

# A New Era for Bitcoin?

April 2023

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## Key Takeaways

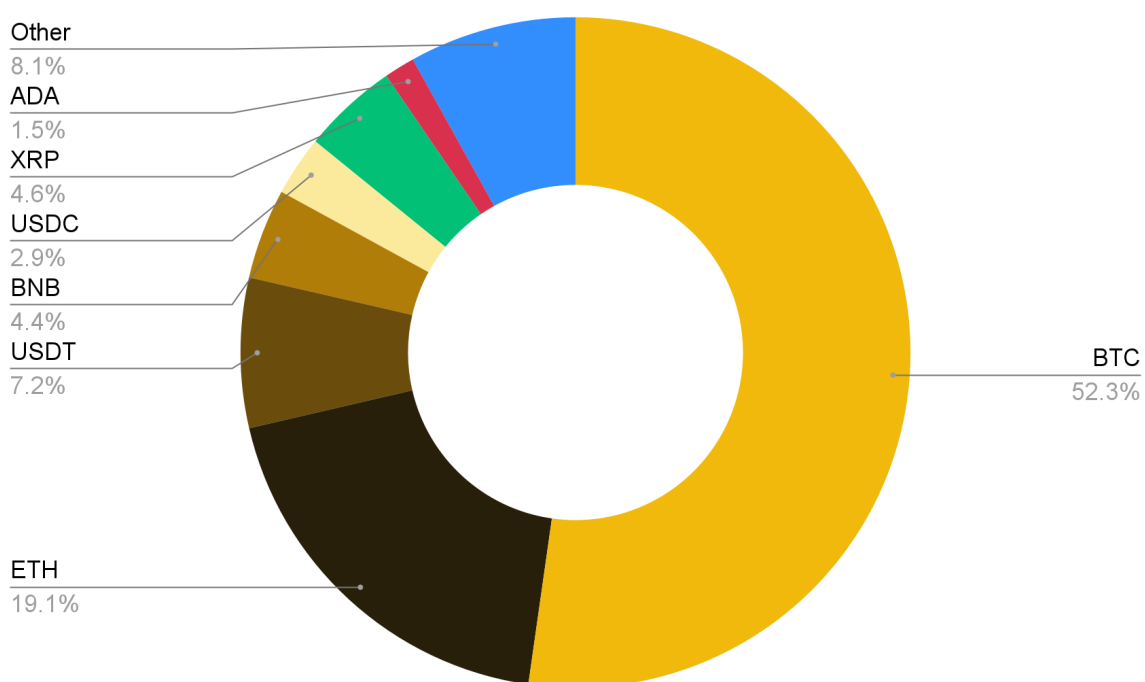
- ❖ Despite smart contract Layer-1s consistently taking the headlines, Bitcoin has retained its dominant position atop the crypto market capitalization charts.
- ❖ Nonetheless, Bitcoin's sustainability is worth a discussion. How will the falling block rewards (halved every four years) and relatively low transaction fees impact Bitcoin's security model? While Bitcoin has held its lead till now, will this continue in the future without a Bitcoin-native smart contract market?
- ❖ Ordinals and Inscriptions, which emerged at the start of 2023, might have some answers. With this latest innovation, not only are we witnessing the start of "Bitcoin NFTs", we are seeing a resurgence in excitement and attention across the entire Bitcoin ecosystem.
- ❖ Inscriptions have led to a noticeable impact on Bitcoin's on-chain metrics, and transaction fees are on the rise. Perhaps most importantly, the pace of innovation is increasing and developers are shipping updates left, right and center.
- ❖ With increased activity and the opening up of a plethora of new use cases for Bitcoin, the very natural question of scalability follows. How will Bitcoin handle the increased traffic? Enter Bitcoin Layer-2s.
- ❖ While the Lightning Network continues to grow and remains specialized in its payment use-case, Stacks and Rootstock provide Bitcoin developers with access to layers for general-purpose smart-contract execution. Rootstock boasts EVM-compatibility, while Stacks' upcoming sBTC solution might finally provide a highly trust-minimized way of moving BTC from Layer-1 to Layer-2. Rollkit's take on a sovereign Bitcoin rollup is also interesting and worth following carefully.
- ❖ A fully-fledged Bitcoin smart contract market, Bitcoin rollups, and the upcoming Bitcoin halving are some of the key themes that we conclude this report with.

## Introduction

While smart contract platforms like Ethereum, BNB Chain and Solana continue to take the headlines, have a quick peek at crypto market capitalization (“market cap”) and one thing is clear:

*Bitcoin remains dominant.*

**Figure 1: Bitcoin accounts for over 50% of total crypto market cap (~US\$600B of ~US\$1.1T)**



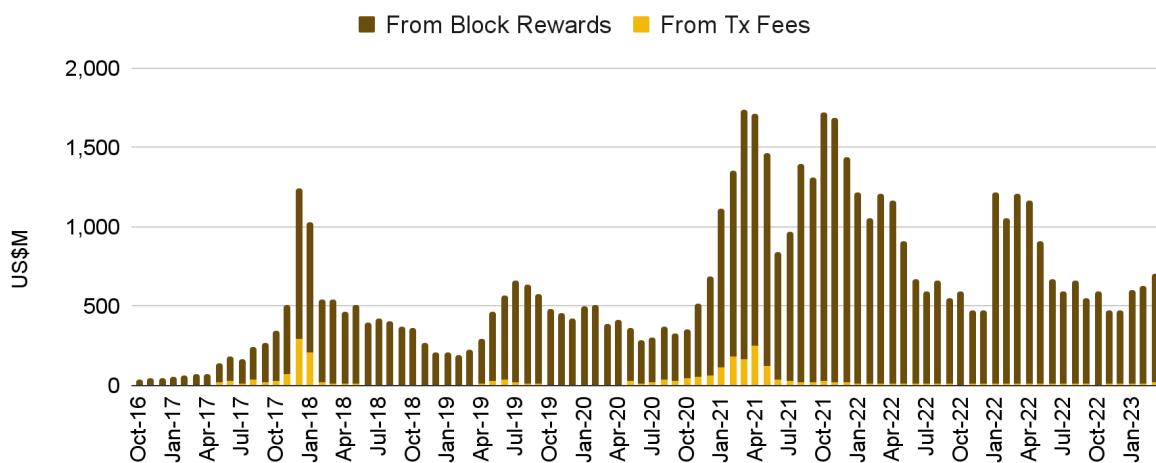
Source: CoinMarketCap, Binance Research  
Data of 30 Mar 2023

Even though Bitcoin dominance has trended downwards from 60-70% in 2020 and 2021, the pioneer of crypto still accounts for the majority of the market. **Considering the relative lack of smart contract functionality on the Bitcoin layer-1 (“L1”) blockchain, this is a testament to the belief that Bitcoin HODL-ers have in the asset.** It would also indicate that Bitcoin is more likely to be held for its original purpose, as a form of hard money, rather than for non-monetary use cases, given the relative lack of DeFi, NFT and infrastructure markets for the network.

While we have seen some level of innovation, Lightning Network and Stacks being notable examples, nothing has come close to the level of smart contract behemoths mentioned

above. While this is perhaps by design and due to the slow and cautious nature (and ultimately a major selling point) of the Bitcoin network, it is still something of note. It is particularly concerning due to the **consistent questioning of Bitcoin's security model**. Bitcoin entices miners through two economic incentives: coinbase rewards and transaction ("tx") fees. Coinbase rewards, also sometimes referred to as block rewards, are halved roughly every four years, and will eventually diminish to zero. Thus, eventually, Bitcoin's transaction fees will be the sole compensation for miners i.e. the security budget of the L1 blockchain. Given the limited use case of Bitcoin, primarily for asset transfer, these fees have been a very small percentage of miner revenues and something of concern in the longer term.

**Figure 2: Bitcoin's annual security budget (block rewards + tx fees) is largely composed of block rewards which are halved every four years and will eventually go to zero**



Source: Dune Analytics, Binance Research

Data as of 30 March 2023

Things have been changing. In January this year, the **Ordinals** protocol went live. **Ordinals enables arbitrary data (images, video, text etc.) to be inscribed on the Bitcoin blockchain, creating digital artifacts or effectively, NFTs.** Total Inscriptions are now over 600K and growing fast. With this change has come a renewed level of excitement in Bitcoin, with increased focus on projects building around the network and the entrance of major players like Yuga Labs and Magic Eden. Not only has Bitcoin seen an impact through its mempool, transaction fees, and block sizes, there has also been a cultural shift with how Bitcoin is being looked at. Existing projects are getting more attention, while new builders are flocking to the ecosystem. Seems like there is suddenly an organic demand for Bitcoin blockspace.

In this report, we provide a brief update on Bitcoin's recent performance, deep dive into Ordinals & Inscriptions, discuss Bitcoin's nascent layer-2 ("L2") ecosystem, and provide a view of what we expect next for Bitcoin.

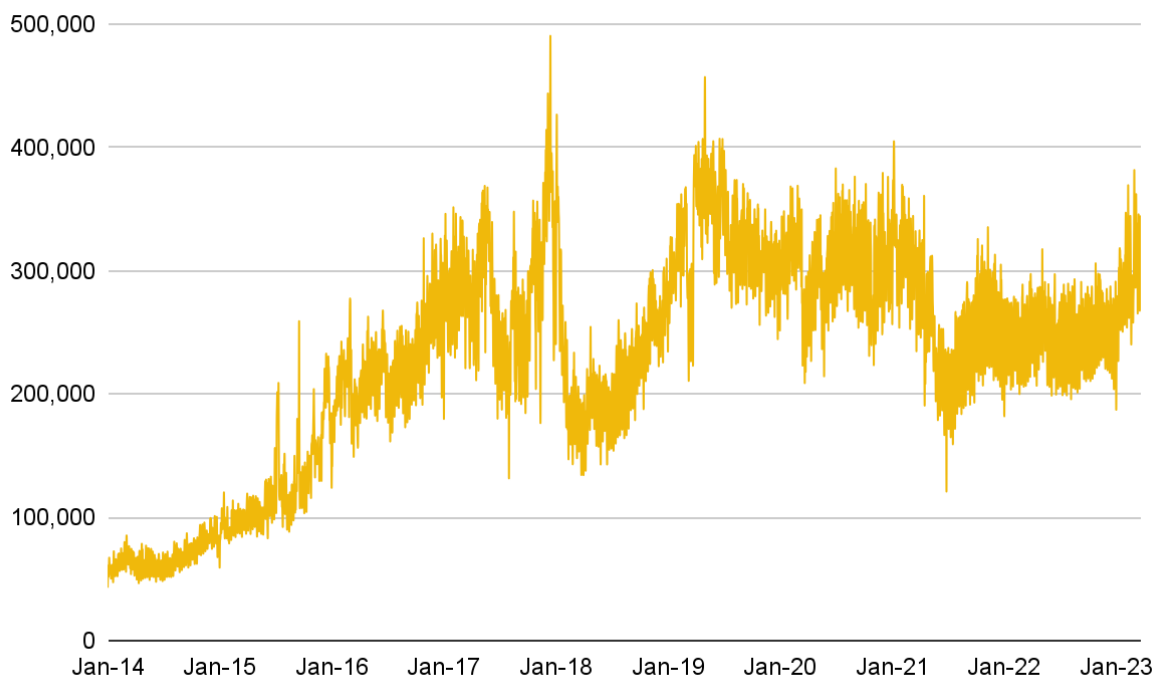
# What's been happening with Bitcoin?

To give you a refresher on what is the latest in the world of Bitcoin, we're going to look at three main areas. On-chain metrics, mining, and recent technical upgrades. While not exhaustive, we feel that getting to grips with these key areas will provide you with the necessary knowledge to better understand the rest of this report.

## On-Chain Metrics

To start, let's look more carefully at **Bitcoin's daily transaction data**. After moderating from the highs of the 2021 bull market, which saw days of 300K+ transactions, activity stayed around the 250K per day mark for the majority of 2022. This trend was broken recently, with daily transactions finally starting to rise through 2023. **Daily transactions are now back above 300K** - at least partially due to the **increased activity that Ordinals and Inscriptions have brought** to the blockchain (explored more in the [Ordinals, Inscriptions and NFTs on Bitcoin](#) section)

*Figure 3: Bitcoin's daily transactions have been on the rise in 2023 after a stable 2022*

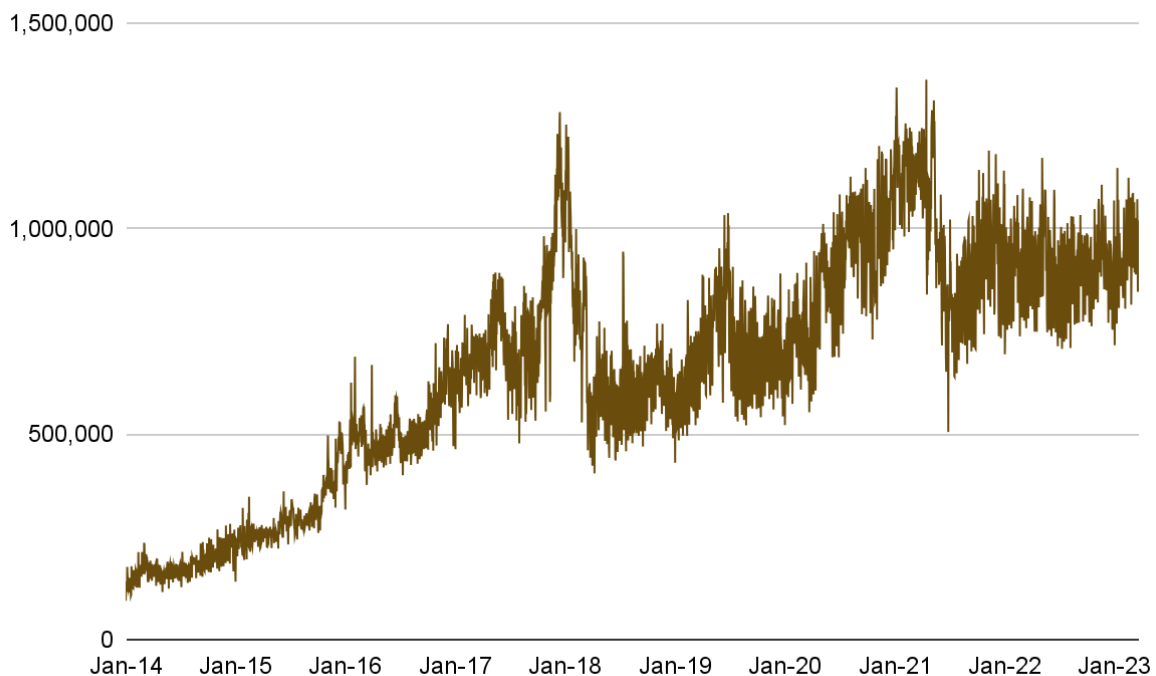


Source: Glassnode, Binance Research  
Data as of 22 Mar 2023

How about **daily active addresses**? In a similar vein to Bitcoin's daily transaction data, daily active addresses on Bitcoin fell substantially from the highs of 2021, where they

peaked around 1.2M. Having spent 2022 around the ~900K mark, **Bitcoin's daily active addresses have slightly increased this year and currently sit around 1M per day.**

*Figure 4: Bitcoin No. of Active Addresses*













*Source: Glassnode, Binance Research  
Data as of 22 Mar 2023*

Another metric we can look at and seek to evaluate is **development activity in the Bitcoin ecosystem**. If we look at full-time developer (“dev”) data for the top ecosystems, Bitcoin’s recent history looks relatively modest. Among the top 10 most valuable ecosystems, Bitcoin ended on the lower end in terms of full-time dev count.

- ❖ Between 2021 and 2022, **Bitcoin full-time devs fell 4%. This ties with Tezos as the bottom performer** and compares to a +17% average for the group.
- ❖ Between 2020 and 2022, **Bitcoin full-time devs increased 15%. This is the lowest in the group** and compares to a +252% group average.



**Figure 5: Bitcoin has been the notably weaker performer in terms of full-time developer count among the top 10 most valuable ecosystems**

Ecosystem		FT devs at the end of 2022	1yr change	2yr change
	<b>Ethereum</b>	1,873	+9%	+67%
	<b>Polkadot</b>	752	+9%	+119%
	<b>Cosmos</b>	511	+34%	+122%
	<b>Solana</b>	383	+36%	+623%
	<b>Bitcoin</b>	300	-4%	+15%
	<b>Polygon</b>	253	+17%	+584%
	<b>Kusama</b>	250	+21%	+225%
	<b>NEAR</b>	205	+16%	+400%
	<b>Cardano</b>	163	+16%	+81%
	<b>Tezos</b>	147	-4%	+43%

Source: Electric Capital, Binance Research

## What does this mean?

What the first two charts show us is that Bitcoin maintained stable network activity across 2022. While stable network activity during a generally challenging year is commendable, **it is notable that Bitcoin's daily transactions have not demonstrated great strength and are similar to levels observed in 2017.** Daily addresses demonstrate a stronger sustained growth. In terms of development activity, Bitcoin's performance is notably weak and perhaps not surprising given the lack of opportunities there seem to be in the ecosystem.

However, one thing we should keenly note is that **both daily transactions and daily active addresses are up since January 2023.** And while not reflected in year-end developer data from 2022 in Figure 5, we are seeing significant renewed interest in building on Bitcoin. A



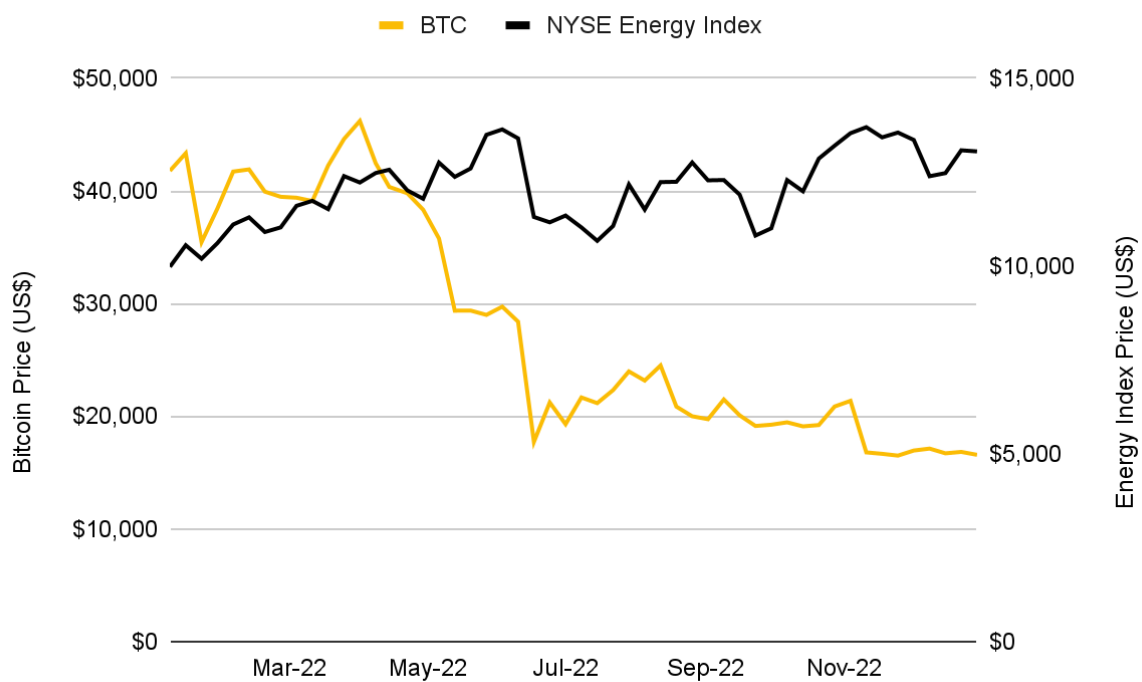
number of new product releases and updates have gone live in the last few months (covered in more detail in the [Ordinals, Inscriptions and NFTs on Bitcoin](#) section).

## Mining

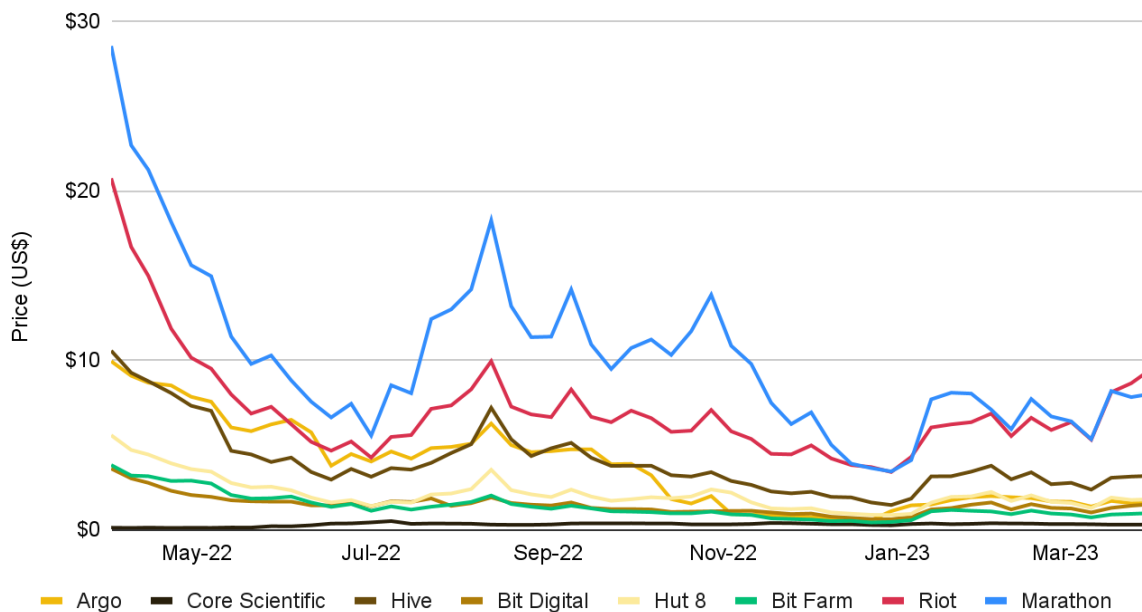
We're going to assume that you understand the basics of mining, but if not, please have a quick look [here](#).

Bitcoin mining had a fairly eventful year. Through the course of 2022, miners had to deal with a triple whammy of sorts. **Increased energy prices (affecting the day-to-day running of mining rigs), rising interest rates (increasing debt payments / making it more expensive to take out loans to survive) and declining Bitcoin prices (meaning lower profits on miners' output)** all led to significant hardship in the Bitcoin mining space. While a number of miners went bankrupt, some were purchased at cheap valuations, while others just about survived.

**Figure 6: Increasing energy prices and declining Bitcoin price...**



Source: Market Watch, Binance Research  
Data across 2022

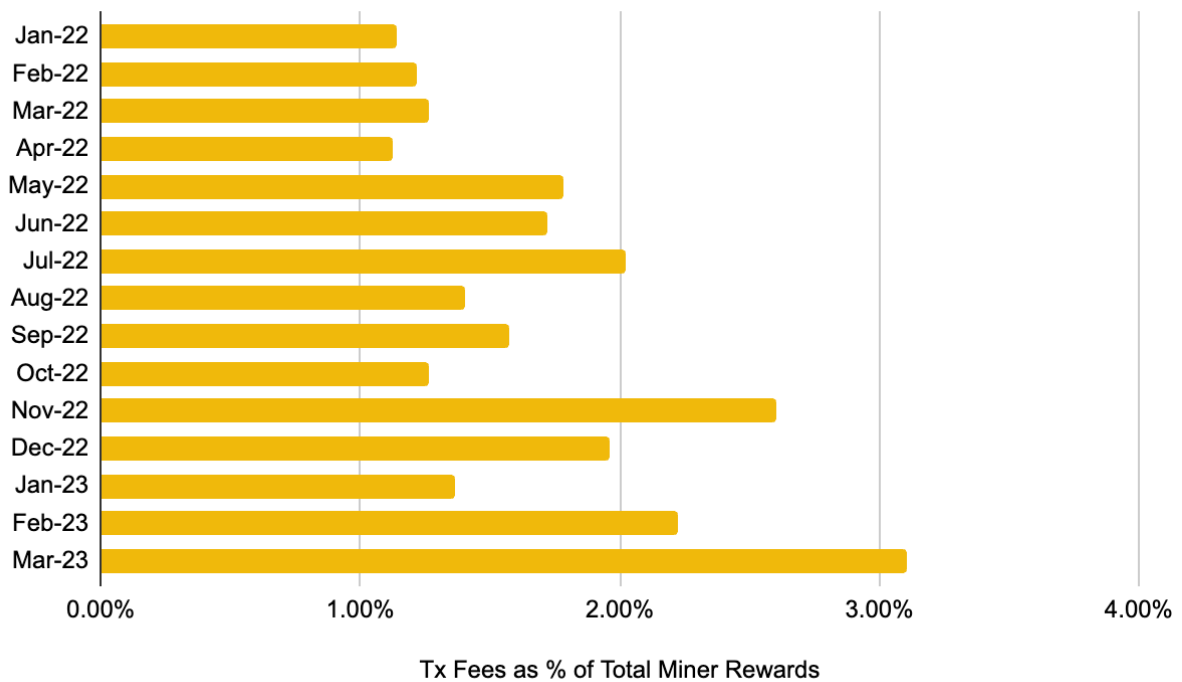
**Figure 7: ...made it a tough year for major Bitcoin miners**

Source: Yahoo Finance, Binance Research  
Data as of 29 Mar 2023

While traditionally, most miners sold part of their mined Bitcoin to fund expenses, a lot of it was HODL'd in order to benefit from rising prices long term. Due to the dire situation through last year, many miners were forced to offload large parts of their stock of Bitcoin, further adding to selling pressure and also meaning that miners had to sell at extremely low prices.

Nonetheless, **things have been improving in 2023**. While energy prices have not really moderated, Bitcoin price has been rising, improving rewards for those miners still operating. Furthermore, as mentioned in the [Introduction](#), a core issue for Bitcoin's security budget has been the limited transaction fees the chain generates. This has meant that miners are almost completely reliant on block rewards. In fact, as we can see below, for the last year, transaction fees have averaged just 1-2% of total miner rewards. However, do note that since the start of this year, this has changed. **Transaction fees are now trending towards 2-3% of total rewards, with Hashrate Index [data](#) even showing certain days where fees exceeded 5%.** While not a significant move, it is definitely a change in the right direction. How much of this move is due to Ordinals and Inscriptions is something that is up for debate, although [on-chain metrics](#) would indicate that they are at least partially behind the increase.

**Figure 8: Bitcoin Transaction Fees as a % of total miner rewards have been historically small, but have been rising since the start of this year**



Source: Dune Analytics, Binance Research  
Data as of Mar 2023

## Recent Technical Upgrades

Since 2017, Bitcoin has gone through **two significant upgrades**: Segregated Witness (“SegWit”) in 2017 and Taproot in 2021.

### SegWit

SegWit was a 2017 Bitcoin [soft fork](#) upgrade. SegWit separated Bitcoin’s transaction structure into two parts: Transaction data and Witness data. It also changed the way block size was measured by introducing the concept of block weight and making it so that the weight of the Witness data is only 25% of that of the transaction data. This effectively meant that Bitcoin’s block size increased and that it became easier and cheaper to store data in the Witness part of the transaction. Essentially, **SegWit allowed Bitcoin’s maximum block size to increase from 1MB to 4MB** (including 1MB Transaction data and 3MB of Witness data).

## Taproot

Taproot was a 2021 upgrade to Bitcoin and also a soft fork. Taproot consisted of three distinct Bitcoin Improvement Proposals (“BIPs”); BIP 340, BIP 341 and BIP 342, which brought more privacy, scalability and composability to the blockchain. Two major effects that Taproot had was allowing **advanced scripting in the Witness section of a block**, as well as, **removing the data limits between the two sections of a block** i.e. allowing up to 4MB of data in the Witness section.

*Figure 9: Taproot adoption started off sluggish but has steadily risen, with Ordinals evidently causing a meaningful jump*



Source: Glassnode, Binance Research  
Data as of 22 Mar 2023

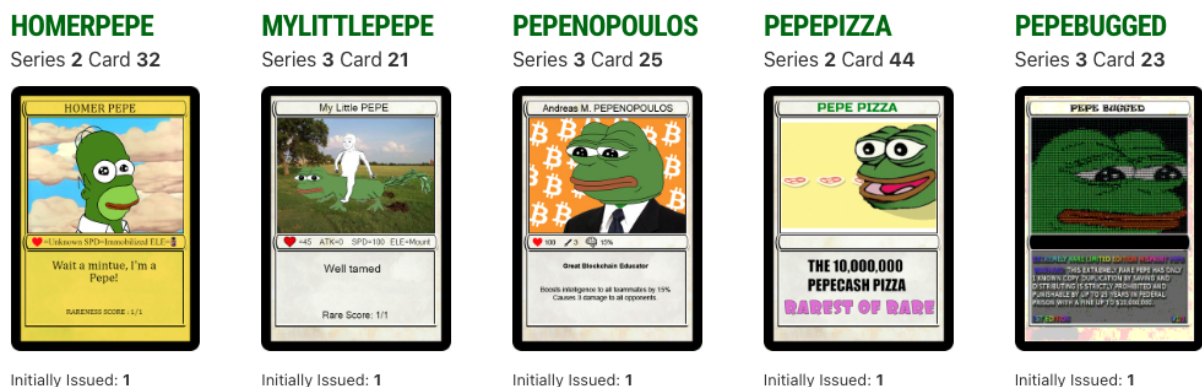
# Ordinals, Inscriptions and NFTs on Bitcoin

## A brief history lesson

It might be surprising to learn, but NFTs on Bitcoin actually emerged before NFTs on Ethereum (and arguably, prior to the invention of Ethereum itself!). 2012's open-source project, **Colored Coins**<sup>(1)</sup>, was the first of such projects, and introduced a methodology to distinguish regular Bitcoins from those that were "colored". In hindsight, this project definitely emerged significantly ahead of its time and lost the attention of the relatively small crypto community of 2012 - 2014.

The next notable project worth mentioning is **Counterparty**. Founded in 2014, Counterparty was built on top of Bitcoin (somewhat analogously to a L2 solution) to allow users to issue and trade tokenized digital assets. Counterparty was responsible for the launch of a decentralized exchange ("DEX"), well before current market leaders like Uniswap and Curve, as well as the now famous Rare Pepe collection. **Rare Pepes, issued on Counterparty in 2016, are perhaps the most famous Bitcoin NFTs of all-time.** Counterparty, and Rare Pepes undoubtedly accelerated efforts to build infrastructure around NFTs, including wallets and marketplaces, and served as an important early influence in the nascent NFT space.

*Figure 10: Rare Pepe NFTs are based on one of the most recognizable memes of all-time*



Source: [Rarepepes.com](https://rarepepes.com)

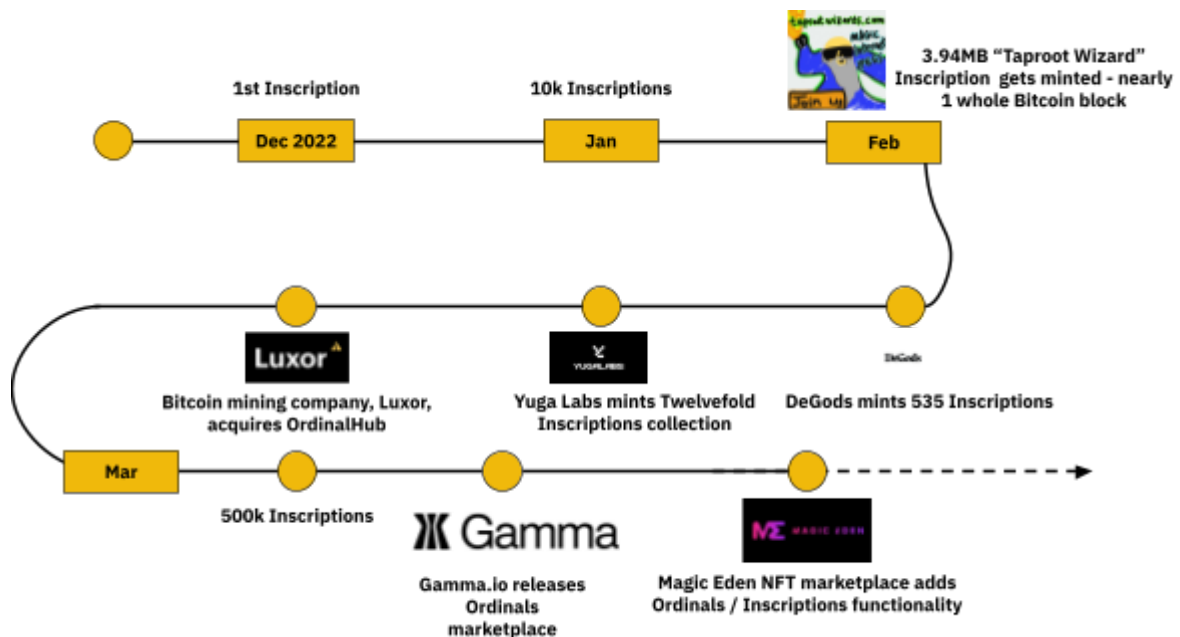
After Counterparty and the Rare Pepes NFTs (among a few other smaller collections), the still very young NFT market shifted towards Ethereum. In 2017, we saw the mint of Cryptopunks, while later in the year, we saw the launch of Crypto Kitties by Dapper Labs. Nonetheless, the real boom for NFTs started in late 2020 and early 2021, with the US\$69M March 2021 sale<sup>(2)</sup> of a Beeple NFT being a major highlight. The **next major move in Bitcoin NFTs came in December 2022, when the first Ordinal Inscription was minted.**

**Figure 11: The first Inscription to be minted on Bitcoin; Inscription 0 (Dec 14 2022)**



Source: [ordinals.com](https://ordinals.com)

**Figure 12: The Ordinals timeline**



Source: *Binance Research*

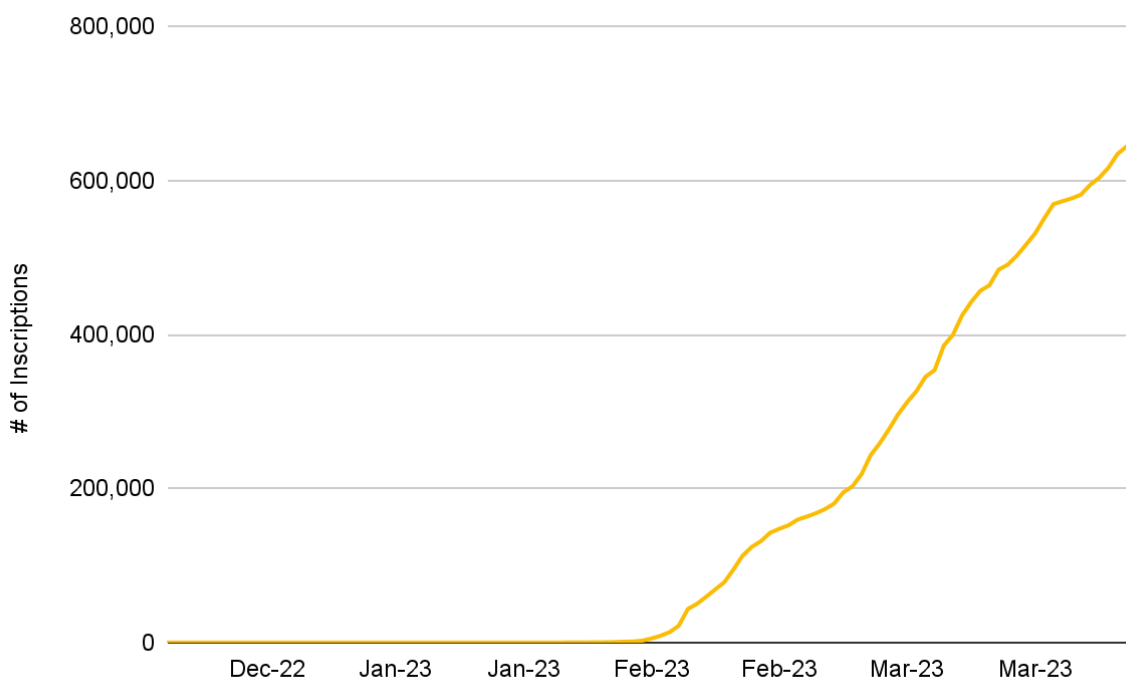
## How do Ordinals and Inscriptions work?

ORD, which is open-source [software](#) that can run on top of any Bitcoin full node, enables the tracking of individual Satoshis based on what founder Casey Rodarmor termed “Ordinal Theory”. Satoshis (“sats”) are the smallest unit of the Bitcoin network, and 1 Bitcoin = 100,000,000 sats. **Ordinal Theory ascribes a unique identifier to every single sat on Bitcoin.** Furthermore, these individual sats can be “inscribed” with arbitrary content e.g. text, images, video, to create an “Inscription” i.e. a Bitcoin-native digital artifact<sup>(3)</sup>, or what can also be called a NFT.

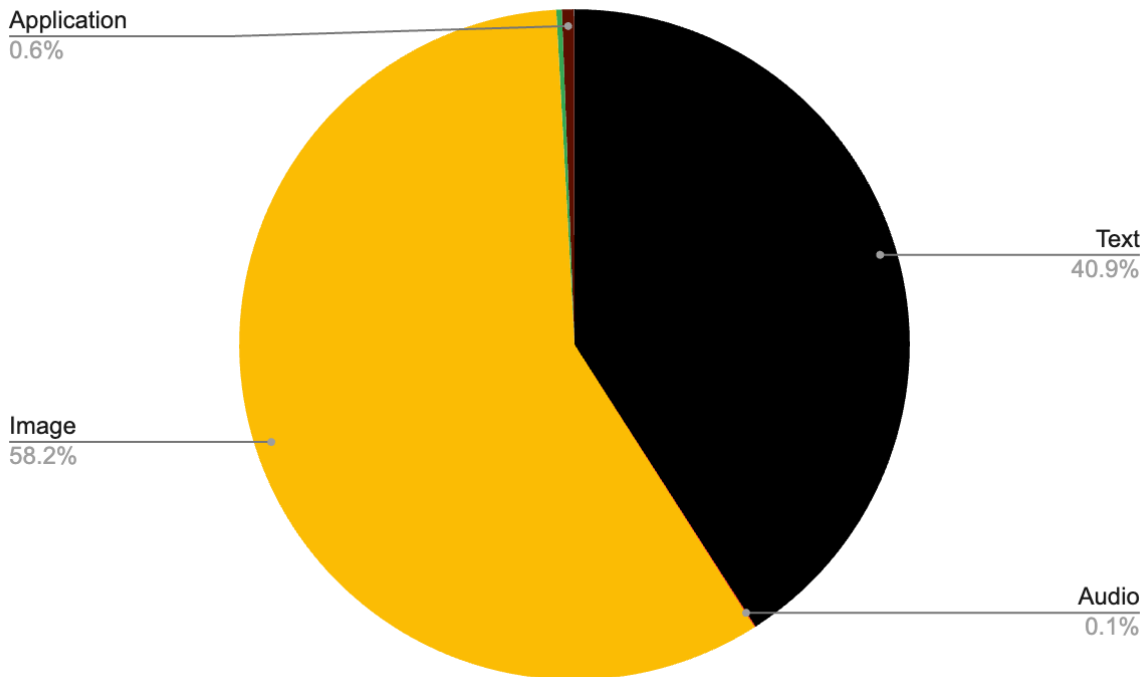
*“...individual sats can be “inscribed” with arbitrary content e.g. text, images, video, to create an “Inscription” i.e. a Bitcoin-native digital artifact, or what can also be called a NFT.”*

Earlier we talked about Bitcoin’s most [recent technical upgrades](#): SegWit and Taproot. SegWit allowed for cheaper data to be put into the Witness section of a transaction and thus effectively increased block size, while Taproot allowed for advanced scripting in the Witness section. Combined, these two updates were critical for Inscriptions given they allowed for up to 4MB of arbitrary data storage in the Witness part of any Bitcoin block. **This forms the upper bound for any Bitcoin Inscription - 4MB.**

**Figures 13 and 14: Over 600,000 Inscriptions have been minted on Bitcoin, vast majority of which are text or image-based**







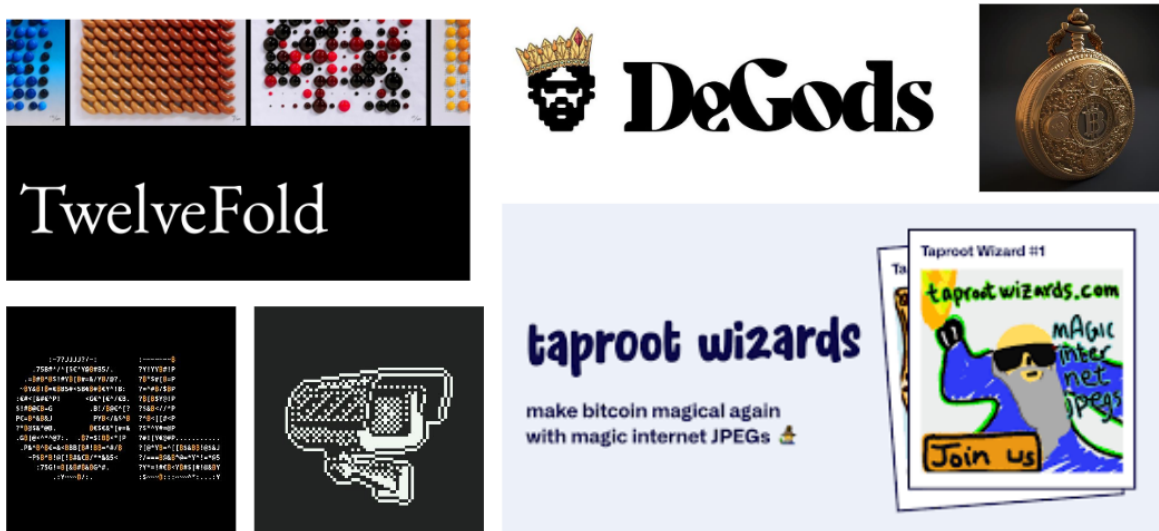
Source: Dune Analytics, Binance Research  
Data as of 30 Mar 2023

## How do Inscriptions look vs the NFTs that we are used to?

- ❖ **Fully on-chain:** Inscriptions are directly stored on the Bitcoin L1 chain. A common criticism of the most popular group of NFTs i.e. [ERC-721](#) NFTs, is that the metadata for many of them is stored off-chain on platforms like IPFS, Arweave or sometimes fully-centralized Web2 servers. These solutions may not be fully reliable and dependant on external factors to continue existing. On the other hand, **Inscriptions will essentially exist as long as Bitcoin exists**. This adds a layer of **permanence**; a quality that could be very attractive to collectors of many types.
- ❖ **Immutable:** Due to being stored directly on-chain, the Inscriptions are always guaranteed to be completely immutable. While many current NFTs are immutable, a lot of them can also be modified or deleted by the contract owner. This is simply not possible with Inscriptions and adds to their sense of permanence.
- ❖ **Ordering:** Given Inscriptions are inscribed onto individual sats using Ordinal Theory, it means that each Inscription is technically ordered. There is a 500<sup>th</sup> Inscription, and a 9999<sup>th</sup> one and so on. This is a unique feature to most current types of NFTs and adds a different level of value; another feature that could be very appealing to collectors e.g. those collecting sub-100k Inscriptions or the first Inscriptions after a block halving etc.

- ❖ **Scarcity / Size Limit:** As previously mentioned, through the combination of SegWit and Taproot, Bitcoin blocks can store up to 4MB of data. This puts an effective upper bound to both the size of Bitcoin Inscriptions and also the number of Inscriptions that can be inscribed on Bitcoin overall i.e. given approximately 144 Bitcoin blocks are mined per day, if the entire 4MB space is an Inscription, that gives us ~210GB per year. There is no such upper limit for most general smart-contract based NFTs, which could theoretically mint unlimited amounts of NFTs.

*Figure 15: Some of the popular NFT houses have already branched out into Bitcoin Inscriptions*



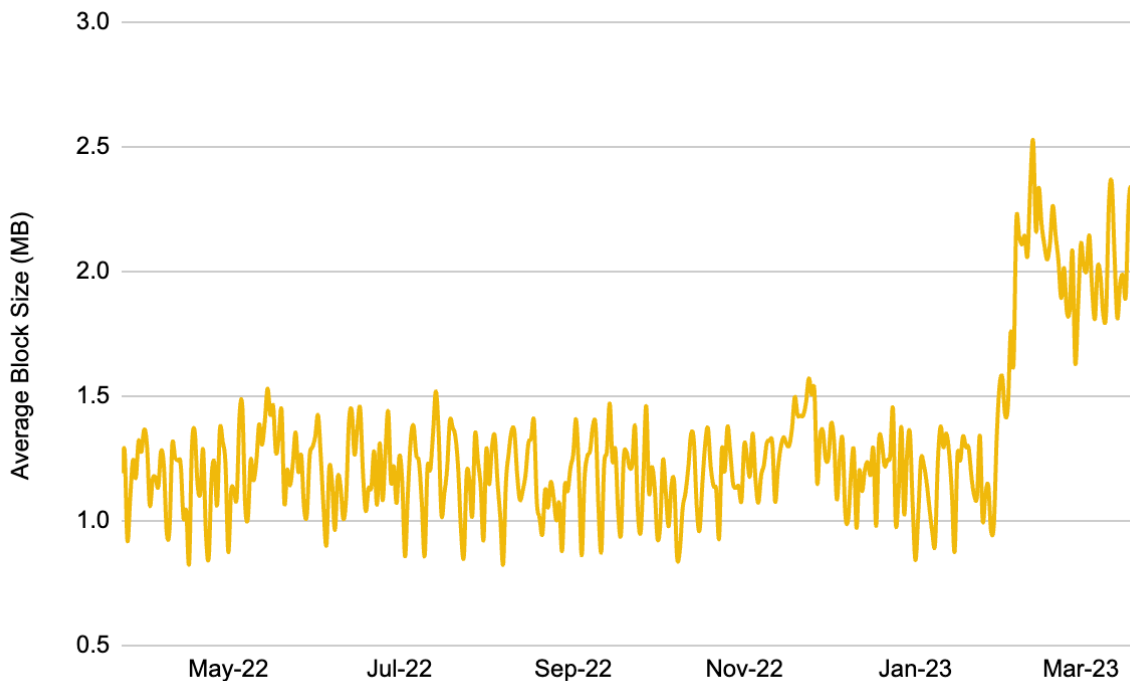
Source: Binance Research

## How have Bitcoin metrics been affected?

As mentioned in [recent technical upgrades](#) Taproot adoption took off earlier this year as Ordinals & Inscriptions started becoming more popular.

- ❖ **Average Block Size:**
  - Inscriptions and Ordinals have ignited demand for Bitcoin blockspace that has never been seen before. The **sharp spike in average block size in early Feb 2023 illustrates this** quite clearly (increasing from 1.2MB in Jan to over 2MB now).

**Figure 16 : Average Bitcoin block size has spiked significantly since Feb-23 and is now at an all-time high (“ATH”)**



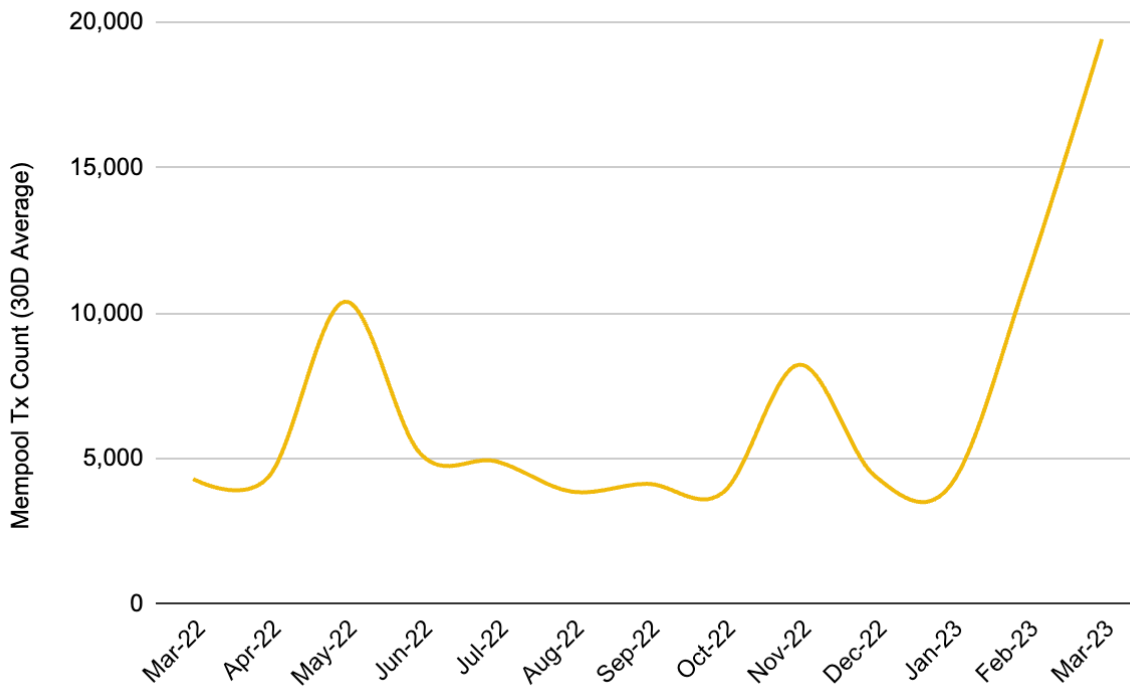
Source: Blockchain.com, Binance Research  
Data as of 22 Mar 2023

*Inscriptions and Ordinals have ignited demand for Bitcoin  
blockspace that has never been seen before*

❖ **Bitcoin Mempool Growth:**

- If we look at data for Bitcoin's [mempool](#), we can see a similar pattern. Remember, the **mempool is essentially a waiting room for unconfirmed transactions** that are waiting to be put into a block.
- Bitcoin's total number of unconfirmed transactions i.e. the **mempool transaction count has been on the rise in early 2023**. Absent two spikes last year, the majority of the year saw the mempool hold around 5K transactions, on average. This number has steadily increased through February and March, and is now near the 25K mark. **Comparing this move to 2022, it would appear that this is a more sustained increase in the mempool, rather than a temporary spike.**

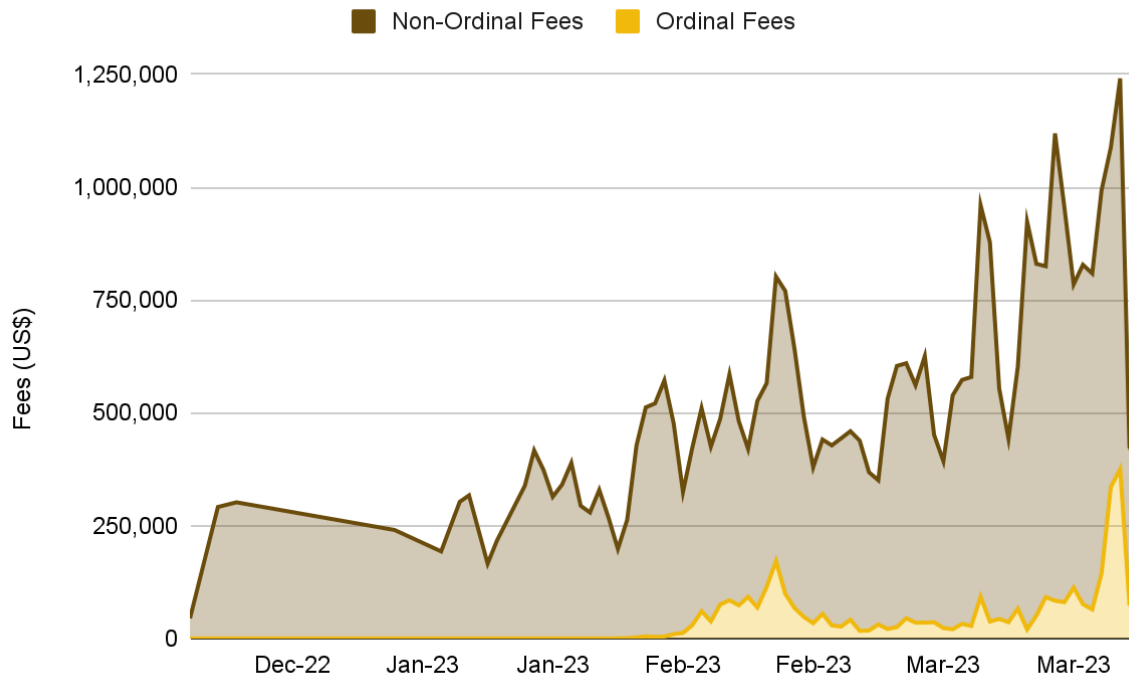
**Figure 17: The total number of unconfirmed transactions in Bitcoin's mempool is steadily rising**



Source: Blockchain.com, Binance Research  
Data as of 22 Mar 2023

❖ **Impact on Bitcoin's transaction fees:**

- As mentioned previously in the Mining section, Bitcoin's relatively low transaction fees have been a concern and remain a long-term issue given the decline in block rewards that happens roughly every four years i.e. every halving.
- Ordinals and Inscriptions have had a positive impact on Bitcoin's transaction fees. As you can see below, **Ordinal fees have been steadily increasing through the last few months and added an extra ~10%, on average, to non-Ordinal transaction fees through the course of March.**

**Figure 18: Ordinal fees have been strengthening miner revenues since the start of the year**

Source: Dune Analytics, Binance Research

Data as of 26 Mar 2023

- In fact, the current **cumulative fees paid for Ordinals Inscriptions minting have exceeded 150 BTC<sup>(4)</sup>**. Assuming that Ordinals continue to gain adoption, this could create a sustainable demand for Bitcoin block space and ensure that Bitcoin miners are less reliant on purely block rewards (given this additional revenue stream).

❖ **Notable spike in Bitcoin full node runners:** As mentioned in [How do Ordinals and Inscriptions Work](#), the ORD software is required to enable the tracking of individual sats, and thus view the Bitcoin chain with the lens of Ordinal Theory. What this means is that, while solutions like Ordinals marketplaces have emerged for casual users, **for a user to have complete control over the entire Ordinal process and “mint” an Inscription, they would have to run a full Bitcoin node** (as opposed to Lightweight nodes). This factor (alongside others) have caused a **surge in the amount of reachable Bitcoin nodes**. The more full Bitcoin nodes that are active, the more decentralized the Bitcoin network becomes. So, while this might just be a one-time bump, the upward move is certainly encouraging and positive for the Bitcoin network as a whole.

**Figure 19: The total no. of reachable Bitcoin nodes spiked in early 2023 and is now at an all-time high**



Source: *bitnodes.io*, Binance Research  
Data as of 22 Mar 2023

#### ❖ Increased pace of innovation within the Bitcoin ecosystem

- The pace of innovation and improvement in Bitcoin infrastructure dApps since the launch of Ordinals has been notable. **Bitcoin wallets like Hiro and Xverse<sup>(5)</sup> have been quick in adding Ordinals support** and releasing products like the **Ordinals Explorer<sup>(6)</sup>**. Bitcoin NFT marketplace (who used to primarily serve Stacks-based projects), **Gamma**, recently released their **Ordinals marketplace<sup>(7)</sup>**. This is in addition to incumbents like **Magic Eden**, who also followed up a day after Gamma with their Bitcoin NFT marketplace. Notable NFT studios, **Yuga Labs** and **DeGods**, both also released Ordinals-based projects within the last month.

## The debate in the Bitcoin community

The emergence of Ordinals has sparked a debate within the Bitcoin community.

One camp believes that Ordinals should not exist on the Bitcoin blockchain; more specifically **they argue that the true purpose of Bitcoin is to serve as a form of hard, non-fiat money, and be used to facilitate trustless peer-to-peer payments**. In the eyes of these Bitcoin-ers, any deviation away from serving the money/payments role would

detract from Satoshi's initial vision for the network. It is their view that data-intensive Ordinal transactions only serve to congest the Bitcoin network, drive up fees, and ultimately discourage peer-to-peer transactions. Pundits of this camp have pointed to the large amount of block space Ordinal transactions are taking up and the recent rise in transaction fees as evidence to support their arguments.

*Figure 20: One point of view regarding Ordinals*



**Pledditor**   
@Pledditor

...

RE: Ordinals

There's no single correct way to use [#bitcoin](#) , but Ordinals are using it in a way that is not ideal for its design

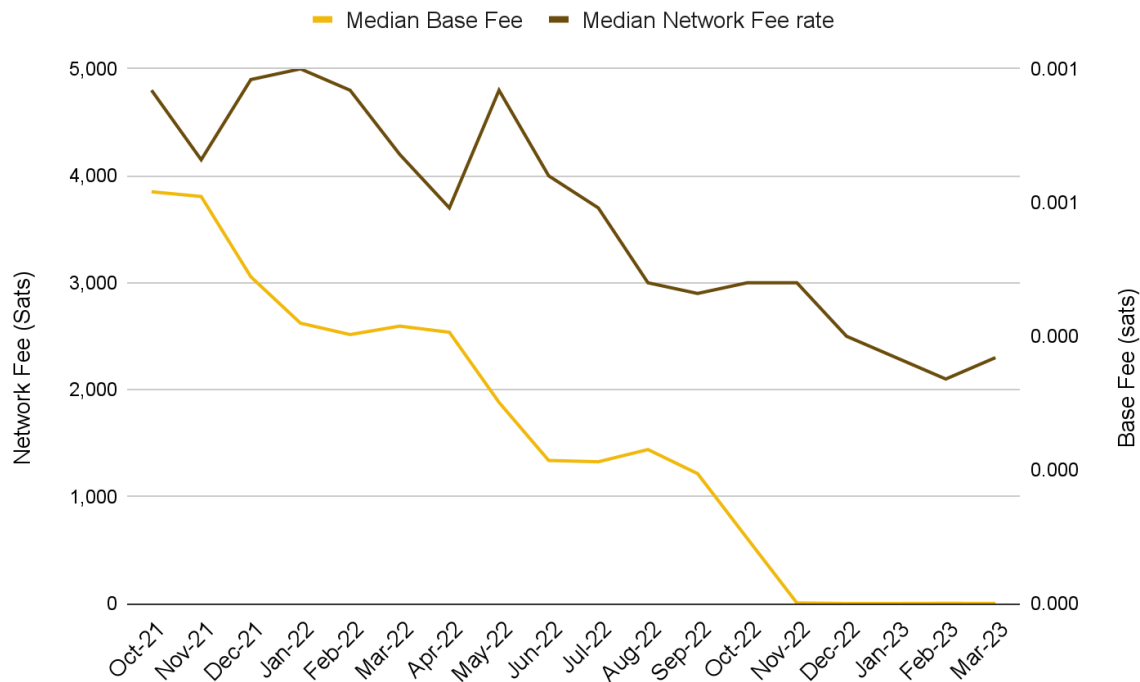
It's akin to parking in a spot designated for ambulance vehicles, obstructing their access and slowing down their ability to save lives

*Source: Twitter*

It is certainly true that transaction fees have increased on the Bitcoin L1 network, and something that we have highlighted previously. Specifically, between Jan 30 and Mar 28, average Bitcoin fees per transaction increased ~112%<sup>(8)</sup>. However, this is not something that we see as a problem. On the contrary, as discussed, Bitcoin has long had the issue of low transaction fees and what this will mean for Bitcoin's security budget as the block rewards continue to decline. With **increased transaction fees bolstering miner revenue by adding to block rewards, we finally have a stream of income for miners that is not reliant on rewards, but rather organic usage of the blockchain.** With regards to the criticism that increased fees discourages those in need of conducting peer-to-peer transactions, the response is simple; they should not be using the Bitcoin L1 chain to send payments to begin with - **they should be using the Lightning Network** (See [Lightning Network](#) section for more). As you see below, **Lightning Network fees have continued to fall in the last few months.** Given this is Bitcoin's chosen solution for fast and secure peer-to-peer payments, cheaper fees are encouraging and indicate that higher transaction fees on the Bitcoin L1 do not necessarily translate (at least not proportionally) to higher fees for Lightning.



**Figure 21: Lightning Network fees consist of a flat base fee and a network fee (which depends on transaction value). Both have been falling, with median base fees now at 0**



Source: Glassnode, Binance Research

Data as of 26 Mar 2023

The opposing camp to the Bitcoin-maximalist crowd also argue that, in order to achieve mass adoption and continued innovation, **new use cases for the Bitcoin network should be embraced**. Proponents point to other major blockchains, such as Ethereum and BNB Chain, and the various business and use cases that have built atop these networks. Why can't Bitcoin do the same in its own unique way? They point towards **increased network usage since the arrival of Ordinals**, as well as the fact that **developers have been consistently shipping updates**, while also **welcoming new entrants from other parts of crypto e.g. Yuga Labs and Magic Eden**.

Furthermore, discriminating against a particular use case of the network would stand opposed to the neutrality of Bitcoin. It should be recognized that within any true decentralized network such as Bitcoin, it is inevitable that debates will arise; decentralization enables greater voice amongst a network, and at the same time, creates an environment that is more susceptible to disagreements.

Overtime, the Bitcoin network has remained secure through a number of different debates (e.g. SegWit debates). Only when debates have intensified, usually because a change in the network will infringe on a certain group of user's core values or assets, has Bitcoin

undergone a fork (eg. Blocksize wars). The Ordinals debate does not appear to be on the path to any fundamental disruption to the Bitcoin network. However, the debate will still remain noteworthy to watch, as it will shape the purpose and use of the Bitcoin network for the long term.

**Figure 22: There are also others who are optimistic about what Ordinals have unlocked**

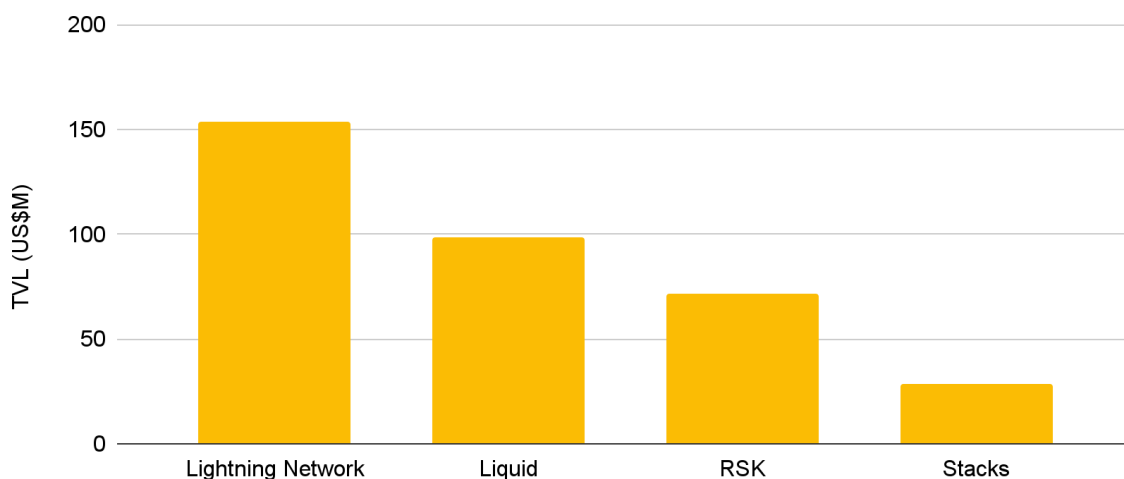


Source: Twitter

## Bitcoin Layer-2s

Bitcoin's proven security and network effects have attracted many developers, who view Bitcoin as a key blockchain base layer. These developers are building a number of different Layer-2 ("L2") projects on top of the Bitcoin base layer.

**Figure 23: Total Value Locked ("TVL") across highlighted Bitcoin L2 projects**



Source: DeFiLlama, Binance Research  
Data as of 29 Mar 2023

Currently, the TVL of L2 projects on Bitcoin is only a fraction of Bitcoin's US\$500B+ market cap. **The top four, most notable L2s in Bitcoin only comprise around US\$352.65M of TVL, or ~.06% L2 market dominance. This seems to suggest that Bitcoin L2s are still in their nascent stage.** When comparing Bitcoin L2 market dominance to L2 market dominance on other chains, this becomes even more clear. [Binance Research 2022 Full Year Report](#) found that on Ethereum, scaling-specific L2s alone have a market dominance of +10%.

The relatively small amount of value locked on L2s also suggests that use cases beyond peer-to-peer transactions have not yet found their product market fit on Bitcoin. Since the Bitcoin base layer does not have an Turing-complete, expressive smart contract engine, such as the [EVM](#) on Ethereum, L2s are required to add such programmability to the Bitcoin. If users were actively demanding to engage in use cases on Bitcoin beyond more simplistic peer-to-peer transactions, they would be using and adding value to Bitcoin's L2s, but this has not yet proven to be the case.

However, things have been developing in the background. Lightning has been growing steadily, while Stacks has been working on major upgrades to help grow the Bitcoin smart-contract market. Rootstock has also been upgrading, while the addition of sovereign rollup builder, Rollkit, is a great new addition.

The L2 solutions currently available on Bitcoin have different purposes, with some L2s attempting to further scalability to the network whereas others are attempting to add more expressive programmability. In this section, we highlight some of the most notable Bitcoin L2s.

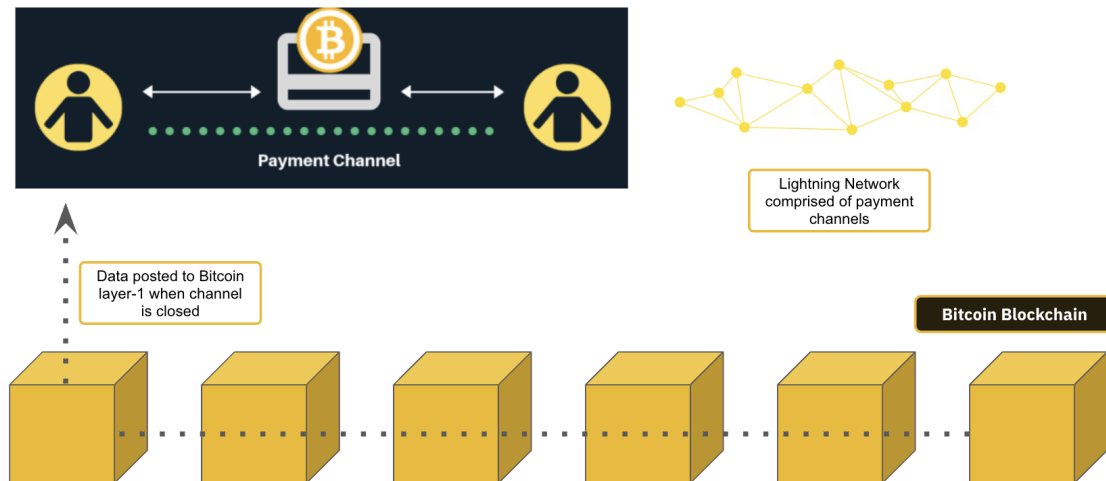
## Lightning Network

Along the spectrum of the [Blockchain Trilemma](#), Bitcoin's implementation optimizes for decentralization and security as opposed to scalability. As a result, Bitcoin compared to other L1 networks such as Ethereum or BNB Chain has generally slower throughput and higher transaction fees. To maintain its dominance in an increasingly competitive L1 landscape and to fulfill Satoshi's ambitions of creating a practical payment system, Bitcoin needed to find a way to improve scalability.

Lightning Network<sup>(9)</sup> was proposed in 2016 by Joseph Poon and Tadge Dryja to directly address Bitcoin's scalability issues. **The Lightning Network is composed of "payment channels," which are practically just [multisig](#) smart contracts that facilitate transactions between two users.** By utilizing payment channels, users can transact off-chain, away from the Bitcoin blockchain. This translates to high throughput and low fees, as users don't have to compete for blockspace or wait for L1 consensus to transact. Ultimately, once Lightning Network users decide that they are finished transacting via the

payment channel, they can elect to close the channel. Subsequently, an aggregate transaction that summarizes off-chain activity is settled on-chain to the Bitcoin network. In this way, the Lightning Network not only inherits Bitcoin's security, but also allows for amortized transaction fees and unconstrained transaction throughput.

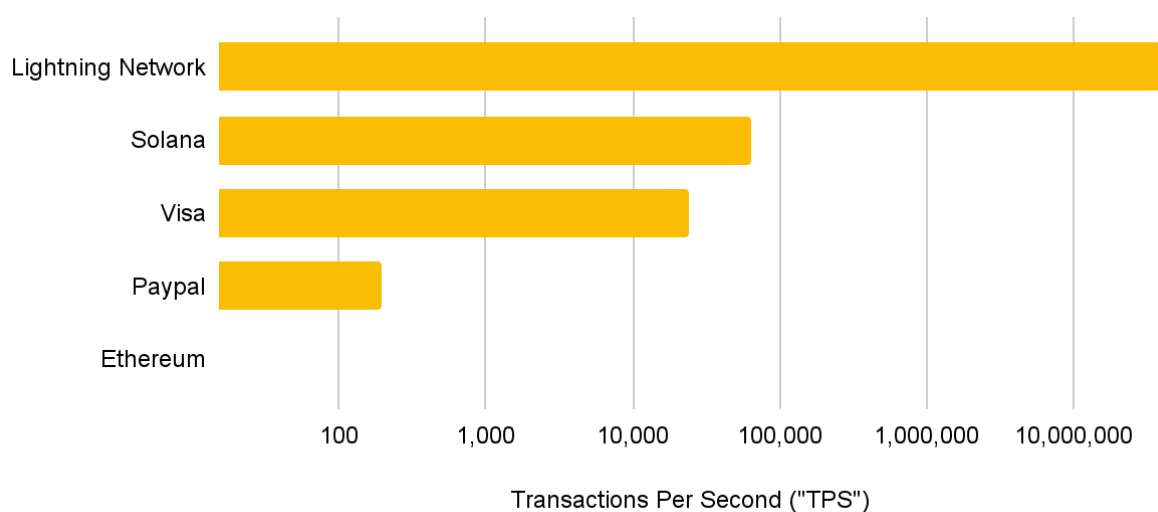
**Figure 24: The Lightning Network**



Source: Bitpanda, Binance Research

Due to its unique design, the **Lightning Network has the theoretical capacity to facilitate over +40M transactions per second**. This is much greater capacity in comparison to other blockchains and even traditional payment rails.

**Figure 25: Transaction throughput of Lightning Network vs. other payment rails**

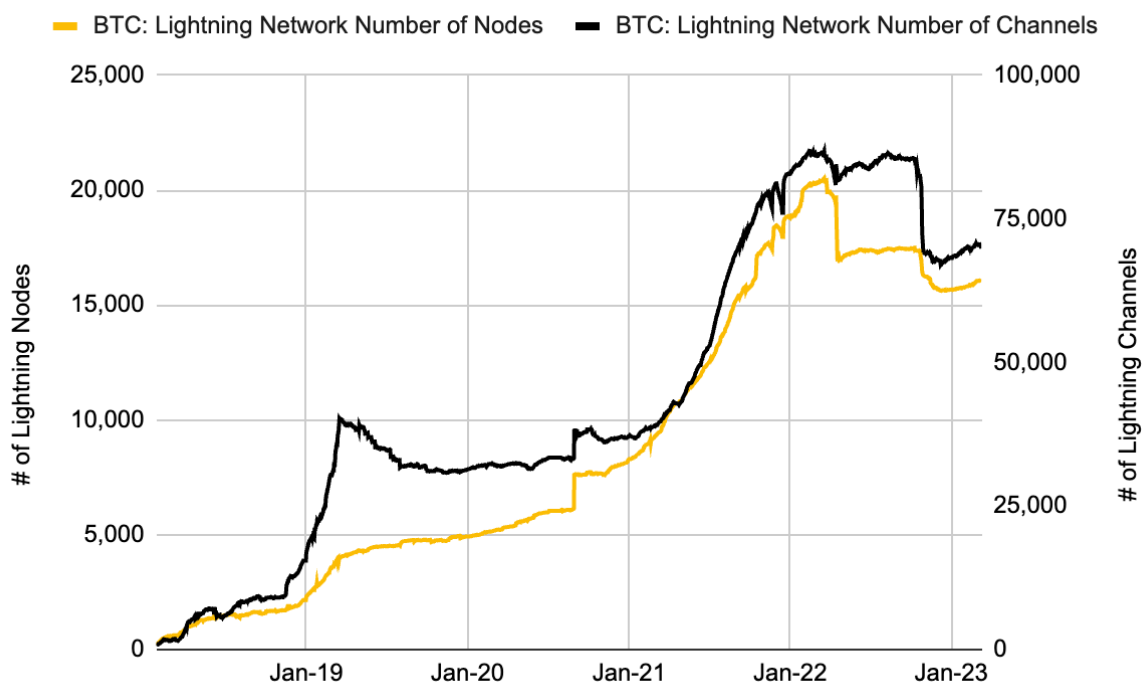


Source: Blockstream, Binance Research

Furthermore, the **Lightning Network has rendered transaction fees to be negligible**. Lightning Network nodes are incentivized to route payment channel transactions by being paid two types of fees: a base fee, and a fee rate. At the time of writing, the base fee to transact through a payment channel at a median value of only US\$0.000000572. The fee rate to send a specific quantity of BTC through a payment channel is also miniscule, at a median rate of US\$0.000000005735/satoshi. As shown in **Figure 21**, both of these fees are continuing to fall as use of the Lightning Network increases and competition to run a Lightning Network node also increases.

Lightning Network's potential to scale Bitcoin is being broadly recognized. With Bitcoin usage starkly rising since 2016 (as shown by **Figure 3** and **Figure 4**), many users have flocked to the Lightning Network to minimize transaction fees and render transacting on Bitcoin to be more practical. As a result, the Lightning Network is being increasingly used. As shown in **Figure 26** the number of Lightning Nodes has been on an uptrend for the past few years. Similarly, the number of channels created on the Lightning Network have increased.

**Figure 26: The Lightning Networks' capacity has steadily increased and recently hit an ATH**



Source: Glassnode, Binance Research  
Data as of 10 Mar 2023

Lightning Network use has also been catalyzed by country-level and corporate-level integrations. For example, after El Salvador made Bitcoin legal tender in 2021, the Lightning

Network was publicly recognized by the government and ultimately, made compatible within the government's commissioned [Chivo Wallet](#). On the corporate-level, both Twitter and Cash App added compatibility to the Lightning Network into their platforms.

The future prospects of the Lightning Network seem bright, as many different projects and investors are working to build out the layer-2 network.

For example, Jack Dorsey's Bitcoin-focused startup, Block, recently launched a new venture arm called "c=", which will be solely focused on new funding tools and services on the Lightning Network. This is a significant expansion to the funding that the Block has already given to Spiral, an open-source collaborative of developers who are working on a new implementation of the Lightning Network.

Spiral is building the so-called [Lightning Developer Kit](#) ("LDK") implementation, which aims to make the user experience of the Lightning Network more appealing to mainstream users. Currently, the user experience of setting up a Lightning node is difficult. Furthermore, to send a payment on Lightning, the receiver has to be online (with their Lightning wallet open). The LDK implementation resolves these issues and includes numerous other changes that will enhance the usability of the payment system.

Lightning Labs, the core team behind the Lightning Network, is also working to release the "Taro" update. Taro, which is an acronym for "Taproot Asset Representation Overlay," will use Bitcoin's Taproot update to bring new assets to Bitcoin. More specifically, Taro leverages the Lightning Network, Bitcoin's UTXO accounting model, and Taproot to create a private network for non-BTC asset transfers. Ultimately, Taro will allow users to issue and transfer synthetic assets, tokens, and NFTs on Bitcoin.

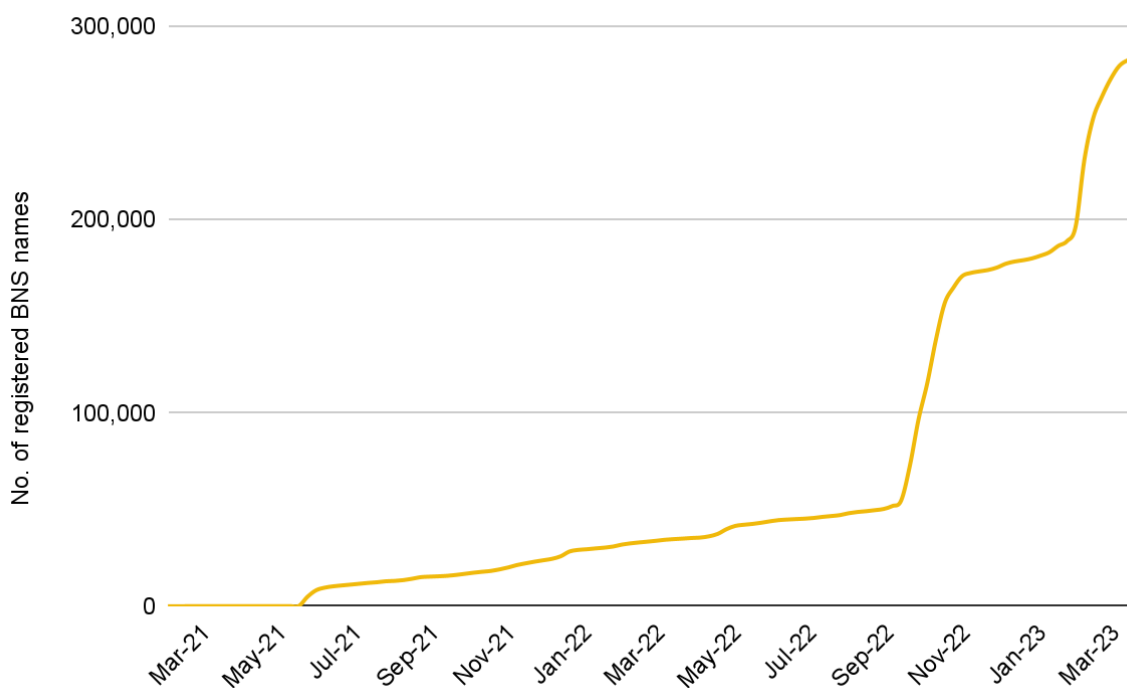
Lastly, companies like Zeebeedee and Strike, are coordinating with different countries' fiat onramps to onboard new swaths of users onto the Lightning Network. Zeebeedee, recently "debuted a payment feature on its app that allows users to instantly send any amount of money to five jurisdictions, including Nigeria and Brazil."<sup>(10)</sup> Strike has already expanded into El Salvador and other central American countries, and is now "expanding its international money transfer service that runs on Bitcoin's Lightning Network" to the one of the world's largest remittance market in the Philippines.<sup>(11)</sup>

## Stacks

Stacks calls itself a “Bitcoin Layer”. While it is definitively not a sidechain, it does not quite fit all the definitions of what most of us call a L2 ([more](#) on this later). To put it simply, **Stacks is a blockchain that functions as a secondary layer for Bitcoin smart-contracts**. The Stacks chain uses the STX token to incentivize miners and for transaction fees and relies on a novel **Proof of Transfer (“PoX”)<sup>(12)</sup> consensus mechanism**. Through PoX, the Stacks blockchain settles transactions on the Bitcoin L1, allowing Stacks transactions to benefit from Bitcoin’s security. The STX token can also be “stacked” in order to earn BTC-denominated yield.

Developers can build all sorts of dApps on the Stacks chain, with a particular focus on DeFi and NFTs. Stacks uses the **Clarity programming language<sup>(13)</sup>** for its smart contracts - designed for many reasons, including the prevention of some of the security risks that have been commonplace with Solidity, including re-entrancy attacks. Since the mainnet launch in Jan 2021, a number of different [projects](#) have been built or deployed on Stacks, including **Bitcoin Name Service (“BNS”)**, which has seen growing interest through 2022 and a notable spike this year.

**Figure 27: The number of total registered BNS names is nearing 300K**



Source: Stacksonchain.com, Binance Research



## What is next for Stacks?

### ❖ **sBTC**

- This will introduce a **trust-minimized, non-custodial two-way peg system, allowing users to “bridge” BTC from L1 into sBTC on to the Stacks layer** (1:1 peg with the BTC used to mint it). Users will be able to send BTC to a multi-sig wallet on the L1 (controlled by a decentralized group of “stackers” who have locked up their STX to secure the Stacks chain) and mint an equivalent amount of sBTC on Stacks. This sBTC can then be used for DeFi, NFTs and more.
- Stacks sees this as the final “piece” in their vision of a fully-expressive Bitcoin execution layer and are seeking to unlock the US\$500B+ of capital within Bitcoin with this solution.
- **sBTC will have full access to smart contracts on the L2 level** and the team expects this to take Stacks’ DeFi and NFT use cases to go to the next level.

### ❖ **The Nakamoto Release**

- Nakamoto refers to the upcoming upgrade of the Stacks chain to enable sBTC.
- Additionally, **following the release Stacks will use 100% of Bitcoin security to determine finality on Stacks layer.** In practice, this means that after the upgrade, to reorganize (“reorg”) Stacks’ blocks/transactions the attacker would have reorg Bitcoin L1 itself. Given Bitcoin is by far the most decentralized crypto, this is very hard to do and thus adds a significant amount of security to Stacks as a Bitcoin layer.

While a detailed timeline has not yet been released, the **earliest these features are set to go live will be in the second half of 2023.**

Stacks has seen a significant uptick in interest in the last few weeks, benefiting from the discussion around Ordinals and what it means in terms of increased Bitcoin use cases. Stacks have capitalized on this well, with co-founder Muneeb Ali doing the rounds of the top crypto podcasts recently. Investors are likely also positioning themselves for the upcoming Stacks upgrades, with all eyes on sBTC and what it could potentially deliver for the largest crypto in the market.

**Figure 28: Stacks DeFi TVL has been spiking in 2023**

Source: DeFiLlama, Binance Research

Data as of Mar 30 2023

## Rootstock

Rootstock (“RSK”) functions as an EVM-compatible sidechain for general-purpose Bitcoin smart contracts. The RSK chain uses a unique variation of Bitcoin’s [Nakamoto consensus](#) called DECOR+. This gives **RSK the ability to be merge-mined with Bitcoin**, which essentially allows for RSK to be mined simultaneously with Bitcoin (historically between 40-50% of Bitcoin miners have chosen to also merge-mine RSK<sup>(14)</sup>).

**Smart Bitcoin (“RBTC”) is the native currency within RSK** and used to pay transaction fees. It is **pegged 1:1 with BTC** (meaning that RBTC also has a 21M hard cap). The Bitcoin L1 and RBTC are connected via the **“Powpeg”<sup>(15)</sup>**, which is a **two-way bridge used to transfer BTC between the two chains** - this is referred to as in “pegging-in” and “pegging-out”. This bridge was initially governed by a federation who managed a multi-sig wallet (Check out our report, [Wallets: A Deep Dive into Crypto Custody](#), for more details on different types of wallets). **RSK has since further decentralized the bridge, although the process still requires some degree of trust given that peg-out requests are still subject to at least 51% of signatories being online.** The federation still manages parts of the process<sup>(16)</sup> and members act as notaries who protect the locked BTC, as well as hold other

communication-related responsibilities. There are currently nine members<sup>(17)</sup> providing support to the Powpeg.

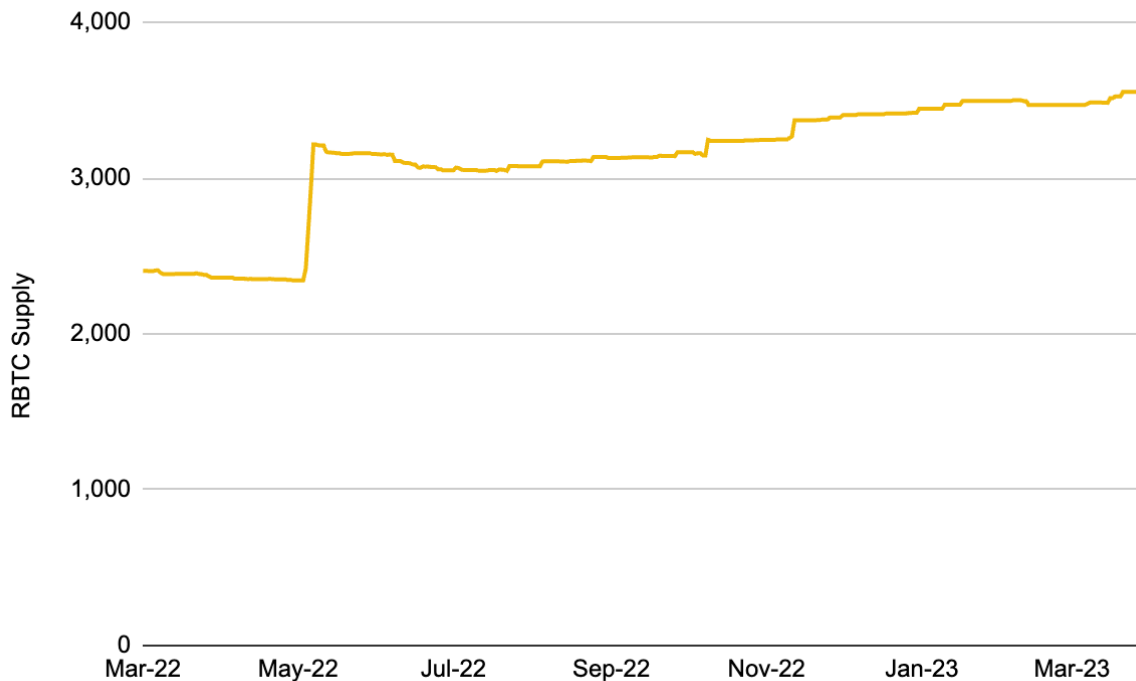
**Figure 29: The group currently providing support to RBTC's Powpeg bridge**



*Source: Binance Research*

The **RSK Virtual Machine (“RVM”)** and its compatibility with the EVM is a key advantage for RSK. This also means that RSK smart contracts can be written in Solidity. One of the more notable RSK projects include **Sovryn**, which is a non-custodial, smart contract platform for lending, borrowing, and margin trading with Bitcoin. This fits in with one of RSK’s major aims, which is to enable DeFi on Bitcoin. **A major milestone that RSK recently announced<sup>(18)</sup> was the removal of the 4,000 RBTC cap (extending it to the whole 21M BTC supply).** This is notable as RBTC supply had been trending towards 4K mark, and thus was extremely limited in what it could achieve in terms of use in Bitcoin DeFi. With the removal of the cap, the entire 19M+ current supply of Bitcoin is now eligible to be locked up on RSK in exchange for RBTC. We can imagine that this news has attracted the attention of new developers or possibly re-engaged existing developers, who can now see an increasing possibility set with RBTC. It will be important to monitor if we see any notable announcements of new dApps being launched on RSK.

**Figure 30: RBTC supply had been trending towards the 4K hard cap in recent months. This cap has now been removed**



Source: CoinMarketCap, Binance Research

Data as of 29 Mar 2023

## A word on Stacks' sBTC vs RSK's RBTC

- ❖ Although sBTC is yet to be released, a key difference between its planned design and RBTC is that of **decentralization**. One of the factors that is addressed from the very first paragraph of the sBTC whitepaper<sup>(19)</sup> is that their peg mechanism does not rely on any centralized or pre-determined group of actors, instead relying on a decentralized and economically incentivized group of signors. **Stacks' sBTC set up can be referred to as a collateralized bridge**. While RSK has moved away from its mainly federation-dependent origins, there are still elements of trust within the architecture of RBTC. Thus the **RBTC solution could be seen more closely to a federated bridge**. This is in contrast to **fully centralized solutions like WBTC** and **theoretically trustless validity bridges like Arbitrum and Optimism** on Ethereum.
- ❖ One other factor to consider is the **choice of programming languages** between the two. RSK smart contracts are written in Solidity, while sBTC contracts will be written in the Clarity language. Given the use of Solidity in Ethereum, BNB Chain and a number of other leading L1s, compared to the relatively limited use of Clarity (primarily Stacks) - it might perhaps be the case that RSK is able to attract more smart contract developers than Stacks.

## Liquid Network

The Liquid Network is a [sidechain](#) L2 which enables settlement and issuance of digital assets, such as stablecoins, security tokens, and other financial instruments, on top of the Bitcoin blockchain.

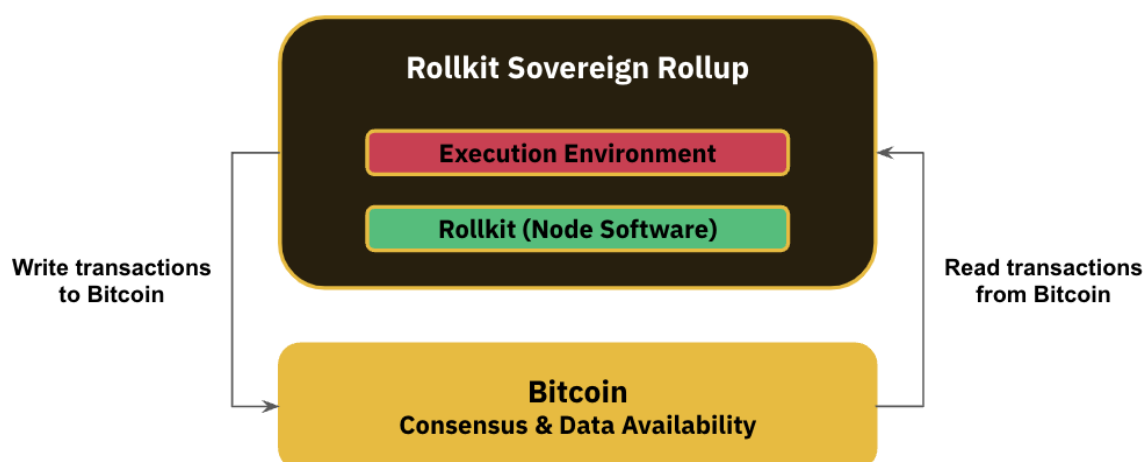
Unlike other L2 solutions mentioned thus far, Liquid Network is relatively centralized, and secures itself through a federated consensus mechanism that is managed by 60 functionary members. Functionary members are tasked with validating blocks and adding transactions to the Liquid Network sidechain.

Similar to RSK, the **Liquid Network has a token, called “L-BTC,” that is pegged 1:1 to BTC. At the time of writing, there are ~3,556 L-BTC in circulation.** The primary and most pervasive use case of the token is in the Lightning Network for relatively higher transaction speeds and throughput as compared to the Bitcoin mainchain. It should also be noted that users of the Liquid Network can also use their L-BTC for other Liquid Network enabled applications such as lending or purchasing security tokens.

## Rollkit

Developed by the Celestia team, **Rollkit is a modular framework for Bitcoin rollups.** Many L1 chains today, including Bitcoin, exist as a monolithic chain, meaning that consensus, data availability, and execution processes operate on the same layer. Rollkit renders Bitcoin to have a modular framework, meaning that Bitcoin’s consensus and data availability processes are separated from its execution environment.

**Figure 31: Rollkit Modular Framework**



Source: Binance Research

This modular framework and the Rollkit node software **allows L2 Bitcoin developers to deploy a custom, Turing-complete execution layer on top of Bitcoin, all while being able to securely write and read from Bitcoin's data availability layer.**

How does it work? Rollkit allows developers to deploy “**sovereign rollups**”. These use Bitcoin as the Consensus and Data Availability layer (giving the rollup transactions the same level of security as Bitcoin) and then provide an environment to execute complex transactions with your Bitcoin. **These transactions, whether they be DeFi, NFT, or Infrastructure related, are bundled, and ultimately sent to the Bitcoin L1, so they can be included within the Bitcoin ledger.** Rollkit also utilizes the [Taproot and Segwit upgrades](#) that Ordinals and Inscriptions rely upon. The execution environment is customizable, making it possible to even operate an EVM on top of the Bitcoin network. Sovereign rollups are easy to launch, given that they don't have to maintain their own consensus or validator sets. In this way, Rollkit's so-called “sovereign rollups” preserve and rely on the “sovereignty” of the Bitcoin L1, while additionally, adding scalability and turing-complete programmability.

Although Rollkit is a rather new take on Bitcoin L2s, given that it was only announced in February, it is already garnering attention. For example, renowned Bitcoin thought leader Eric Wall shared his views on Rollkit and its potential:

*“This is incredible. Instead of putting JPEGs on Bitcoin, you can use the same storage space that Ordinal Inscriptions use to put rollups on Bitcoin. That would allow any execution environment to run, with the \*same\* data availability guarantees and block ordering as Bitcoin itself,”<sup>20</sup>*

An interesting concept to consider is **potential integrations between Stacks' sBTC and Rollkit**. Rollkit provides a platform for developers to build execution-level smart contracts for Bitcoin. Thus, Rollkit requires a way to move BTC from L1 to L2. Given sBTC is a trust-minimized way to both BTC from L1 to another layer, it could be a plausible idea to consider an integration here. Users can move BTC from L1 to a Rollkit rollup for Defi (for example) and then move it back, using sBTC as the medium of transfer.

### What is a “true” L2?

The term L2 predates Ethereum and has meant different things in the Bitcoin ecosystem. For example, the Bitcoin project, Liquid, refers to itself as a L2, but block signing and a multi-sig wallet is managed by a federation, essentially making Liquid a federated sidechain, not a “true L2”.

A “true L2”, in the post-Ethereum world, holds a key property in that, **if a user moves their assets from the L1 to the L2, they should be able to get their asset back without relying on any aspect of the L2** i.e. the L2 should be trustless. I.e. if a user moves their BTC from the Bitcoin L1 to Stacks via sBTC or RSK via RBTC or Liquid via L-BTC, they should be able to get their BTC back to the Bitcoin L1 without relying on any aspect of the mentioned solutions. This is **not the case for Bitcoin L2s**.

**According to this definition, none of these solutions qualify as a true L2.** For Stacks a decentralized group of signers will have to sign the request when you want to move your BTC from Stacks back to the Bitcoin L1. Similarly for RSK, there are requirements of its underlying federation. Liquid is even more closely managed by its federation. Rollkit will require some sort of bridge in order to receive BTC (this cannot be trustless as things stand, but could be trust-minimized).

This is sometimes called **Bitcoin’s two-way peg problem** and occurs because Bitcoin does not have the level of execution environment that can support asset verification (from L1 to L2 and back) e.g. like Ethereum can with its validity rollups, Optimism and Arbitrum. **To reach the level of “true L2”, Bitcoin L2s would require op-code level support from Bitcoin i.e. a soft fork.** While this is possible, it is likely a multi-year project, and not something that can definitely be counted on. In fact, Stacks co-founder, Muneeb Ali, has even stated that Stacks had an implicit working principle that throughout development, they could never ask the Bitcoin L1 for support.



# What is next for Bitcoin?

## Bitcoin smart-contract market

For many years now, Bitcoin has dealt with a lack of developer tooling, slow and sometimes clunky infrastructure and what seemed like relatively limited innovation relative to smart contract giants like Ethereum, BNB Chain and Solana. Finally, things seem to be changing.

Builders finally have something to do with their Bitcoin. Developers are staying up late, sand shipping updates at a rate not seen in Bitcoin in a while - all of it driven by **organic demand**. This is the key part, when an ecosystem is going through a period where organic, genuine user demand is essentially forcing innovation and product development, a **virtuous cycle** can ensue and things can escalate fast.

*Organic demand for product updates → product innovation →  
more attention on the ecosystem from developers and users → big  
names enter → creates further organic demand and so on.*

With names like Yuga Labs, DeGods and Magic Eden having entered the Bitcoin NFT space within weeks of Ordinals, while Celestia builds Rollkit to scale Bitcoin, the wheels are definitely turning. The questions we should be asking ourselves are; **who is the next major brand to enter Bitcoin? What new dApp is going to be released on a Bitcoin L2 that takes the space by storm? What killer use case is currently being worked on by a team whose attention was caught by Ordinals?**

Already we have developers integrating Ordinals into wallets, creating Ordinal explorers, bespoke minting services, auction houses etc. Nonetheless, the infrastructure space remains in its early stage. This presents a sizable opportunity to developers who can look to create all that is available on other smart contract platforms (both in terms of NFTs, but also broader smart contracts) on Bitcoin.

Remember Bitcoin holds over US\$500B in capital in the depths of a BUIDL market. It is clear that Bitcoin is a serious force and that just a splash of this largely dormant capital can make a sizable impact in the broader crypto markets. Let's see who manages to ride this wave.

## The case for Bitcoin rollups

It feels like Ordinals and Inscriptions have reengaged and attracted the attention of large parts of the community. With **on-chain activity on the rise and Bitcoin L1 blockspace continuing to gain value, the reasoning for Bitcoin L2s writes itself**. All signs, from increased block size, mempool, fees, to the increased innovation and excitement around the Bitcoin ecosystem, point this way.

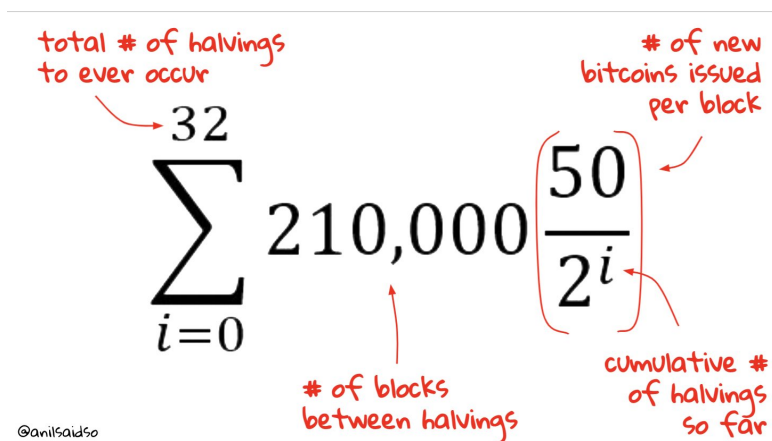
The **key development to watch is if there is any movement on Bitcoin's two-way peg problem**. As previously mentioned, for a completely trustless bridge to exist between the Bitcoin L1 and any L2, op-code level support i.e. a soft fork, is required. This will take time and will likely only be a function of demand.

While we see demand rising, one thing worth considering is the fact there still remain some parts of the Bitcoin community that are against any use case outside hard money. **Given Ordinals and Inscriptions were essentially an unintended byproduct of the Segwit and Taproot updates, this might mean that Bitcoin core developers and community members might be more resistant to the ideas of a soft fork.**

## Upcoming Halving

Part of the allure of Bitcoin is its fixed, programmable monetary policy. Unlike the monetary policy of traditional central banks, Bitcoin's future monetary path is pre-determined and cemented in open-source code. This provides Bitcoin users and miners more predictability into the future issuance of BTC and prevents typical inflationary pressures found in most traditional economies.

*Figure 32: Bitcoin monetary policy formula*



$$\sum_{i=0}^{32} 210,000 \left( \frac{50}{2^i} \right)$$

Handwritten annotations in red:

- total # of halvings to ever occur (points to 32)
- # of new bitcoins issued per block (points to 50)
- # of blocks between halvings (points to 210,000)
- cumulative # of halvings so far (points to  $2^i$ )

@anilsaidso

Source: Twitter @anilsaidso, Binance Research

More specifically, Bitcoin follows a monetary policy and fixed issuance schedule until there is a maximum supply of 21M BTC in circulation. Since the genesis block, miners have been rewarded with newly issued BTC. The amount of BTC that is issued depends on the formula seen in **Figure 32**; Every 210,000 blocks, the block reward is halved, meaning that the BTC issued decelerates over time.

**Currently, the block reward or the amount of new BTC issued per block is 6.25BTC. Estimates show that Bitcoin will reach its next “halving event” sometime in March 2024** (i.e. the time in which 210,000 blocks had been mined since the last halving event in May 2020). At that point the block reward and the amount of new BTC issued per block will be halved to 3.125BTC.

As mentioned before, miners are primarily compensated for securing the Bitcoin blockchain by the block reward. **If one holds the purchasing power of Bitcoin and the current fee market fixed, each halving event implies that miners will effectively lose half of their revenues.** Under these assumptions, halving events in this way are potentially detrimental to miners and the security of Bitcoin in the long term.

However, the **recent rise of Ordinals and the spike in transaction fees may serve as early indicators for a developing fee market.** If the transaction fee market was to mature as a result of increased use cases of the Bitcoin network and more competition for blockspace, then miners wouldn't be so reliant on block rewards. In the long term, even as block rewards decline, miners could feel confident that transaction fees would compensate them enough for securing the Bitcoin network.

## Closing Thoughts

Ordinals and Inscriptions have introduced a fresh vibrancy to developing on Bitcoin, instilled a new set of stakeholders with differing voices and opinions and ultimately, injected life and enthusiasm into an ecosystem which has been somewhat lagging in the age of monkey NFTs and perpetual swap driven DeFi markets.

The increase in transaction fees being paid to miners ultimately incentivizes security of the blockchain and means that Inscriptions and innovations based around them are accretive to the long-term sustainability of Bitcoin.

With regards to what “Bitcoin should or should not be used for”, ultimately, there is no such social contract in the code, and if the transactions are paid for and go through consensus, who is anyone to say that they are not “what Bitcoin was designed for”?

There is a noticeable shift in Bitcoin culture. People are excited. Watch this space carefully.

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