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How Much Is Bitcoin's Security Worth?

Bitcoin's store-of-value narrative is the very thing undermining its security budget. Why Bitcoin is NAT prepared.

Bitcoin is NAT Certain

Introduction

Bitcoin, at its core, is not merely a technological artifact or a digital currency; it is a profound cultural and philosophical construct that challenges humanity's longstanding conceptions of value, trust, and power. Born from the ashes of the 2008 global financial crisis, Bitcoin emerged as Satoshi Nakamoto's audacious response to centralized fiat systems, encoded in a pseudonymous whitepaper that blended cryptography with a vision of decentralized sovereignty.

Since then Bitcoin's interpretive value has taken many forms, shaped by collective narratives, power dynamics, and evolving societal needs. It is less a fixed "thing" than a mirror reflecting our anxieties about authority and freedom. Value in Bitcoin does not derive solely from utility or scarcity (though these are foundational); it arises from how we imbue it with meaning. However, the underlying unifier must be identified as

Bitcoin's ability to consume energy to maintain network security. This energetic commitment is the bedrock upon which all interpretations of Bitcoin's value rest.

To effectively track the status of energy consumption in relation to the preservation of network security, new metrics need to be utilized that provide a dynamic lens to assess whether Bitcoin's energetic foundation remains robust against evolving threats, ensuring that its decentralized sovereignty and interpretive value can endure as societal needs and power dynamics continue to shift.

The Bitcoin Security Intensity (BSI) is a critical metric that quantifies the proportion of Bitcoin's market capitalization actively defended by miner revenue, calculated as the annualized miner revenue (block subsidies plus fees) divided by the market cap.

$$\text{BSI} = \text{Miner Revenue (annualized)} / \text{Market Cap}$$

Energy Security Ratio for Proof-of-Work Systems (ESR)

Bitcoin's proof-of-work consensus relies on significant energy consumption to secure its network against 51% attacks, where an adversary could control the majority of the hash rate. To assess this vulnerability, we use the Energy Security Ratio (ESR), defined as Bitcoin's energy consumption divided by the global electricity surplus. This surplus represents the energy pool available for potential attacks, assuming equivalent mining efficiency.

Using 2024 data as a benchmark:

- **30,856 TWh**: Global electricity generation
- **27,000 TWh**: 2023 Global electricity consumption
- **3,856 TWh**: Global electricity surplus
- **186 TWh**: Bitcoin's annualized energy footprint

$$\text{ESR} = \text{Bitcoin Energy Consumption} / \text{Global Electricity Surplus}$$

$$\text{For 2024: ESR} \approx 186 / 3,856 \approx 0.048 \text{ (4.8\%)}$$

The **Attack Opportunity Index (AOI)**, defined as $1 - \text{ESR} \approx 0.952$ (95.2%), indicates that 95.2% of the surplus could theoretically be redirected to attack the network. To enhance security, Bitcoin's energy use must exceed 50% of the surplus (>1,928 TWh), making attacks infeasible by dominating available resources.



Metric	Description	2024 Benchmark	Target
Global Generation	Total electricity produced worldwide	30,856 TWh	N/A (exogenous variable)
Global Consumption	End-user electricity demand	~27,000 TWh (2023)	N/A (exogenous variable)
Surplus Energy	Generation minus consumption (incl. losses)	~3,856 TWh	N/A (exogenous variable)
Bitcoin Consumption	Network's annual energy use	186 TWh	Scale to >50% of surplus
Energy Security Ratio (ESR)	Bitcoin / Surplus	0.048 (4.8%)	>0.5 (50%) for attack resistance
Attack Opportunity Index (AOI)	1 - ESR	0.952 (95.2%)	<0.5 (minimize vulnerability)
Bitcoin Security Intensity (BSI)	Annualized miner revenue / Market Cap	0.0088 (0.88%)	>0.01 (1%) for robust defense

Why the Existing Economic Model Fails

The existing economic model of Bitcoin, centered on miner revenue from block subsidies and transaction fees, is structurally inadequate to drive the Energy Security Ratio (ESR) to a level where the Attack Opportunity Index (AOI) falls below 50%, thereby ensuring absolute security against 51% attacks.

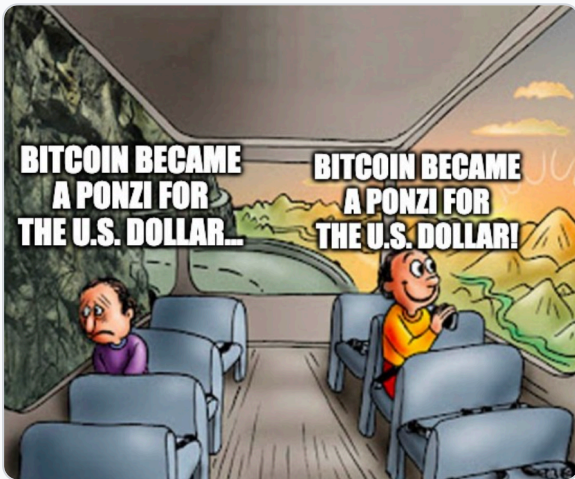
The BSI has dropped to 0.88% in 2025, a significant decline from historical levels (e.g., 3.9% in 2014). This metric reflects the proportion of Bitcoin's valuation actively defended by miners. The current block subsidy of 3.125 BTC, post the 2024 halving, combined with stagnant fee growth, has eroded miner revenue.

Who Will Foot the Bill for Security?

Without sustainable monetary incentives in Bitcoin's security model, nation-states may become the most likely actors to sustain it. The United States, already has a vested interest in maintaining Bitcoin's security to support a dollar-centric financial reset and can absorb costs by treating Bitcoin mining as a strategic investment.

In this scenario, the United States will likely prioritize security to protect their BTC holdings and dollar stability, driving energy consumption toward dominance of the global surplus. This could stabilize the Energy Security Ratio (ESR), reducing the Attack Opportunity Index (AOI) below 50%, but **at the cost of losing Bitcoin's decentralized ethos.**

Bitcoin Timeline



Bitcoin centralized by nation states

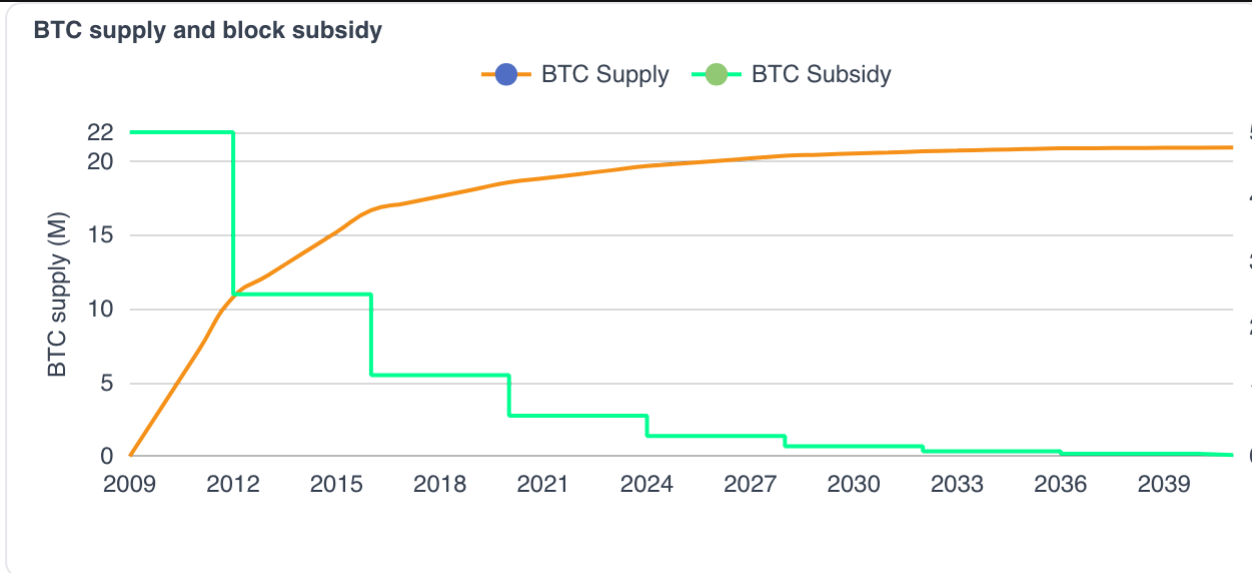


Bitcoin decentralized

Is Bitcoin NAT Worth Securing?

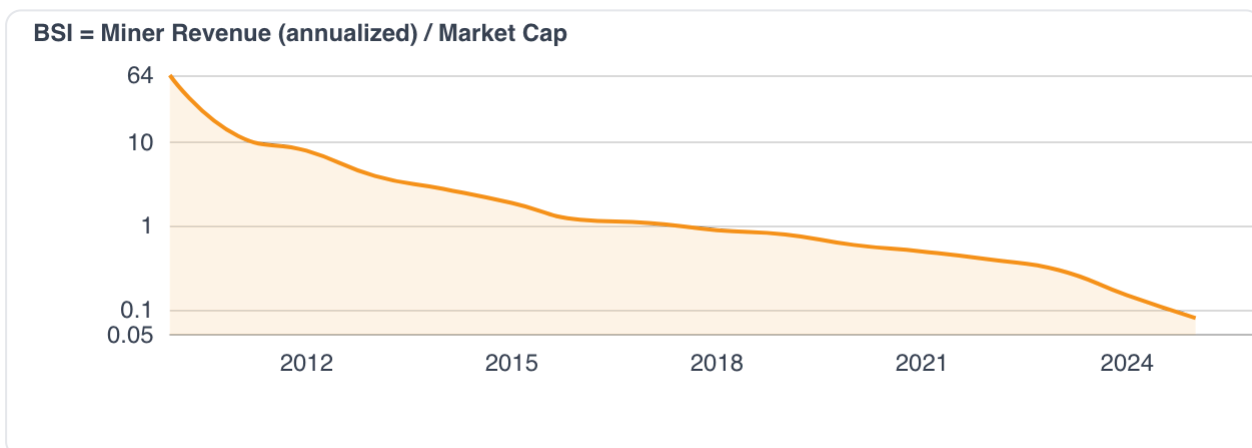
The Problem

The Bitcoin network secures its decentralized ledger through proof-of-work mining, incentivized primarily by block subsidies that halve approximately every four years or 210,000 blocks. As these subsidies diminish, the network's long-term security increasingly relies on transaction fees, which historical data indicates constitute a negligible and volatile portion of miner revenue, often less than 5% of total rewards over the past three years.



Broken Fee Model (Store of Value vs Digital Cash)

Bitcoin's growing adoption as a store of value, rather than a peer-to-peer electronic cash system as originally envisioned, exacerbates the security budget issue by suppressing transaction fee revenue, which is critical to sustaining miner incentives as block subsidies halve every four years.

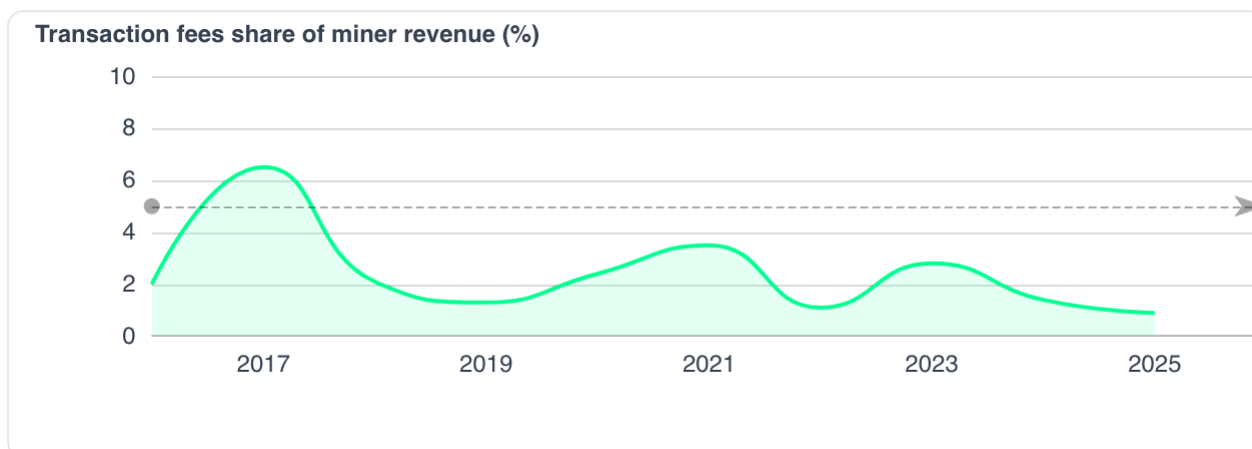


Miner Revenue Declining Implies Greater Security Risks

Declining miner revenue in Bitcoin, driven by the programmed halving of block subsidies every four years and insufficient growth in transaction fees to offset the shortfall, undermines the network's incentive structure, leading to a reduced cost to attack as profit-driven miners scale back operations or exit the ecosystem.

- **51% Attacks:** With a lower overall hash rate, it becomes cheaper for a malicious actor to amass more than half of the network's mining power.
- **Increased Centralization:** Diminished revenues may force smaller miners out, concentrating hash power among a few large entities.

- **Chain Reorganizations:** A weaker hash rate slows block propagation and increases the likelihood of competing chains.
- **Bribery and Coercion Vulnerabilities:** Underpaid miners become more susceptible to external incentives.



Why This Problem Cannot Be Ignored

As Bitcoin integrates more deeply into the traditional financial system, evidenced by the proliferation of spot ETFs, institutional custody solutions, and regulatory frameworks that treat it as a legitimate asset class, the security budget problem becomes increasingly critical to address.

NAT a Problem Anymore

The Solution

Introducing the Non-Arbitrary Token (NAT), a meta-protocol-derived digital commodity produced natively from Bitcoin's block data patterns, as a **complementary subsidy** token to bolster miner incentives without altering Bitcoin's core infrastructure, OP codes, or consensus rules.

Pioneers Began Questioning The Sustainability

The Bitcoin security budget concern is not a contrived narrative engineered to support the value thesis of innovations like NAT; rather, it is a genuine, long-standing debate that has preoccupied the Bitcoin community for well over a decade.

Additional Network Subsidy (NEW)

By providing a perpetual, inflationary yet difficulty-adjusted subsidy that increases overall miner profitability, encouraging greater participation and investment in hash rate

without altering any of the core design principles or economic foundations to Bitcoin itself.

\$NAT Market Cap	Additional USD/Block	vs BTC Fees (~\$3,390)	vs BTC Subsidy (~\$353,125)
\$50M	\$50	Negligible (1.5% of fees)	Minimal (0.01% of subsidy)
\$500M	\$500	Minor boost (15% of fees)	Negligible (0.1% of subsidy)
\$1B	\$1,000	Approaches fees (30% of fees)	Minor (0.3% of subsidy)
\$3B	\$3,000	Near parity (89% of fees)	Small (0.8% of subsidy)
\$6B	\$6,000	Exceeds fees (177% of fees; surpasses typical tx revenue)	Modest (1.7% of subsidy)
\$100B	\$100,000	Significant (29× fees; dwarfs tx revenue)	~1/3 of subsidy (28% of subsidy)
\$350B	\$350,000	Massive (103× fees; far exceeds tx revenue)	Matches subsidy (99% of subsidy; doubles total rewards)

What the NAT?

How it Works

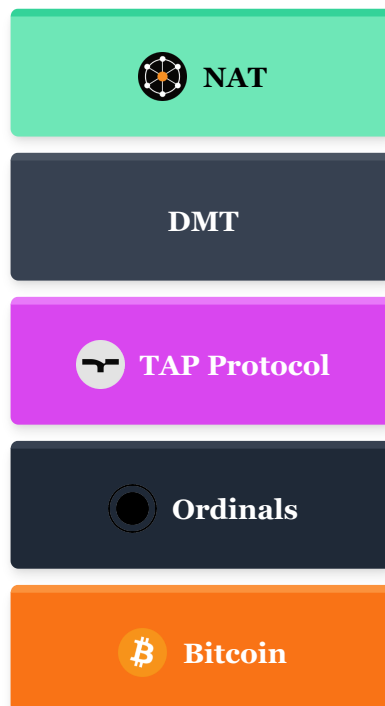
Using the Digital Matter Theory (DMT) framework, \$NAT issues rewards to miners that adjust with Bitcoin's difficulty. Emissions are tied to the Bits field, which encodes difficulty. As hash power increases, difficulty rises, Bits falls, and \$NAT issuance declines.

Meta-protocols On Bitcoin

Meta-protocols in the context of Bitcoin are secondary layers or frameworks built on top of the Bitcoin blockchain that leverage its existing data structures, such as block headers and transaction outputs, to create new functionalities, assets, or incentive mechanisms without altering Bitcoin's core code.

Ordinals

The Ordinals Protocol, built on Bitcoin, assigns unique identities to individual satoshis by tracking their mining



order, using SegWit and Taproot to embed data like text or images as inscriptions.

TAP Protocol

The TAP Protocol enhances Bitcoin's Ordinals by providing a flexible framework for complex token issuance models, such as the Digital Matter Theory based Non-Arbitrary Tokens (NATs).

DMT/NAT

The Digital Matter Theory (DMT) protocol creates non-arbitrary tokens by treating Bitcoin's blockchain data as a thermodynamically secured substrate for deriving digital commodities.

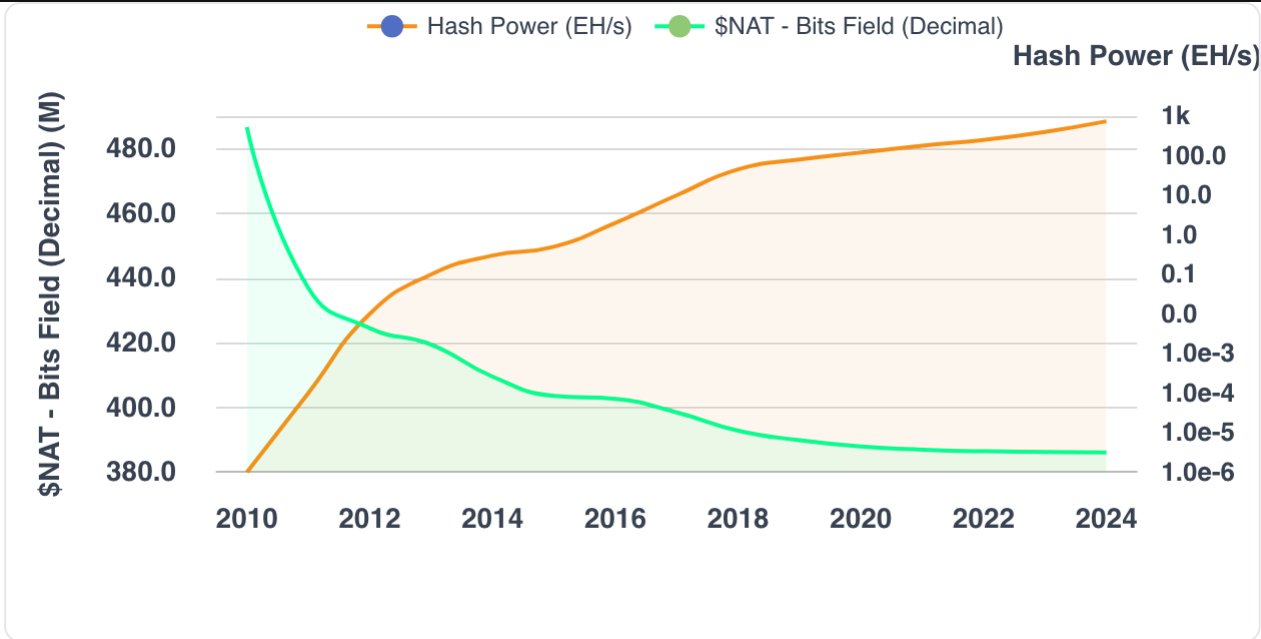
Bitcoin is NAT Source Data

Bits Field

The token's value proposition ties to Bitcoin's "bits" field in block headers, a compact 32-bit representation of mining difficulty (target hash). Difficulty adjusts every 2016 blocks based on hashpower. As hashpower rises, the bits value decreases (inverse relationship), reflecting network strength.

Impact on Difficulty

As network hash power increases, the target decreases (more leading zeros), which reduces s (smaller exponent) and c (coefficient), leading to a numerically smaller Bits value.



Hash Power ↑ → Difficulty ↑ → Target ↓ → Bits Numerical Value ↓

$$\text{\$NAT} = \text{bits} = s \times 2^{24} + c$$

Invoking Bits Value Using DMT & TAP Protocol

1. Pattern Registration - Ordinals

Pattern: `dmt.11.element`

2. Protocol Syntax - TAP

```
{
  "p": "tap",
  "op": "dmt-deploy",
  "elem": "63b5bd2e28c043c4812981718e65d202ab8f68c0f6a1834d9e9ea49d8fac7e",
  "tick": "nat",
  "dt": "n"
}
```

3. Execution Miner Redirect

```
{
  "p": "tap",
  "op": "reward",
  "type": "miner",
  "block": "885588"
}
```

NAT Another Aircoin

First Principles

For NAT to fulfill its mission as a complementary subsidy to the Bitcoin mining network, it must overcome skepticism about its core fundamental value proposition.



Principle 1: Belief Creates Value

- Tokens like BTC gain value through collective belief in their utility.
- For \$NAT: If people believe it solves Bitcoin's subsidy problem, they buy/hold it.
- Result: Each \$NAT mined becomes worth more in dollars, boosting miners' total rewards.

Principle 2: Incentives Align Miners and Holders

- Miners seek profit maximization. If \$NAT's value rises, mining becomes more lucrative.
- Holders benefit: Higher hashpower increases Bitcoin's security.
- Feedback Loop: More belief → higher \$NAT price → higher miner rewards → more hashpower.

Principle 3: Non-Arbitrary Scarcity and Utility

- \$NAT's utility is anchoring to Bitcoin's difficulty (bits field), making it a proxy for network health.
- Inverse Property: As difficulty rises (bits decreases), \$NAT's narrative strengthens.

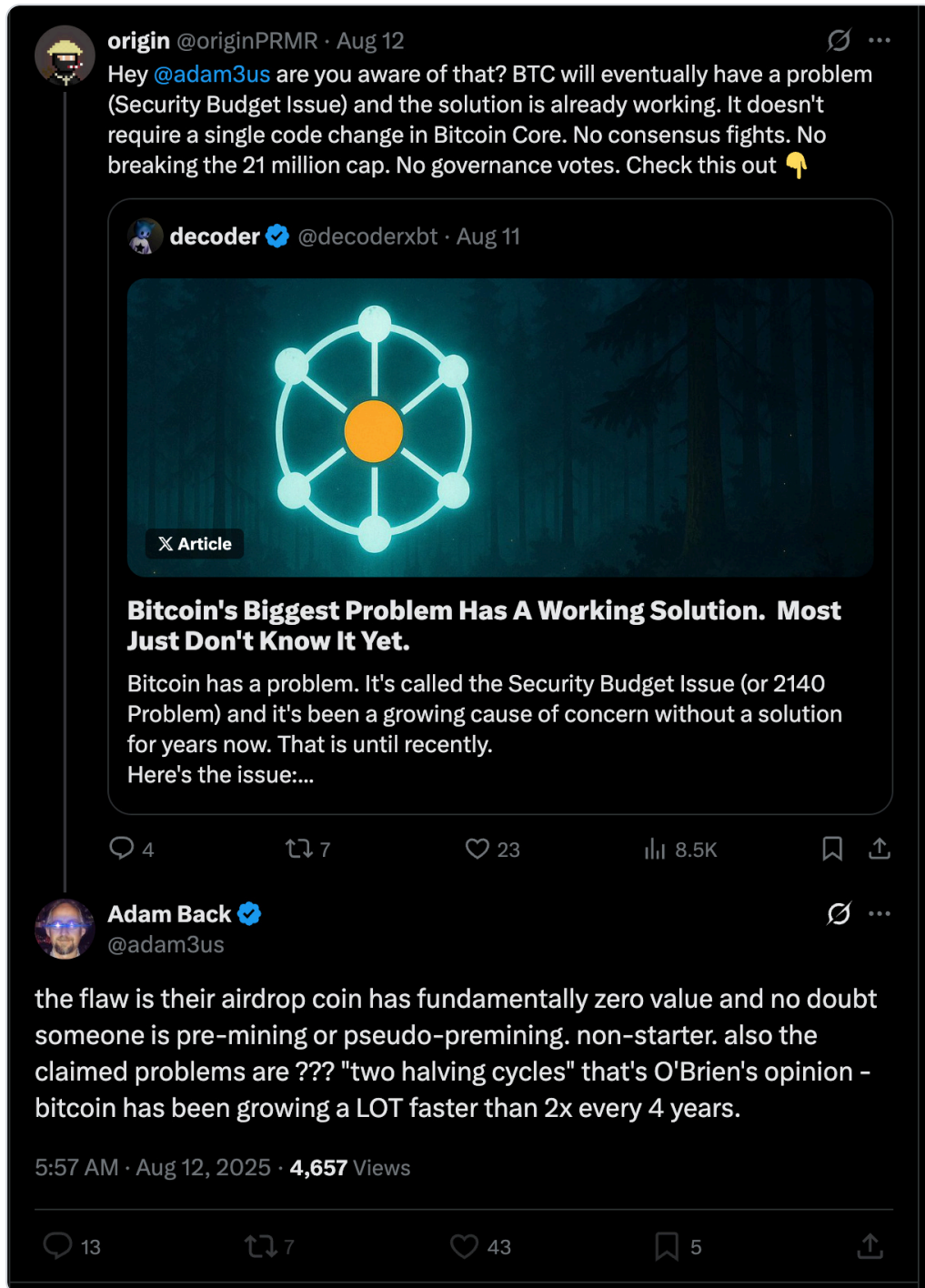
Principle 4: Thermodynamic Alignment

- Bitcoin mining converts physical energy into digital security (hashpower).
- \$NAT, as a Bitcoin-native asset, inherits this thermodynamic grounding.

NAT Another Premine

Distribution Lore

The \$NAT token was first distributed through a fair mint system. This meant anyone could participate on a first-come, first-served (FCFS) basis, no pre-mines, no reserved allocations, keeping the launch open and decentralized in line with Bitcoin's ethos.



Launch Details

- **Date:** November 20, 2023

- **Method:** Anyone could mint \$NAT by inscribing JSON data into a Bitcoin transaction.
- **Starting point:** Block 817,709
- **Participation:** Over 20,000 people joined, minting all available blocks in 7 days.

Post Blockout Distribution

- The FCFS minting method continued until block 885,588.
- After that, the system switched to a miner-redirect model.
- Bitcoin miners automatically receive newly generated \$NAT with each block.

NATstoppable Force

Aligning With Bitcoin Ethos

Aligning \$NAT with Bitcoin's ethos requires open-source, peer-to-peer indexing and validation to preserve the value of both systems.

The Three Pillars of Bitcoin's Ethos

Decentralization

Bitcoin: No single entity controls the network, enabling trustless, peer-to-peer interactions.

\$NAT: The TAP Protocol's reliance on Bitcoin's Ordinals Protocol ensures that asset creation and management occur without a central authority.

Censorship Resistance

Bitcoin: Transactions cannot be stopped or altered, protecting financial sovereignty.

\$NAT: By leveraging Bitcoin's proof-of-work security, TAP ensures that NAT transactions are resistant to censorship.

Transparency

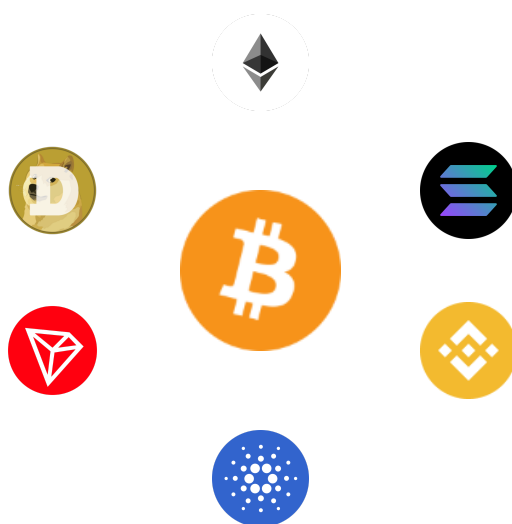
Bitcoin: An open-source, auditable blockchain ensures verifiable integrity.

\$NAT: TAP's use of Bitcoin's immutable blockchain as a data root provides full transparency in asset issuance.

NAT The End Of The Story

Digital Matter Theory Interchain Application

To convert the Digital Matter Theory (DMT) framework into an accessible client for developers deploying smart contracts or building apps on other chains like Solana and Ethereum, we can develop a cross-chain SDK or library that abstracts DMT logic while leveraging oracles for secure Bitcoin data access.



A successful NAT = precursor to a non-arbitrary crypto era

1. Metaverse & Gaming

The earliest implementation of Digital Matter Theory (DMT), Bitmap, showcases how non-arbitrary Bitcoin blockchain data can be used to generate digital land. Bitmap is a protocol that leverages Ordinals to inscribe individual Bitcoin blocks as unique, non-fungible assets, each block representing a district composed of parcels. These parcels inherit their uniqueness from the immutable, thermodynamically secured data of the block itself. The transaction data within each block shapes the topography, transforming raw blockchain information into a procedurally generated digital landscape.

By further using the substrate data embedded in each block, additional layers of the virtual ecosystem can be built under the same tamper-proof, verifiable rules. This enables features such as resource distribution, landscapes that evolve with underlying patterns, or in gaming contexts, the probabilistic appearance of a world boss in specific locations. All of these elements inherit the trustless, immutable qualities of Bitcoin, ensuring consistent and fair digital environments free from the arbitrary parameters that dominate most virtual worlds today.

2. AI

Stanford's "Generative Agents" initiative, led by researchers at the Human-Centered Artificial Intelligence (HAI) institute, simulated 25 AI agents in a virtual town ("Smallville") using large language models (LLMs) to generate human-like behaviors based on predefined personality traits (e.g., Big Five model: openness, conscientiousness, extraversion, agreeableness, neuroticism). Agents formed memories, planned actions, and interacted socially/economically, demonstrating emergent behaviors like information diffusion and relationship formation.

<https://arxiv.org/abs/2304.03442>

For non-arbitrary variables to apply to this experiment and others like it, assign each agent a unique Bitcoin block in the form of a UNAT (Unique Non-Arbitrary Token) as its foundational "DNA". Then extract non-arbitrary patterns from block header data:

- Bits field (e.g., 386,018,193 from block 912,962): Encodes mining difficulty; use its value to derive "openness" trait (higher difficulty → higher openness, reflecting adaptability to "harsh" environments).
- Nonce (e.g., 3,182,121,568): A random-like value solved via proof-of-work; map its digits or parity to "extraversion".
- Merkle Root (hash string, e.g., starting with "d9"): Convert hex to numerical values or entropy measures for "agreeableness" (higher entropy → lower agreeableness, simulating "complex" interpersonal dynamics).
- Timestamp and Tx Count (e.g., Sep 03, 2025, 3:31:42 AM; 1,663 txs): Use epoch time components for "conscientiousness" (e.g., minute/second for punctuality proxy) and tx count for "neuroticism" (higher volume → higher neuroticism, reflecting "stressful" block activity).

Result: Each agent possesses a verifiably unique, non-arbitrary personality that is queryable on the blockchain and linked to a distinct "DNA" signature. This prevents duplication and ensures full traceability. These features reduce bias in trait assignment, leading to greater credibility to the experiment's findings.

3. Digital Art

NatCats is a pioneering digital art collection consisting of 8,064 unique pixelated cat artworks minted on the Bitcoin blockchain using the Ordinals and TAP protocols, launched in February 2024 as the first generative art project under DMT's UNAT

framework. Each NatCat is autonomously generated from Bitcoin's raw block data, rendered as generative SVGs without human intervention, creating collectible profile picture (PFP)-style cats that vary in traits like color, pose, and features based on the blockchain's non-arbitrary inputs. As a fair-mint project, it allowed for open participation via inscriptions, with no pre-mines, and has achieved significant traction, including over 600 BTC in trading volume.

One of the key features enabled by the UNAT standard is the non-arbitrary expansion of the NatCats supply, triggered by the recurrence of a specific pattern defined by the DMT protocol. In NatCats' case, this pattern is "3b" in the bits field. Throughout Bitcoin's history, this pattern has only appeared during four difficulty adjustment periods, each spanning 2,016 blocks, resulting in the current total supply of NatCats.

Future generations of NatCats will be created only when this rare "3b" pattern naturally reappears, entirely independent of the original creator (EV). This mechanism permanently aligns NatCats with the ongoing production of new Bitcoin blocks, enabling the collection to grow autonomously. As a result, new and potentially rare traits may emerge over time, introduced not by human discretion, but by blockchain-native randomness. This ensures NatCats will continue evolving indefinitely, even long after the original creator is gone.

4. Prediction Markets

By anchoring the virtual dimension to non-arbitrary patterns found in Bitcoin's on-chain data, a new class of trustless, verifiable events can emerge, such as spawning a world boss, triggering dynamic weather systems, or unlocking rare in-game assets. These events act as provable triggers within virtual environments, enabling the creation of a powerful new prediction market. Since all outcomes are based on publicly accessible, immutable blockchain data, they inherit Bitcoin's security guarantees, ensuring tamper-proof execution and complete independence from centralized control.

These events are not predictable in advance, because:

- Block data is only known after mining.
- Bitcoin's mining process is probabilistic and external to any virtual platform.

This framework enables users to speculate on the occurrence or outcome of these blockchain-driven events. Since the triggers are provably random and outside the influence of any participant (including the event creators), the resulting markets are inherently fair and transparent. By aligning virtual outcomes with naturally

emergent patterns in Bitcoin, DMT provides a robust foundation for decentralized forecasting, enabling long-term, self-sustaining ecosystems where meaningful digital events unfold autonomously and remain verifiable on-chain.

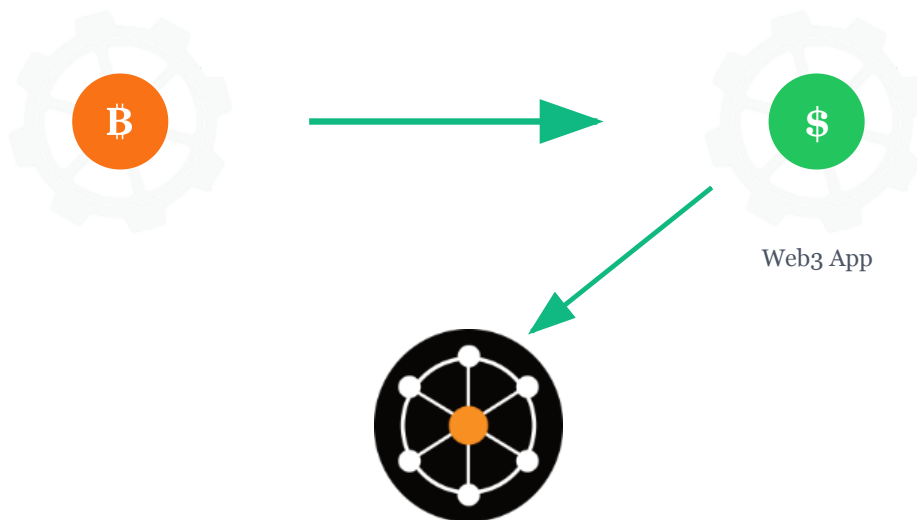
5. DeFi

Digital Matter Theory (DMT) can revolutionize DeFi yield mechanics by enabling the creation of non-arbitrary yield-bearing assets, where returns such as staking rewards or lending interest are dynamically calibrated based on Bitcoin's immutable blockchain data patterns. This reduces arbitrary inflation risks, enhancing economic resilience, and fostering more sustainable, trustless protocol incentives for applications like automated market makers or liquidity pools.

NATwork Effect

Symbiotic Relationship

The proliferation of the DMT ecosystem must be tightly aligned with \$NAT's growth to ensure a symbiotic relationship that enhances both the ecosystem's adoption and \$NAT's economic viability.



NATwork Flywheel: Bitcoin → \$NAT → Web3 Applications

Multi-chain Integration: Bitcoin's Export Economy

Assume a theoretical mature non-arbitrary token market achieves parity with the existing arbitrary digital asset market's on-chain volume. This parallel market embeds fees (0.05%, 0.1%, 0.25%) on transactions, with proceeds exported to the Bitcoin mining network.

Year	Non-Bitcoin Volume	Tariff @ 0.05%	Tariff @ 0.1%	Tariff @ 0.25%
2021	\$12.5 trillion	\$6.25 billion	\$12.5 billion	\$31.25 billion
2022	\$7.63 trillion	\$3.815 billion	\$7.63 billion	\$19.075 billion
2023	\$6.06 trillion	\$3.03 billion	\$6.06 billion	\$15.15 billion
2024	\$25.71 trillion	\$12.855 billion	\$25.71 billion	\$64.275 billion

BRC20 vs DMT Comparison

Category	BRC20	DMT
Onchain Dependency	Fully reliant on Bitcoin's main chain for all operations: inscriptions for minting ("mint" ops), transfers ("transfer" inscriptions), and trading (bundled tx).	Uses Bitcoin for initial asset genesis (e.g., referencing "bits" field), but offloads minting, trading, and transfers to other chains (e.g., Solana), limiting Bitcoin to data reads.
Network Bloat Impact	High: Embeds large data payloads, bloating UTXO set by 10–20% during peaks and causing mempool backlogs (>300,000 unconfirmed tx).	Low: Minimal writes on Bitcoin (occasional inscriptions). Offloading reduces bloat; if scaled, could shrink UTXO growth by avoiding persistent data-heavy tx.
Fee and Congestion Effects	Drove average fees to >50 sat/vB in late 2023; non-monetary tx accounted for 36% of 2023 fees, totaling >5,000 BTC in cumulative BRC20 fees since March 2023.	Lowers fees natively on Bitcoin, stabilizing the network for monetary usage while harnessing fees from other execution layers to deliver back to Bitcoin in the form of a \$NAT buyback to increase the value of the \$NAT subsidy for miners.
Scalability and Mitigation Potential	Limited: All activity stays on Bitcoin, exacerbating congestion without Layer 2 solutions; no inherent offloading.	High: Hybrid model preserves Bitcoin as secure substrate but shifts volume off-chain, reducing concerns drastically while maintaining non-arbitrary value through data references.
Overall Network Benefits	Neutral to negative: Increases miner fees short-term but risks long-term usability and centralization from bloat.	Positive: Minimal footprint enhances scalability, with potential economic boosts (e.g., tariffs funding miner subsidies via \$NAT).

Are you NAT Entertained?

Conclusion

Supporting Bitcoin's long-term viability is a challenge we must solve today, as it is critical to onboarding billions into the digital store of wealth.

Untapped Substrate

The integration of multi-chain mechanisms, exemplified by the \$NAT token and Digital Matter Theory (DMT) protocol, represents a transformative step toward addressing Bitcoin's sustainability and security challenges.

The Bitcoin Security Intensity (BSI), currently at 0.88% in 2025, underscores the urgent need to bolster miner revenue relative to Bitcoin's growing market cap.

To secure Bitcoin's role as the foundation of a global monetary system, we must optimize both BSI and ESR. The target is to elevate BSI above 1% through innovative incentives like \$NAT while driving ESR beyond 50%.

Call To Action

In the shadow of centralized powers that seek to control the flow of value and information, we, the architects and advocates of NAT, draw inspiration from the genesis of Bitcoin. NAT emerges as a steadfast guardian of this legacy, extending Bitcoin's core principles into new frontiers.

The Oath of Unity In Preservation Of Bitcoin's Ethos

Rooted in Satoshi Nakamoto's vision of a decentralized and trustless world, we join with all who share this conviction to advance innovation in harmony with Bitcoin's core principles. With unwavering commitment, we work to strengthen its resilient network and uphold NAT as a unifying beacon. Not to divide, but to realign and empower the true guardians of decentralization. Our purpose is not separation but solidarity, ensuring that Bitcoin's ethos of sovereignty and freedom endures, ethically, inclusively, and for generations to come.



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