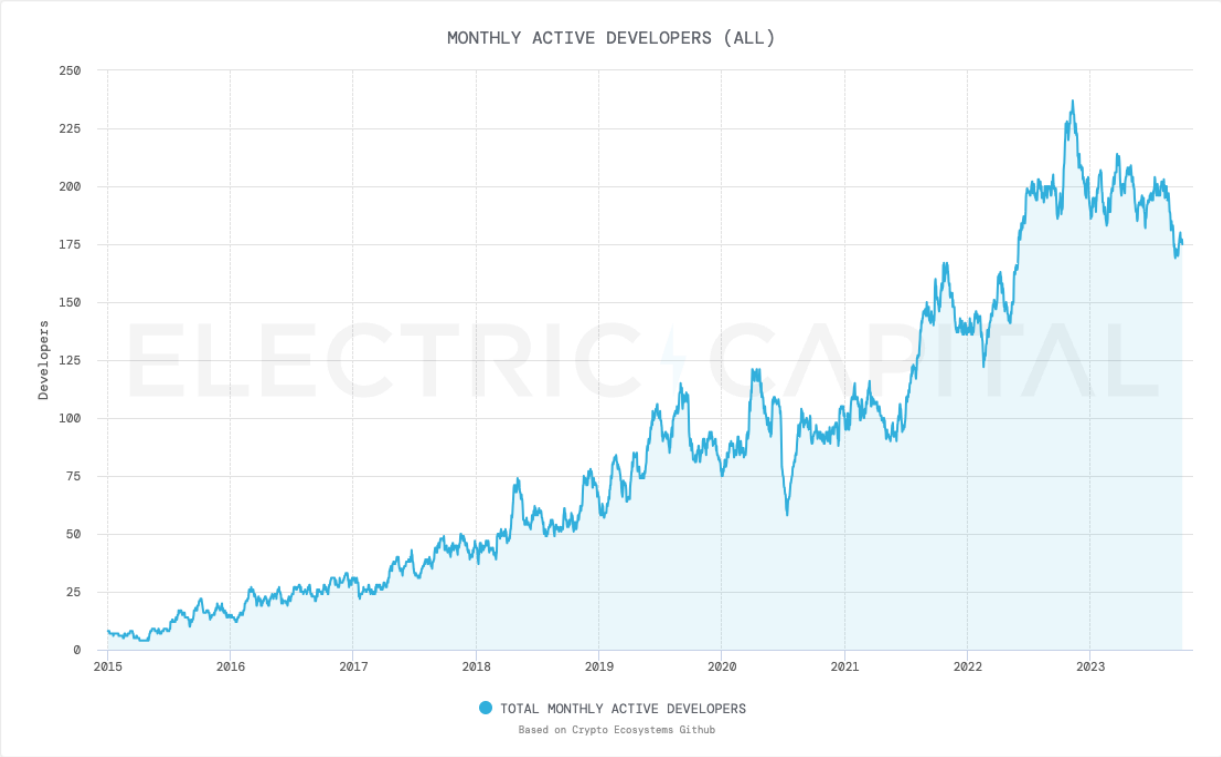
	Bitcoin	Lightning	Stacks	Rootstock	Liquid
Token	BTC	BTC	STX	RBTC (Wrapped BTC)	L-BTC (Wrapped BTC)
Smart Contracts	N	N	Y	Y	Y
Programming Language	Bitcoin Script	Go	Clarity	Solidity	Simplicity
Consensus Mechanism	Proof of Work (PoW)	—	Proof of Transfer (PoX)	Proof of Work (Merged-mined with Bitcoin)	Federated Sidechain
EVM Compatible	N	N	N	Y	N

The Comparison of the "Big Four" of Bitcoin L2s

1. Stacks: The Bitcoin L2 project began in 2017 by Princeton computer scientists Ryan Shea and Muneeb Ali to enable smart contracts for Bitcoin. The initial version of the Stacks Network[23] launched in January 2021, allowing smart contracts and decentralized applications to use Bitcoin as a secure L1. The Stacks Bitcoin L2 activates the Bitcoin economy thanks to its *Proof-of-Transfer (PoX)* consensus mechanism that runs parallel to and reuses the computational power of Bitcoin's *Proof-of-Work (PoW)* consensus**.**

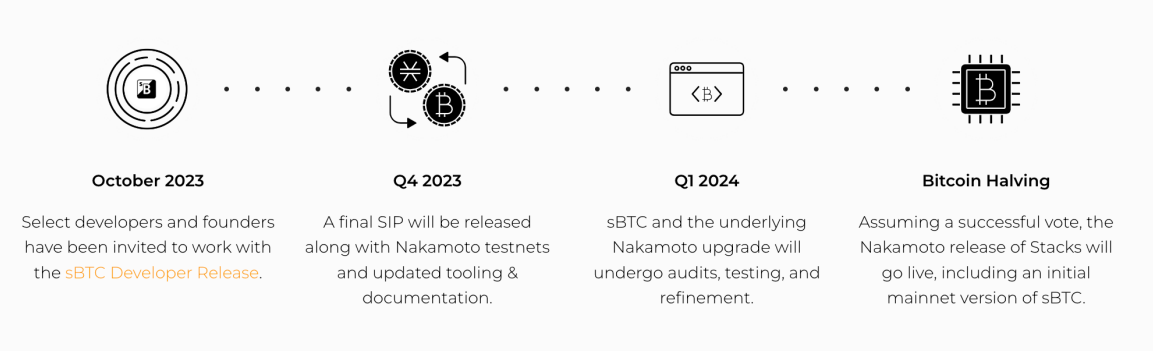
- The network is further secured by "Stacking," in which Stacks token holders commit the network's native STX token ($252.87M[24] in the current Stacking cycle) to validate transactions, secure the Stacks network, and earn rewards in BTC.
- Smart contracts on Stacks are coded in Clarity, a native language that is human-readable and can respond to Bitcoin transactions and atomic swaps of assets with BTC.
- The STX token, which is used as gas on the L2, was the **first-ever SEC-qualified token offering**[25] in 2019 and later decentralized filing updates with the SEC as a non-security before the 2021 mainnet launch.
- STX is a top 50 project and is **the only Bitcoin L2 with a native token** that is also listed in CoinMarketCap's top 100 at the time of writing. It was ranked #38 for developer activity across the industry in the 2022 Electric Capital Developer report[26] with an increasing number of monthly active developers since 2015, with 175 active developers in Oct. 2023.

[23] *Stacks GitHub Repo - https://github.com/stacks-network/stacks*
[24] *Cycle #37, Stacking Club, Dec. 2023 - https://stacking.club/*
[25] *Blockstack Regulation A+ SEC Filing - https://www.sec.gov/Archives/edgar/data/1719379/000110465919020748/a18-15736_1partiiandiii.htm*
[26] *Electric Capital's Developer 2022 Report - https://www.developerreport.com/developer-report*



Monthly Active Developers on Stacks. Source: Electric Capital

- Upcoming Catalysts:
  - **Nakamoto** network upgrade (Q2 2024) will enable Stacks with fast & cheap BTC transfers on an L2 with 100% of Bitcoin security (reorg resistance). Additionally, transaction speeds on the network will improve from the current 10-30+ minutes settlement times that mirror Bitcoin to be reduced to ~5-second blocks, a 1,000x improvement in between two Bitcoin blocks. As of December 2023, two major milestones in the upgrades development had been achieved, v0.1 known as "Mockamoto" and Neon (v0.2) the "controlled' testnet featuring a single miner, single Stacker, and Stacker signing.
  - **sBTC**, a decentralized 1:1 Bitcoin-backed asset that can be deployed and move BTC between Bitcoin and the Stacks (L2) and used as gas in transactions without requiring additional assets. sBTC transfers are 100% secured by Bitcoin hash power. For a transaction to be reversed, an attack must be made on Bitcoin itself.



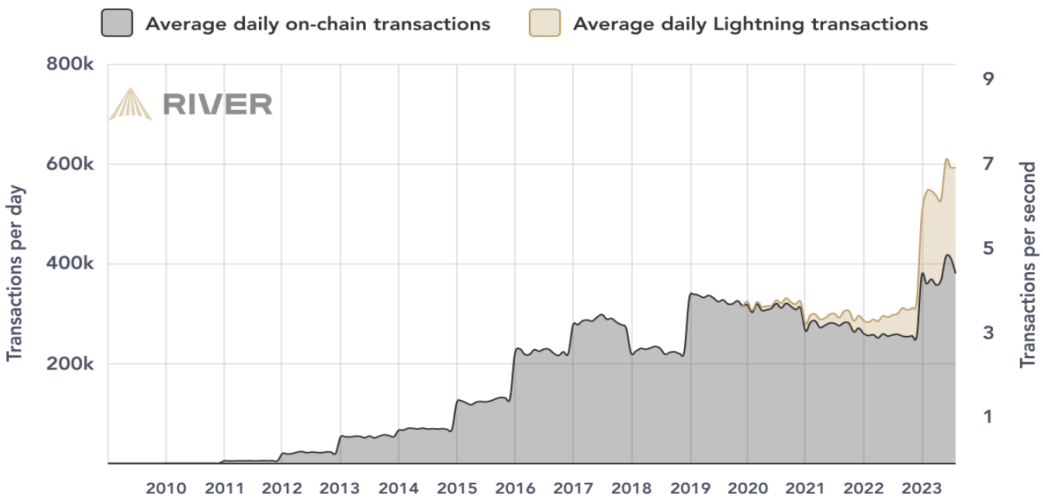
sBTC Release Roadmap. Source: sBTC

- The resulting Stacks layer makes Bitcoin a fully programmable asset in a decentralized manner. In succeeding, it will drive more demand for both Stacks and Bitcoin. This can provide an environment for the Bitcoin economy to accelerate, unlocking hundreds of billions of dollars of passive Bitcoin capital and making Bitcoin the backbone of a more secure web3.

2. Lightning Network: Released in 2018 (whitepaper in 2016), Lightning enables micropayments on Bitcoin that can be sent instantly, anywhere, for little to no cost. Lightning's significant transaction handling capacity and its increasing adoption underscore its role in enhancing Bitcoin's scalability and transaction efficiency.

- The protocol leverages smart contracts to create payment channels combining on-chain settlement and off-chain processes.
- As a channel is closed, the transactions are consolidated and sent to the underlying network, Bitcoin. Lightning's native asset is Lightning Bitcoin (BTC).
- The network is handling ~6.6M routed transactions in August 2023, or about ~213K per day, representing ~52% of the public capacity on the network[27]. These approximate figures are a 1,212% increase since the August 2021 estimate of 503K Lightning payments by K33.
- Additionally, on average, Lightning is processing at least 47%[28] of Bitcoin's on-chain transactions daily.

[27] *River Research Report. The Lightning Network Grew by 1,212% in Two Years, pg 2 Oct. 2023*
[28] *River Research Report. The Lightning Network..., pg 7, Oct. 2023 - https://river.com/learn/files/river-lightning-report-2023.pdf*



Lightning is increasing Bitcoin's transactions per day. Source: River

3. Rootstock (RSK): Founded by RSK Labs in 2015, the network brought EVM-compatible smart contracts to Bitcoin through its RSK Virtual Machine (RVM). With RVM, developers can port Ethereum contracts on top of Bitcoin. RSK's native asset is Smart Bitcoin (RBTC). RBTC maintains a 1:1 peg with BTC but is not trustless. It continues to depend on centralized custodians due to its security of blocks being based on "merged mining," highlighting the trade-offs between security and decentralization in L2 solutions.

4. Liquid Network: Released in 2018 by Blockstream, the Liquid Network sidechain enables users to perform fast, secure & confidential transactions on Bitcoin. Liquid operates independently of Bitcoin and has its own ledger, and forgoing leveraging Bitcoin's PoW consensus mechanism in favor of the Liquid Federation, made of ~60 members who serve as the creators of new blocks. Liquid's native asset is Liquid Bitcoin (L-BTC), a "wrapped" version of BTC. This independent operation of Liquid Network showcases the diversity of approaches within Bitcoin's L2 ecosystem.

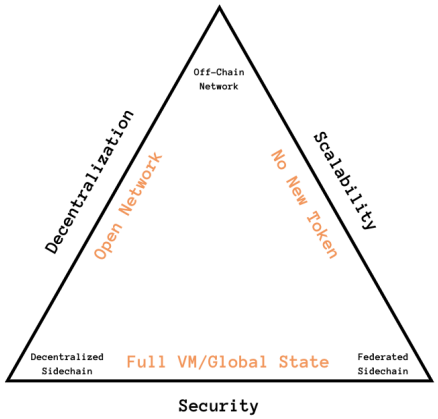
Today, while no single Bitcoin L2 holds more than 10,000 BTC or boasts a user base in the millions, the potential for exponential growth remains vast, underscoring the critical role of these solutions in Bitcoin's future scalability and functionality. As Bitcoin L2s improve technically, they have begun to open multiple pathways to enable rapid experimentation around BTC while maintaining the stability of the core network. The success of future L2 solutions hinges on their ability to offer full execution environments akin to EVMs, addressing the current limitations and fostering a more inclusive development landscape.

Navigating The L2 Trilemma

In the pursuit of unlocking scalability within the Bitcoin Layers, a new issue has arisen: the L2 Trilemma. Revisiting Blockchain's Trilemma but applying it to Bitcoin L2s, we see that it remains all the same with slightly different tradeoffs. With the L2 Trilemma, the choices are limited to:

A. Be an Open Network or a Federation.
B. Introduce a new Token or not.
C. Have a full/global virtual machine (VM) or have limited off-chain contracts.

Bitcoin Layer-2 (L2) Trilemma



Attempts to solve: Merged mining, Drivechains (soft fork), validity rollups (soft fork)

The industry has witnessed attempts to square this triangle to reuse the existing set of Bitcoin miners to mine the L2. RSK (formerly Rootstock) and Drivechains are examples of those making these attempts. In the approach, incentives for miners become an open question, similar to how gas fees, particularly in the early years, may not be enough for incentives.

- Lightning has chosen A and B but has no global state of full VM.
- Stacks has chosen A and C with a new token (STX).
- Liquid has chosen B and C, operating as a Federation.

Early discussions amongst developers have circulated around new Opcodes at Bitcoin (L1), which, in theory, could help square today's triangle. The new op-code, like that of the op-snark-verify, could be used at Bitcoin (L1) to verify the computations of the L2. However, the historical challenges associated with implementing Softforks or Hardforks like this in Bitcoin suggest that this solution may not be feasible in the short term.

Looking ahead, the Bitcoin ecosystem will likely expand beyond the current handful of L2 solutions, with a need for hundreds more to fully explore and develop the network's potential. For now, developers are navigating these choices to balance the tradeoffs in the L2 Trilemma. A trend is emerging towards leveraging open networks where anyone can mine and freely enter/exit, providing full virtual machine (VM) environments for smart contracts with the global state as essential properties. This approach, mirroring successful structures in other blockchain ecosystems like Ethereum and Solana, is expected to shape the future trajectory of Bitcoin's L2 advancements.

Emerging Innovations

Rapid experimentation continues to occur beyond the established Big Four, surfacing numerous projects across infrastructure tooling, standards, and protocols. As the technical stack takes shape, filling the existing technical gaps in application demand, these innovations are actively introducing new categorical definitions.

Ark is an experimental L2 protocol introduced in May 2023. Ark allows users to conduct off-chain, scalable Bitcoin payments at low costs and anonymously through its always-on, trustless intermediary, the Ark Service Provider (ASP), that provides liquidity to the network. As transactions are conducted on the protocol, recipients can receive payments without acquiring inbound liquidity while preserving receiver privacy at lower costs than Lightning[29].

Babylon, released during Cosmoverse 2023, Babylon is a Proof-of-Stake (PoS) network comprising two security-sharing protocols between Bitcoin and other PoS networks, Bitcoin timestamping and bridge-less staking.

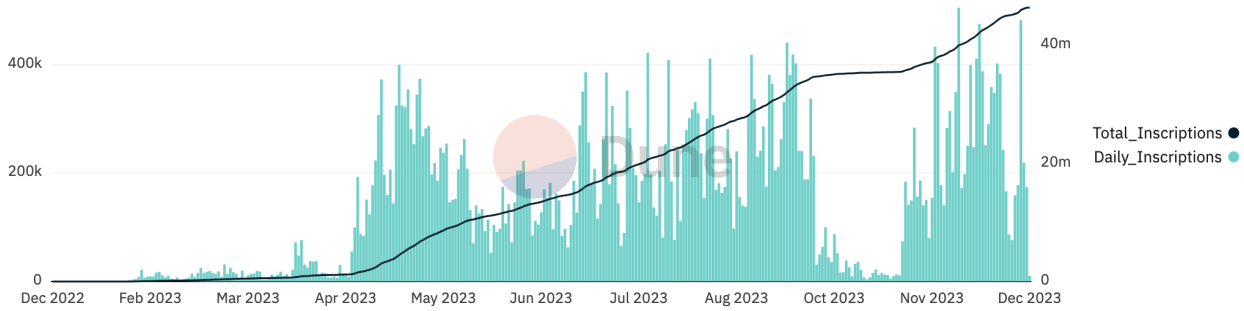
Botanix (Spiderchain L2) is a Proof-of-Stake (PoS) EVM for Bitcoin that leverages a distributed network of multi-signatures, facilitating a two-way peg with Bitcoin and enhancing its interoperability.

Interlay is a modular and programmable network between Bitcoin and multi-chain ecosystems, operating as a Polkadot Parachain. Interlay created a decentralized Bitcoin bridge that enables the minting of iBTC, or "valuated BTC," its multi-chain 1:1 Bitcoin-backed asset.

MintLayer is a Proof-of-Stake (PoS) network designed to act as a sidechain to Bitcoin, optimized for DeFi-related activities, including atomic swaps. With MintLayer, there's no need to use a wrapped version of Bitcoin or smart contract languages (i.e., Solidity, etc.) to create a token, as the network is UTXO-based and would require creating a transaction with additional data embedded into it. The network aims to produce a block every 120 seconds using verifiable random functions, with finality after 1,000 blocks.

Ordinals. Released in June 2022[30], the innovative Ordinal Theory framework sparked a cultural revolution towards building on Bitcoin. Only months after its release, in December 2023, developers took to Ordinals (Ord) which requires no separate side-chain, token, or updates to the Bitcoin core and enables Bitcoin inscriptions. Inscriptions that are immutable on-chain, non-monetary digital artifacts (i.e., Bitcoin NFTs) containing raw file data (videos, audio, images, executable software, etc.) that are permanently recorded on Bitcoin and can be transferred or sent to Bitcoin addresses, wallets, etc.

[29] *Source* - https://brqgoo.medium.com/introducing-ark-6f87ae45e272
[30] *Ordinals GitHub Repo - https://github.com/casey/ord/releases/tag/0.0.2*



Number of Inscriptions. Source: Dune

Ordinals' dramatic growth has only grown exponentially, with new experiments, infrastructure tooling, and standards. In the year since the first inscription occurred on December 14, 2022, over 460K total inscriptions were inscribed during the first 90 days[31], and more than 46.2M year-to-date, driving ~3,365 BTC (~$148.8M[32]) in fees during the period.

RGB Network (Really Good Bitcoin) is a Bitcoin-based protocol leveraging the Lightning Network and is not a token protocol.

Threshold Network is a privacy-focused merged network between Keep and NyCypher, allowing users to leverage Keep Network's ability to secure private data through off-chain containers and NuCypher's privacy tools for secrets management and dynamic access control. Threshold is the creator of the tBTC Bitcoin Bridge, a decentralized and permissionless bridge between Bitcoin and Ethereum.

These protocol experiments represent just a fraction of those developers are releasing every week. The continuous introduction of new protocols and standards indicates a vibrant and evolving landscape for Bitcoin's technical stack. The momentum generated by these developments, particularly in the context of the upcoming Bitcoin halving event in Q2 2024, suggests a promising trajectory for further innovation and adoption within the Bitcoin ecosystem.

The Rise of Token Standards

On the heels of several emerging protocols, the community has begun experimenting with new token standards as well, giving an early preview of token designs that could leverage Bitcoin's unique architecture. While in their infancy, it's important to highlight those that have been introduced to developers and note the similarities to their counterparts in the Ethereum ecosystem.

[31] *Reference data through 3/14/23, Bitcoin Ordinals Inscriptions Analysis - https://dune.com/queries/2008613/3324931*

[32] *Reference price of BTC on 12/6/23 - 44,221.00 USD*

BRC-20 is an experimental token standard created by DOMO and released in early March 2023 to create fungible tokens on Bitcoin. Utilizing Ordinal inscriptions and JSON data, this standard mirrors Ethereum's ERC-20 model but is tailored for Bitcoin's ecosystem with limited functionality. Several platforms soon followed, rapidly developing tooling and launchpads (ALEX, Bitget, Leather, OrdinalsBot, UniSat Wallet, Xverse, etc.)[33] for the experimental token standard. Notably, the ORDI token, the first to be deployed under this standard, achieved a market cap exceeding $1B by May 2023, ranking #52 on CoinMarketCap with a market capitalization of over $1.3B at the time of writing.

BRC-721E is an experimental token standard similar to the widely adopted ERC-721 brought to life in collaboration between Bitcoin Miladys, Ordinals Market, and Xverse. In its initial state, the experimental standard allows users to bridge NFTs from Ethereum to Bitcoin, inscribing a less detailed version of the NFT with a link back to the original Ethereum version and airdrop capabilities. Once an NFT has been bridged, it will automatically appear on the Ordinals Market. The experiment opens many possibilities for cross-chain interactions between the two networks.

ORC-20 is an experimental open token standard with the intention of improving upon the BRC-20 experiment with backward compatibility between BRC-20, flexible naming space, and the introduction of UTXOs to prevent double-spending in future developments.

ORC-CASH is an experimental token standard based on the Ordinals Protocol, designed to best suit the UTXO security model and as a simplified version of the ORC-20 standard.

RUNES is an experimental fungible token protocol proposed in September 2023 by Ordinals creator Casey Rodarmor as an alternative to the BRC-20 standard. Runes intend not to rely on off-chain data or demand a native token but instead hold balances by UTXOs, and transactions are identified using specific script conditions.

SRC-20 is a token standard created by Mike In Space, known as Bitcoin Stamps (Bitcoin Secure Tradeable Art Maintained Securely), which are digital artifacts stored directly on Bitcoin's blockchain and cannot be pruned as they exist in the UTXO set (unsent transactions).

STX-20 is an experimental inscription protocol standard released in Dec. 2023 for creating and sharing digital artifacts on the Stacks blockchain by embedding protocol information, limited to a 34-symbol limit, within the metadata of STX token transfers. The release of STX-20s led to one of the largest blocks to occur on the Stacks network with over 10,000 transactions.

Privacy and Security Solutions

[33] *BRC-20 Token Standard Integrations - https://mythbtc.xyz/brc-20-integrations/*

In addition to scaling, developers have contributed great efforts towards bringing rollups to Bitcoin and adding a significant layer of security as well. While in early development, some of the notable experiments in the category include Urbit, Rollkit, ZeroSync, Alpen Labs, Bison Labs, Chainway, Kasar Labs, and many more.

Other experiments in the ecosystem include purpose-designed protocols and more, such as 1btc, BNSx, and Rooch Network, with new emerging categorical definitions such as Drivechains, Spiderchains, Federated Chains, Spacechains, and Softchains, each witnessing projects developed with the intent to contribute to the expansive technical stack.

These innovations enhance the network's intrinsic value and position Bitcoin as a more versatile and secure platform. They are pivotal in scaling the network and improving its capacity to support various applications. As these technologies continue to evolve, they are expected to significantly contribute to the network's ability to handle increased transaction volumes and diverse applications while maintaining the foundational principles of privacy and security. The end goal is to create a smooth enough user experience without worrying about the supporting infrastructure.

The Future of Finance with Bitcoin

Bitcoin layers, marked by advancements in Layer-2 solutions and privacy-enhancing technologies, are shaping a trustless financial ecosystem. These developments represent a significant shift in Bitcoin's functionality and potential influence on the financial sector. With its enhanced privacy, security, and scalability, Bitcoin is poised to support a broad spectrum of financial applications, ranging from traditional trading to innovative DeFi solutions. This transformation underscores Bitcoin's growing role as not just an asset but a foundational element in a more secure, efficient, and inclusive financial landscape. As these technologies gain adoption, Bitcoin's contribution to a trustless financial system becomes increasingly central, cementing its position as a key pillar in the future of finance.

III. Towards a Trustless Financial System on Bitcoin

The Bitcoin ecosystem in 2023 is buzzing with an excitement reminiscent of Ethereum's community in 2017. Enthusiastic builders, investors, and community members are exploring various possibilities across Bitcoin Layers. Given Ethereum's impressive trajectory, Bitcoin, with its industry-leading market cap and BTC dominance, stands on the brink of surpassing even those heights. Just as Bitcoin revolutionized trust when it debuted in 2009, the Bitcoin ecosystem is now at another crucial point where it is much closer to fulfilling its original promise, paving the way for a genuinely trustless financial system rooted in its core L1 technology.

The Bitcoin L2 market opportunity is by far the largest in the Bitcoin economy. To establish any case for the total Bitcoin L2 market opportunity, the focus would be on the existing market for Ethereum L2s. In the estimates below for the L2 market cap on Bitcoin, the guiding ratio of TVL for all Ethereum L2s to Ethereum's overall market cap, which is approximately 5.62%[34] at the time of writing, was utilized and applied to Bitcoin's market cap.

- **Bear case**. The bear case suggests that the Bitcoin L2 market cap can reach a market value of $4.8B, only ~10% (0.56%) of the total Ethereum L2 market at the time of writing.
- **Base case**. The base case suggests that the Bitcoin L2 market cap can reach a market value of $24B, only ~50% (2.81%) of the total Ethereum L2 market at the time of writing.
- **Bull case**. The bear case suggests that the Bitcoin L2 market cap can reach a market value of $48B, matching 100% (5.62%) of the total Ethereum L2 market at the time of writing.

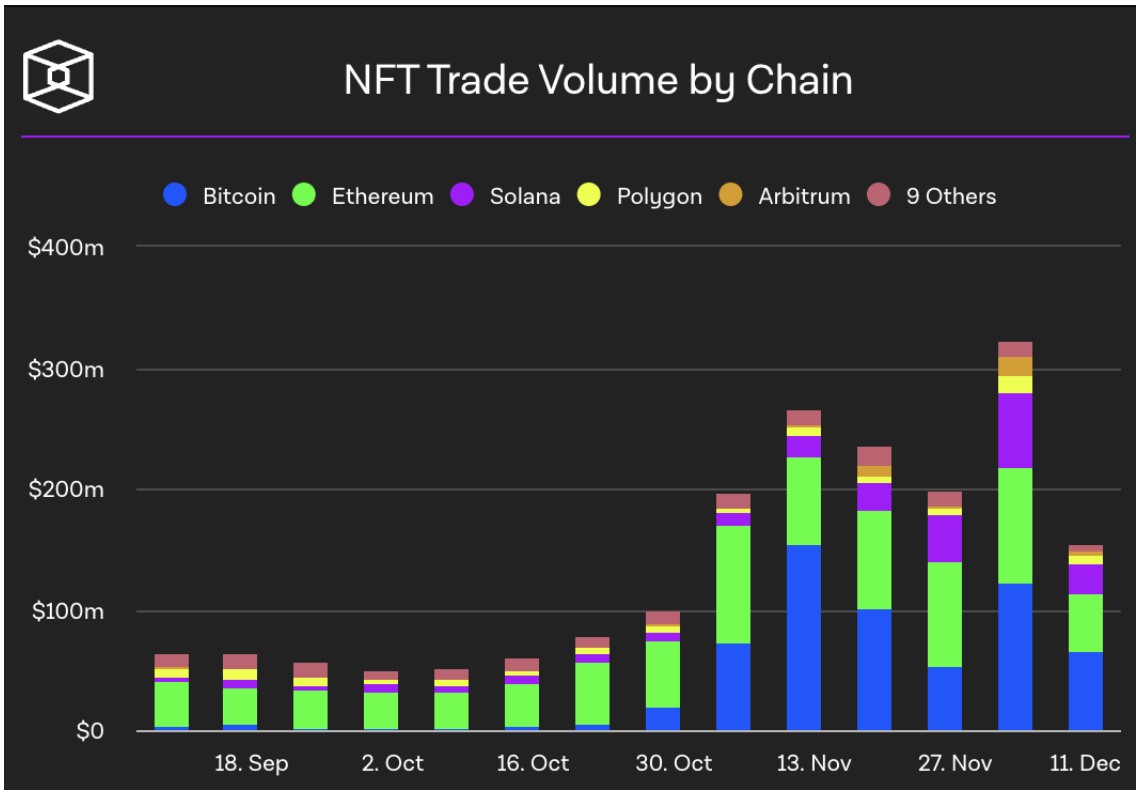
With current market sentiment surrounding Building on Bitcoin, the projections are based on a two-year time horizon, with no additional YoY growth calculated, and assume Bitcoin L2s continue to expand. The accelerated development in Bitcoin L2s and protocol standards, correlated with existing infrastructure today provide key elements in estimating that the **Bitcoin L2s will reach a $24B market cap by 2025.** The potential roadmap and industry events described in the following section will likely impact our bear, base, and bull case scenarios.

Immediate Outlook: Sustained Cultural Influence of Ordinals

In the short term, the cultural impact of Ordinals remains a significant driver in the Bitcoin ecosystem. The unique allure of Ordinals, whose ability to integrate art and collectibles into the Bitcoin blockchain, resonates deeply with a community that values authenticity, creativity, and permanence. This cultural resonance cemented the place of Ordinals within the Bitcoin landscape and continually attracted and retained a diverse audience. By tapping into the zeitgeist of the digital age, they are expanding the reach and influence of Bitcoin far beyond its original confines.

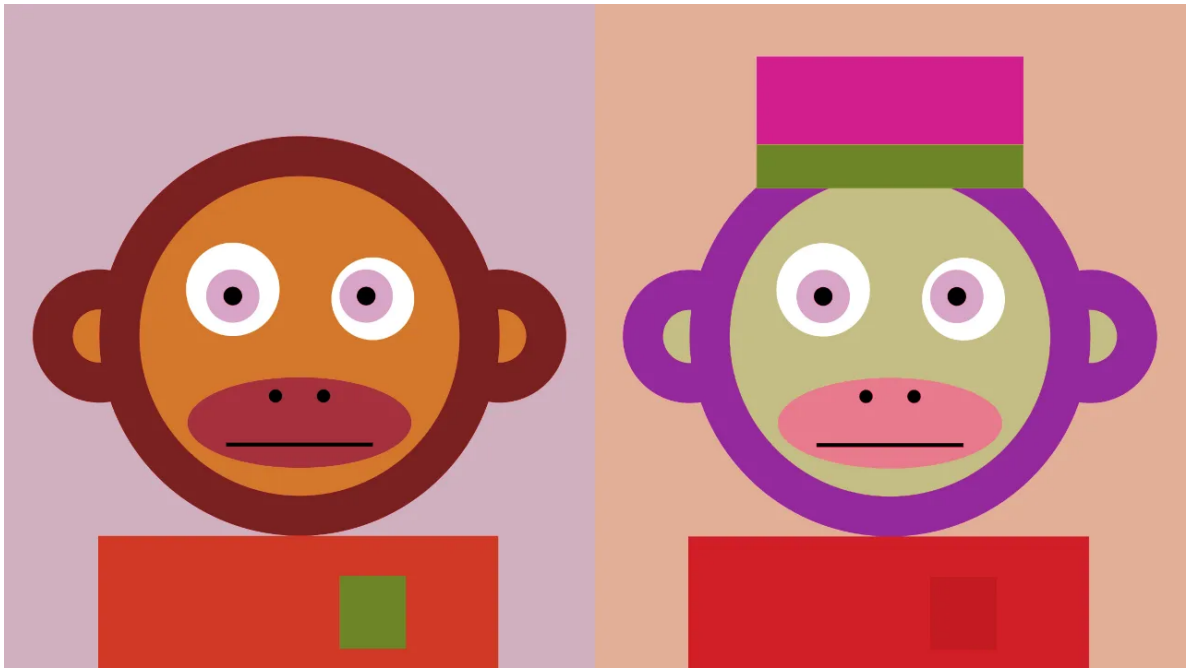
[34] *Source: Ethereum L2 TVL data from L2Beat - https://l2beat.com/scaling/summary*

As of the end of 2023, the rapid adoption of Ordinals has led to Bitcoin becoming the one of the largest NFT platforms, overtaking Solana, even without smart contract capabilities. Over the month of Nov., Bitcoin NFT (Ordinals) has seen a staggering 500%[35] increase in sales volume, surpassing Ethereum's and Solana's figures for the same period. While Ordinals have only been around for about a year, data suggests that assets deployed on Bitcoin can also garner higher value due to its immutability and permanency when stored on the Bitcoin network.



NFT Trading Volume by Chain. Source: The Block, CryptoSlam

[35] *Source - https://www.theblock.co/data/nft-non-fungible-tokens/nft-overview/nft-trade-volume-by-chain*



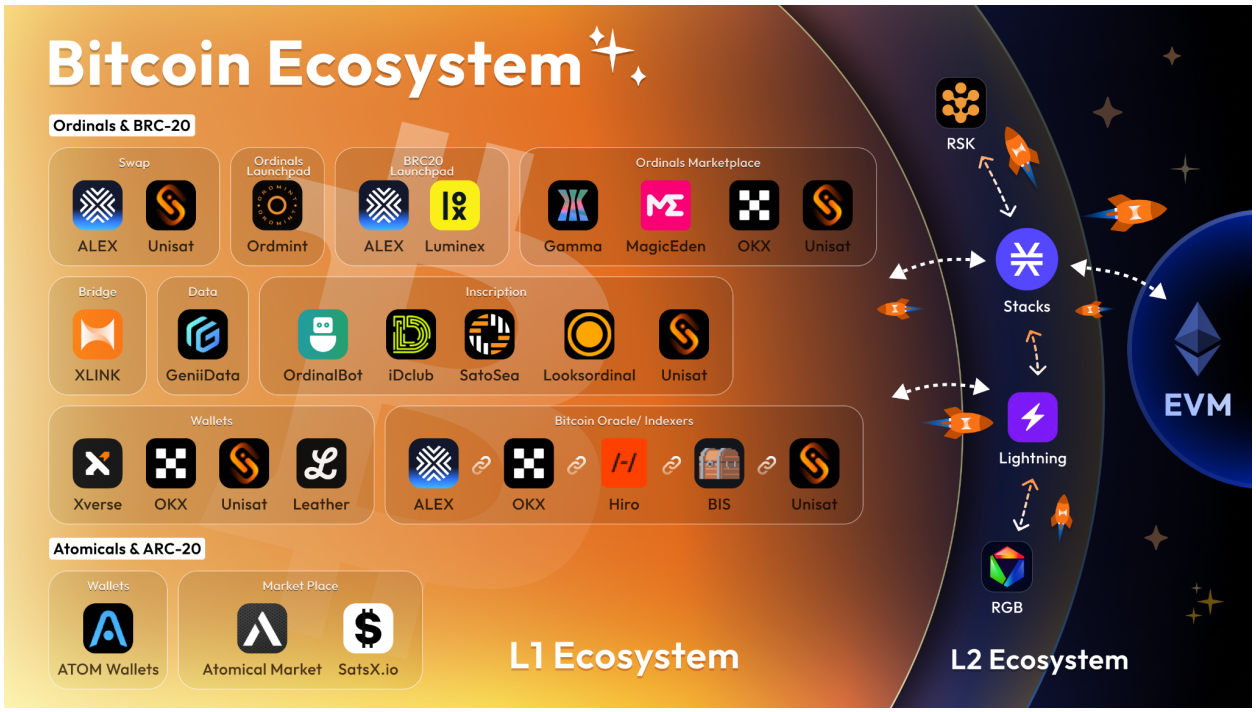
OnChain Monkey NFTs Double in Price After Creators Put Them on Bitcoin. Source: Metagood

The rising popularity of Bitcoin NFTs, exemplified by events like the doubling of OnChain Monkey NFT prices post-integration with Bitcoin, indicates a growing curiosity among users. This will naturally lead users to explore further within the Bitcoin ecosystem, eager to delve into other use cases such as DeFi and gaming. While this curiosity paves the way for significant shifts, many innovations are still happening on the protocol level, as there remain inherent limitations on the transaction speed, smart contract compatibilities, and scaling as mentioned.

- Many early-stage projects in the ecosystem, for instance, are not able to issue tokens that have the same utility and governance capabilities as those on Ethereum (e.g., BRC-20 vs. ERC-20).
- These projects then have to rely on equity fundraising and are unable to bootstrap the community by leveraging tokens of their own.
- Solutions include issuing fungible tokens on Stacks, which provide smart contract capabilities with the SIP-10[36] fungible token standard, or other nascent token standards.
- Dual-sided bridges, like MultiBit for cross-network transfers between BRC-20 and ERC-20 tokens, are emerging to address these gaps. Nevertheless, these solutions are not definitive.

[36] *SIP 10 - Fungible Token Standard - https://github.com/stacksgov/sips/blob/main/sips/sip-010/sip-010-fungible-token-standard.md*

Ongoing innovation is essential to overcome these challenges. As L2s continue to make progress toward reducing transactions and simultaneously inheriting 100% Bitcoin finality. In parallel, innovations are percolating through Bitcoin L1. Developers and enthusiasts are already experimenting with use cases despite these challenges.

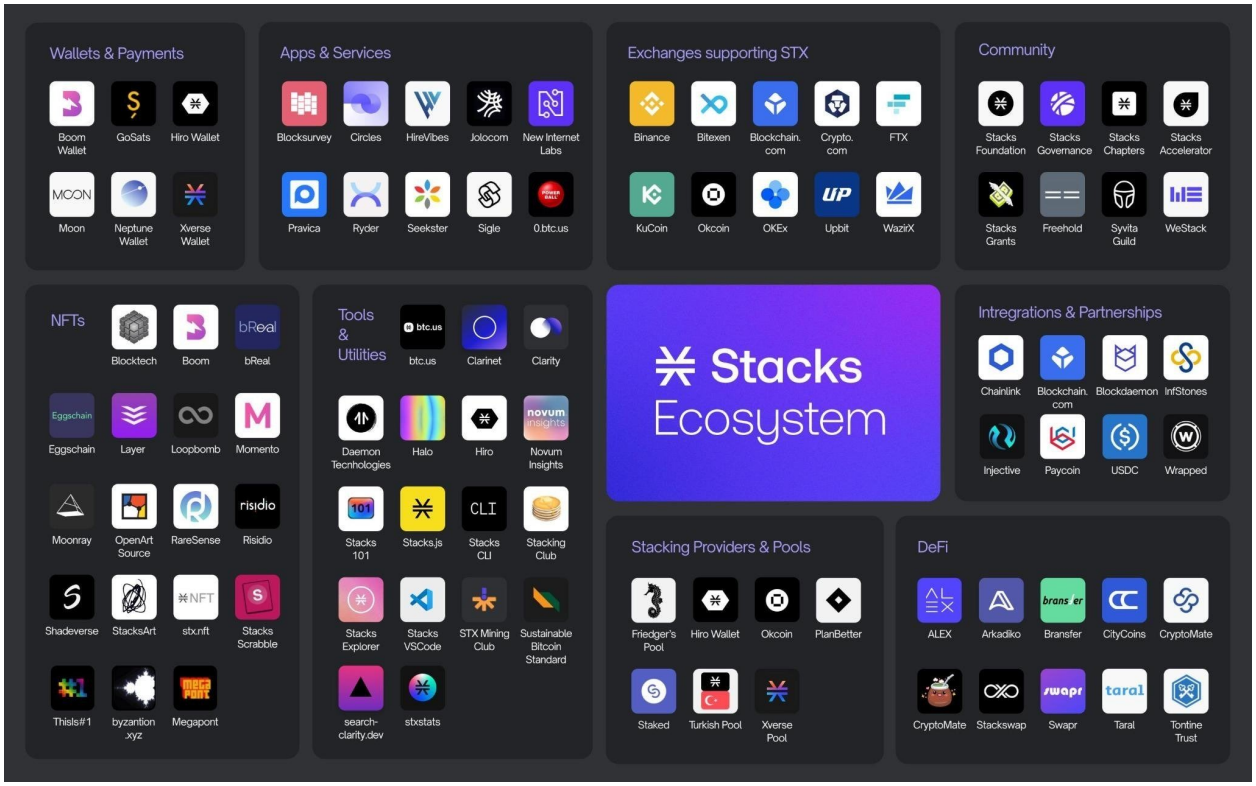


Most of the innovations we see today still percolate through Bitcoin L1. Source: ALEX

Mid-Term: Breakthroughs in Bitcoin L2s and Emerging Use Cases

The Bitcoin ecosystem is poised for significant breakthroughs in the mid-term, primarily driven by advancements in L2 technologies like Stacks' Nakamoto Release and the introduction of sBTC[37]. These developments are not merely incremental but transformative, especially in the realm of Bitcoin DeFi and other applications.

[37] *SIP 021: Trustless Two-way Peg to Bitcoin - https://github.com/stacksgov/sips/pull/113?ref=stacksroadmap*



A map of the growing ecosystem of Stacks and smart contracts for Bitcoin. Source: Stacks

The significant reduction in block times (from 10+ minutes to 5 seconds) and enhanced security are instrumental in crafting a smooth, 'Ethereum-like' user experience, which is essential for attracting new developers and catalyzing a cycle of adoption and innovation.

- The implementation of fast blocks and sBTC will enable Stacks to offer high-performance, BTC-denominated applications such as a NFT marketplace, facilitating more efficient trading of Ordinals and unique L2 NFT collections.
- The DeFi landscape on Bitcoin is expected to undergo considerable expansion, such as lending and borrowing, which are made possible with sBTC. The Zest Protocol team is already building this in advance on Stacks.
- ALEX is preparing for all DeFi functionalities, having recently surpassed 500M transaction volume and has already built the foundation for an sBTC-denominated swaps market for other sub-tokens. Each of these different applications can be explored all while generating an automatic yield based on Stacks.

Unleash the Bitcoin market cap by creating user adoption flywheels like Ethereum. As infrastructure continues to mature, a range of new use cases across all Bitcoin layers will emerge, gaining traction with end-users. The Bitcoin ecosystem not only has the biggest potential TVL in the industry but also has a larger target audience - building for mainstream users. Some of the key developments that set up the ecosystem for success include:

- Trust Machines is building Bitcoin applications with the objective of growing the Bitcoin economy by presenting new use cases for Bitcoin that can maximize the network's value.
- To prepare for the expected influx of developers, Hiro is enhancing developer tools across Bitcoin layers.
- Wallets like Xverse, Leather, and Ryder among others are focusing on seamless user experiences for mass adoption, compatible with various assets across Bitcoin Layers.
- Bigger centralized exchanges started Ordinal Marketplaces soon after it gained popularity, such as Binance, Magic Eden, and OKX. Other marketplaces also sprouted quickly, including Ordzaar, Gamma and more. On-chain Monkey also recently launched its own marketplace Osura.
- Other notable developments include the launch of the first-ever Bitcoin-based game by Ordz Games, which introduced its BRC-20 token, $OG.
- The friend.tech project New Bitcoin City, built on Bitcoin L2 NOS by Trustless Computer, which has surpassed $1M[38] in TVL in October 2023.
- StackingDAO brought liquid stacking functionality to the Stacks with the introduction of liquid STX (stSTX) in December 2023.
- Additionally, Darewise, part of Animoca Brands, is pioneering a metaverse built on Ordinals, showcasing the expanding realm of possibilities within the Bitcoin ecosystem.

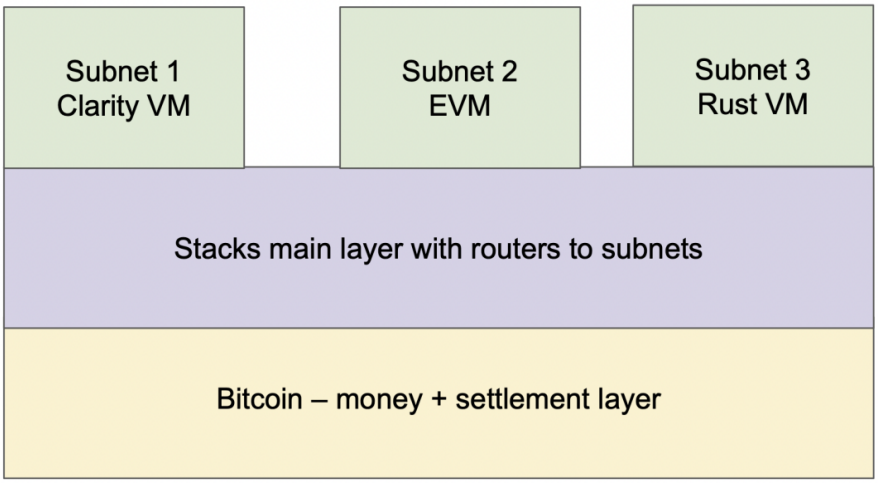
Snapshot of Bitcoin Applications as of Dec. 2023[39]

[38] *Source - https://www.theblock.co/post/256557/social-finance-apps-tomo-and-new-bitcoin-city-break-above-1-million-in-tvl*

[39] *The market map represents a snapshot of Bitcoin applications. New experiments, projects, applications, etc., are being created daily. If your project is not listed but would like to be included in future versions, please reach out!*

Ultimately, this L2-driven Bitcoin ecosystem expansion is not only about adding new features and attracting new users but also about weaving Bitcoin more intricately into the global blockchain economy. Projects like ALEX are at the forefront of this movement, designing BTC-native permissionless yield-bearing stablecoins and BTC cross-chain bridges such as XLink to connect Bitcoin to Ethereum and other ecosystems. These initiatives are crucial in fostering a Bitcoin ecosystem that is not only more interconnected but also more productive, setting the stage for a wide array of financial innovations and services across the industry in the long term.

Additionally, the development of further scaling solutions on Stacks is set to significantly enhance the interoperability of the Bitcoin ecosystem with other blockchain networks on the L2 level. With the upcoming Nakamoto upgrade, Stacks will introduce new subnets that support a variety of programming languages and execution environments, including EVM subnets and Rust VM. Moreover, there is ongoing work to integrate WASM support directly at Stacks L2, which will be activated alongside the Nakamoto upgrade. In Dec. 2023, a working group within the Stacks ecosystem released details on the integration of the new ClarityWASM virtual machine. This integration will open the doors to a wider range of languages like Rust, Solidity, and others, directly within the Stacks L2 environment.



Stacks Scalability through subnets and different VMs. Source: Stacks Whitepaper

Long-Term Vision: Paving the Way for Institutional Adoption

The long-term outlook for Bitcoin reinforces it as the leader in institutional digital assets and DeFi adoption. The anticipated approval of the first Bitcoin Spot ETF stands as a pivotal milestone, potentially revolutionizing institutional engagement with Bitcoin. This approval is expected to catalyze a significant paradigm shift, with institutions increasingly focusing on Bitcoin-centric financial products and services. Recognized as a resilient and thoroughly vetted asset class, Bitcoin is on the brink of widespread institutional adoption.

With the approval of a Bitcoin Spot ETF, the demand for 'Bitcoin-native' trading and yield products is expected to surge, propelled by their security and tax efficiency. This burgeoning interest will likely spur the development of various regulated Bitcoin-based financial offerings. By recognizing this shift, traditional banks may begin integrating Bitcoin and these new products with their private blockchains, making them accessible to institutional clients on a large scale.

The significance of institutional integration into the Bitcoin DeFi ecosystem extends beyond mere capital infusion. It represents the creation of a unique synergy, blending the strengths of traditional finance with the revolutionary aspects of decentralized financial systems. This convergence, built on Bitcoin's security and transparency, is set to redefine the landscape of institutional finance, blurring the lines between conventional and modern financial systems.

The culmination of these developments – from cultural shifts to technological innovations and institutional adoption – is set to significantly boost Bitcoin's market capitalization and the Total Value Locked in its ecosystem. As we navigate this version of a decentralized financial future, it's clear that Bitcoin emerges not just as a digital asset but as a cornerstone of a new, trustless financial paradigm.

Concluding Thoughts

The evolution of Bitcoin from a dormant asset to a dynamic, foundational technology for decentralized finance is being driven by its more than $850B market capitalization, underpinned by the network's stability and security. However, a key challenge is the underutilization of the Bitcoin network's functionalities, a result of the often-overlooked distinction between Bitcoin as a network and BTC as a digital asset. To activate this dormant capital and realize Bitcoin's full potential, it's essential to harness the network's capabilities, transitioning Bitcoin from just a store of value to a core infrastructure within the Bitcoin Economy.

This transition is mirrored in Bitcoin's development of "layers" over its core network (L1) to address the scalability problem, drawing inspiration from Ethereum's scalability and flexibility, and catalyzed by the introduction of Ordinals, which signifies a cultural and developmental shift. While major L1 upgrades like SegWit and Taproot have mitigated some issues, the rising transaction fees underscore an increasing demand for more advanced L2 solutions like Stacks.

As we approach the 2024 halving event and anticipate the approval of a Bitcoin Spot ETF, Bitcoin's development is shaping up a more scalable and secure ecosystem. This evolution is expected to foster significant institutional adoption, with Bitcoin at the forefront of a new financial paradigm that seamlessly integrates traditional and decentralized systems. The potential of Bitcoin's smart contracts, particularly in the context of the cultural impact of Ordinals and the expanding use cases in DeFi and gaming, will likely draw increased interest and capital.

In the mid-term, breakthroughs in Bitcoin L2 technologies, especially with Stacks' Nakamoto Release and the introduction of sBTC, promise to revolutionize the DeFi landscape. These developments are expected to create a smoother, more efficient user experience and open up new possibilities for Bitcoin-based NFT marketplaces and DeFi applications.

In the long term, Bitcoin is set to become a key player in the institutional adoption of digital assets and DeFi, especially with the potential approval of the first Bitcoin Spot ETF. This event could trigger a substantial shift in institutional investment towards Bitcoin-based financial products and services, enhancing the synergy between traditional finance and decentralized financial systems. This integration is not just a capital infusion but a convergence of strengths from both worlds, paving the way for a new era in institutional finance.

Overall, these developments are expected to significantly boost Bitcoin's market capitalization and the Total Value Locked in its ecosystem, marking a new chapter in the journey toward a decentralized financial future. With innovations like Ordinals, the Nakamoto Release and sBTC from Stacks, and the potential for institutional adoption post-Bitcoin Spot ETF approval, Bitcoin is not just maintaining its relevance but actively reshaping the future of finance, emerging as a cornerstone of a new, trustless financial paradigm.

Appendix

Additional Resources

- Hal Press of North Rock Digital, Stacks Thesis and the December 2023 updated Stacks Thesis
- Catrina Wang of Portal Venture, Bitcoin Thesis
- Paul Veradittakit of Pantera Capital, Stacks Thesis
- River's October 2023 Lightning Report
- Sora Venture's, Bitcoin Utility Q3 2023
- Messari's State of Stacks Q2 2023 Report

Bitcoin Builder Communities

- Bitcoin Builders HK Telegram Group
- Bitcoin Builders BKK Telegram Group
- Bitcoin Builders Association (BBA)
- Bitcoin Frontier Fund Accelerator
- Bitcoin Startup Lab