Heroglyphs Protocol:
Incentives for Transforming Ethereum Validator Dynamics

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Abstract. Liquid staking bifurcates Ethereum's validation into distinct economic and validation contributions. While reducing entry barriers for token staking, this approach consolidates validation within a limited number of specialized node providers. This paper outlines Heroglyphs, a protocol whose use creates incentives for "Complete Validators," which are entities that are both economic and validation contributors, by refining Graffiti, a small piece of arbitrary data that validators can include in the blocks they propose. Heroglyphs consists of an Encoder for densely embedding information in Graffiti and a Translator for transforming this information into a variety of onchain operations, including but not limited to the creation, emission, transfer, and transformation of various tokens. Heroglyphs token mining ensures that all Complete Validators receive rewards for their participation, regardless of whether they are selected as block proposers and irrespective of their stake size, providing smaller validators with a stronger economic foundation. While we believe Heroglyphs will have applications far beyond the mining of tokens, for now Heroglyphs token mining returns fair token distribution mechanisms, pioneered by Bitcoin's [1] Proof-of-Work, to an Ethereum that has transitioned to Proof-Of-Stake [2–4].

1 Introduction

The success of liquid staking protocols [5] highlights the burgeoning demand for accessible staking. However, liquid staking bifurcates the security of the Ethereum network between purely economic contributors, who supply ETH tokens, and validation contributors, who operate nodes. While liquid staking has made it easier than ever to become an economic contributor to Ethereum, it has also created incentives that centralize validation contributions.

Just as the petroleum refinement process creates over 6,000 specialized and valuable byproducts from the act of distilling crude oil, we propose a set of frameworks and tools for "refining" the waste byproducts of Ethereum transaction validation into an increasingly valuable and specialized set of onchain operations (see Fig. 1). We believe that this new set of onchain operations will increase the economic value of being a Complete Validator and help further secure the Ethereum network.
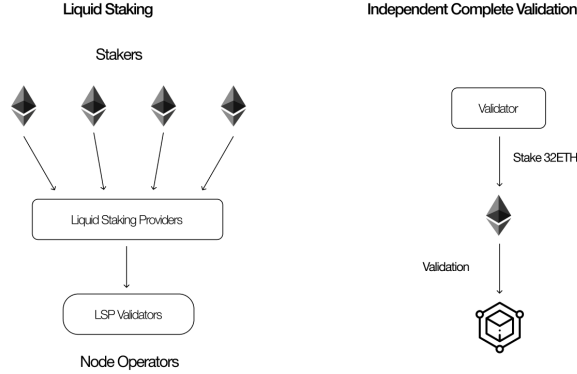
This paper outlines a new protocol whose use creates incentives for "Complete Validators," i.e., entities that are both economic and validation contributors, sometimes referred to as solo validators (see Fig. 2). At its core, Heroglyphs
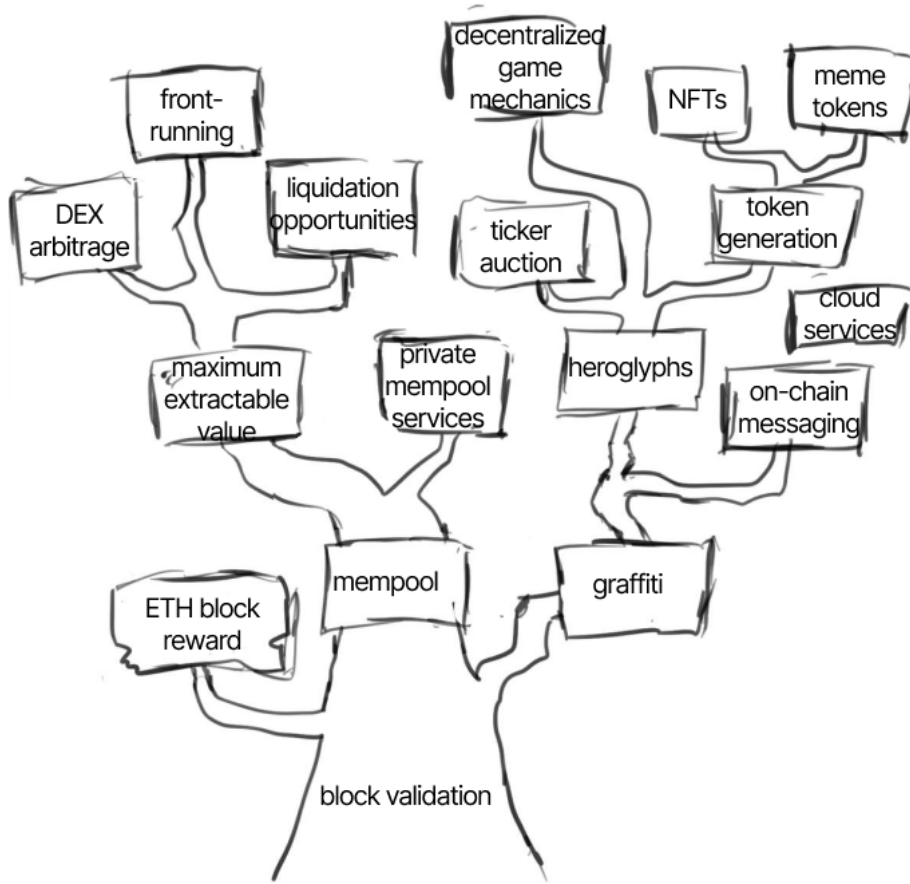
Fig. 1. The tree of validation value.

consists of two modules – an Encoder and a Translator. First, the Heroglyphs Encoder is a protocol for densely embedding information in Graffiti, a currently valueless byproduct of Ethereum's validation operations [6]. Second, the Heroglyphs Translator comprises a set of smart contracts for transforming this information into a variety of onchain operations, including but not limited to the creation, emission, transfer, and transformation of various tokens.

The name "Heroglyphs" itself is a play on two themes: the theme of the hero's journey and the theme of hieroglyphic writing. Our idea of "hero" is very similar to the idea of the hero's cycle monomyth—initiation, separation, and return [7]. We see our work as a multifaceted return in crypto. It is a return of the miners that underpinned proof-of-work validation and of a fair launch. It is also a return to the foundational principles of decentralization, security, and resilience, standing against today's ethos of efficiency, consolidation, and profit.

Liquid Staking

Stakers

Independent Complete Validation

Validator

Stake 32ETH

Liquid Staking Providers

Validation

LSP Validators

Node Operators

Fig. 2. Liquid Staking Protocols make it easy to earn staking yield but diminish network security by centralizing node operation.

Lastly, our idea of "hieroglyphs" echoes the Ordinals and Inscriptions [8] developed on the Bitcoin network. These are also data inscribed into proposed blocks, creating artifacts on top of the blockchain itself. But we aimed to highlight the ephemerality and value of Heroglyphs, since they do not bloat the Ethereum state. Hence, we chose hieroglyphs, which are both impermanent and permanent, as they can be written on paper or inscribed in stone.
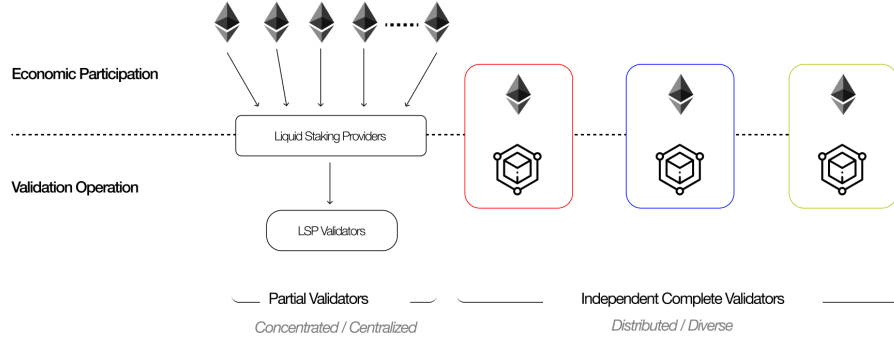
2 Aggregation and Centralization

In Proof-of-Stake systems, node providers secure the network by staking tokens and validating network transactions. Liquid staking protocols enable users to delegate their tokens to node providers, which validate network transactions on the users' behalf.

This model effectively bifurcates validation into distinct economic and validation contributions. By alleviating token holders from technical complexities, these protocols reduce barriers for economic contributors, potentially democratizing rewards from Ethereum validation. However, this approach creates incentives that consolidate validation contributions within a limited number of specialized node providers.

Consolidation occurs for two reasons. First, pooling minimizes variance in Ethereum's staking rewards, resulting in a steady source of yield. Second, specialized node providers can capitalize on economies of scale associated with specialized hardware and software requirements.

The consolidation of validation contributors creates several risks for the Ethereum network. One risk is that the number of node operators decreases, potentially creating points of failure that could affect the network's integrity.

Fig. 3. Partial validation, where economic participation is delegated to a few node operators through aggregation, poses risks. Conversely, having more Complete Validators enhances decentralization and diversity.

Another risk is that consolidation reduces node diversity. Node operators often employ uniform hardware and software configurations across their nodes, which can lead to vulnerabilities in case of widespread issues or exploits. Last but not least, large node operators create a nexus of control which will be an easy target for regulators seeking to use validators as a tool to enforce government financial censorship or speech restrictions [10],[11].

3   Make Ethereum Cypherpunk Again

In our opinion, it is important to incentivize the participation of independent Complete Validators to achieve a more equitable distribution of validation power. This will require thoughtful incentives to attract a diverse range of validators to join the network (see Fig. 3). Conversely, increasing the number of independent Complete Validators can enhance Ethereum's resilience. Complete Validators manage both the economic and technical aspects of validation and are thus fully responsible for their operations, not relying on third parties. This increases their resilience and reduces the risk of central control. A diversity of node operators increases the variety of security measures, software solutions, and geographic distribution of the network's security. This, in turn, makes the Ethereum network robust against any single vulnerability, exploit, or disturbance, whether technical or regulatory.

As one effort to mitigate the risks inherent in the consolidation of validation contributions, Heroglyphs introduces a system of rewards accessible only to independent Complete Validators.

4   Heroglyphs Protocol

4.1   Monetizing Free Real Estate

In theory, blockchains serve to monetize a global consensus state captured in blocks of transactions. In practice, Bitcoin proved that any spare blockspace is valuable. "Also known as Ordinal Inscriptions, Bitcoin Inscriptions are a new way of writing additional data or digital artifacts on the Bitcoin blockchain. The information engraved includes images, videos, texts, audio, and more. This extra data is attached to individual satoshis (sats), the smallest unit of Bitcoin representing 0.00000001 BTC." [8].

With the use of Heroglyphs, Ethereum has the opportunity to incentivize Complete Validators with assets whose value is uncorrelated to ETH. Returning to our petroleum analogy, the demand for illumination (kerosene) was independent and uncorrelated with the demand for automobile transportation (gasoline). Similarly, the demand for Graffiti blockspace that will be unlocked by Heroglyphs will be at least somewhat uncorrelated from the value of ETH itself. This is in contrast with Ethereum's block rewards, which are comprised of ETH and thus serve to leverage exposure to ETH for validators today.

Ethereum validation creates two types of value: block rewards and information privileges. Economic contributors, by delegating their ETH to liquid staking protocols, retain most of the block rewards that accrue to validators. However, they lose any influence over the network's validation operations or decision-making processes. Third-party node operators, in contrast, accrue these crucial information privileges, which can lead to various types of abuses, such as bribery, collusion, and targeted attacks.

Let us not underestimate the power of a validator's information privileges, as they constitute the fundamental governance rights on a blockchain using PoS. These powers include the ability to hard fork the chain itself, as we saw happen with the miner-induced Bitcoin Cash fork, and the ability to censor transactions.

Graffiti, in the context of Ethereum 2.0, also known as the Beacon Chain, refers to a small piece of arbitrary data that validators can include in the blocks they propose. This Graffiti is typically intended for personal messages, identifiers, or just random data, and is embedded directly in the block header.

Graffiti is a symbol of the information privileges that are exclusively accessible to those with control over validation operations. Reimagining how we use Graffiti is not just a way to leave a digital mark. Rather, it is a way to create value from one of validation's "waste" byproducts, thereby incentivizing economic contributors to become Complete Validators, reducing the consolidation of validation operations and enhancing Ethereum's resilience.

4.2   Two Modules – Encoding and Translating

Heroglyphs' framework consists of two modules, an Encoder and a Translator (see Fig. 4). The Heroglyphs Encoder allows validators to embed valuable information in their Graffiti, specifically to create a token, define properties, and
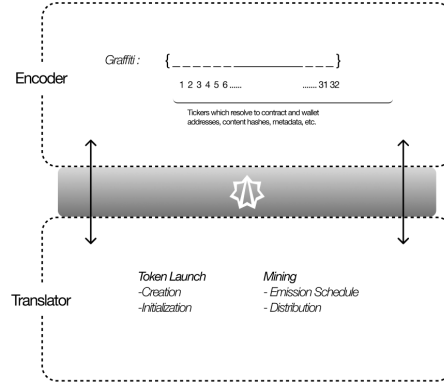
Fig. 4. Encoder and Translator

identify recipient wallet addresses. It is important to note that Graffiti itself is a passive data element; it contains no executable code nor does it engage computational resources that could alter the blockchain's state. This ensures that its use does not impose additional burdens on validators, whether they are newly assuming their roles or are established in their practices.

The Heroglyphs Translator then uses Graffiti written in this way to subsequently mine the token to the recipient addresses according to a predefined emission schedule.

This mechanism highlights a critical truth–entities like Lido, which manage validation operations, retain all associated information privileges while economic participants retain only their share of the block rewards.

Heroglyphs makes tangible and fungible the otherwise abstract and idiosyncratic validator privileges and powers by creating transferable value from the refinement of Graffiti. This process not only increases benefits to Complete Validators but also increases the opportunity cost of not participating as a Complete Validator. After all, the entity engaging in this form of mining—by manipulating the Graffiti—is also the sole entity endowed with validation operations.

4.3   Char - Scarce Resource

Heroglyphs provides a framework for "refining" the raw resource that is Ethereum validation and blockspace. Consider the process of petroleum refinement. Crude oil is a complex mix of molecules. It first became valuable when it could be separated into various components, each with its own use. The most valuable early petrochemical was kerosene, which drove a revolution in illumination. Robert Gordon shows in "The Rise and Fall of American Growth" [9] that in 1800, $20 allowed a household to purchase 5,500 candle hours per year for evening illumi-

nation. By 1890, with kerosene, a petroleum product, those $20 could purchase 73,000 candle hours per year. Gasoline was originally a low-value byproduct of kerosene production, though it eventually became more valuable as a fuel for the automobile revolution. Today, according to the Department of Energy, crude oil is refined into over 6,000 different products.

Heroglyphs' framework is extensible, allowing ever denser and more valuable information to be encoded in Graffiti. Graffiti has a 32-character restriction. If you want to mine multiple tokens, such as Pepe or WIF, you need to indicate these tokens in the Graffiti somehow. A naive use of these 32 characters would, for example, involve writing out token names. However, more value can be extracted from these 32 characters by more densely encoding information therein.

Instead of full wallet addresses or ENS name, miners can purchase wallet tickers for mining optimization akin to code golfing. In the same vein, tokens can also have Heroglyphs tickers attached. To maximize the ecosystem value of each one-character ticker, it would be crucial to allocate tickers to the highest-value activity possible and to prevent squatting. One way to do this is to use Harberger leases, which allow a lessee to point a ticker to a specific address by paying a regular tax. This tax is proportional to a value they publicly assign to that ticker. However, this self-assigned value is also the value at which any other user can take over the ticker, so the rational incentive is for users to honestly report the value they assign to each ticker and no more, no less.

To prevent a small number of partial validators who delegate validation operations from becoming the beneficiaries of this system and further centralization, validators whose deposit/withdraw address is a contract address could be automatically excluded from mining.

More complex models that consider different edge cases, including Complete Validators managed via multisig with contract addresses, will be released in future versions.

4.4   Merge and Hybrid Mining on PoS

One way to understand Heroglyphs is as a framework for injecting some of the benefits of Proof of Work (PoW) validation into a network that has Proof of Stake (PoS) at its core. Our initial use case will be a fairer way to mine and distribute tokens, although Heroglyphs' utility extends beyond this.

The concept of fair launching has recently garnered significant attention, highlighted by platforms such as Pump.fun, which have achieved considerable traction. The principles underlying fair launching trace their roots back to the Proof of Work (PoW) mechanism utilized by the Bitcoin blockchain, which pioneered this method with the inaugural distribution of its coins. Notably, even Satoshi Nakamoto, the anonymous creator of Bitcoin, was required to mine his initial holdings, emphasizing the egalitarian nature of this distribution method.

Heroglyphs allows users to create tokens and specify their total supply, specific emission schedule, and initial distribution. What makes these tokens special is that this specific type of blockspace value is exclusively mineable by Complete

Validators. A token launched in this manner thus helps to level the playing field between large node operators and Complete Validators.

5   Transforming Validator Dynamics

One primary concern with PoS as an incentive distribution framework is the potential for wealth concentration. Some commentators have raised concerns that validators with larger stakes have a disproportionately high chance of being chosen to validate new blocks and thus earn more rewards. The larger one's stake, the more power and earning potential one possesses, potentially leading to an oligarchy of validators.

However, the real issue is that a validator's control of a network does not depend on their consistent and steady contribution to the network's security. In PoW, miners have to continuously invest to replace depreciating hardware and to secure a steady supply of electric power. In other words, without additional contributions to the security of the network, their information privileges over the blockchain will decay and accrue to other miners. While PoS does entail some hardware and software economies of scale, the biggest capital cost—the actual ETH tokens themselves—do not require additional reinvestment.

As a result, small-scale validators or solo validators have very little chance of increasing their influence over the Ethereum network, since the share of information privileges held by larger validators does not decay over time as it does in a PoW system.

Heroglyphs mining ensures that all Complete Validators receive rewards for their participation, regardless of whether they are selected as block proposers. This counters the economic advantage that larger operators currently hold by providing smaller validators with a stronger economic foundation from which to operate.

In short, control over Graffiti is equitably held by validators, irrespective of their stake size. Refining Graffiti into a valuable validation byproduct establishes an incentive system that incentivizes decentralized validation operations.

6   Conclusion

We stand before the pantheon of cyberspace, where we have found a home, compelled to address a crisis long ignored but universally acknowledged. We believe the risks to Ethereum's security require not only recognition but swift and bold action.

Because of the barriers to running a solo validator, staking and restaking services have exploded in popularity. Unfortunately, these services have concentrated validation power into a small number of node operators, magnifying technical, market, and regulatory risks to Ethereum's security. To reverse these trends, we introduce Heroglyphs, a protocol whose use creates positive incentives for independent Complete Validators.

Crypto promised a revolution but devolved into a speculative coliseum. Thus, restoring the health of our security ecosystem requires that we mobilize our community through its unique, sometimes absurd, culture. Originally a product of our community's fringes, meme culture has entered mainstream consciousness [12], as even politicians are busy auctioning NFTs. In short, the absurdity of our times mirrors the gravity of our challenges.

Thus, let us use the most ludicrous elements of crypto's culture to rectify its most serious of afflictions. Ethereum 2.0 introduced Graffiti, which is embedded directly in the block header and is typically used for personal messages, identifiers, or random data. Heroglyphs comprises a Encoder for densely embedding information into Graffiti and a Translator for transforming this information into a variety of onchain operations, such as the creation, emission, and transfer of various tokens.

With hope as our banner and unity as our call, we commit to this path, resolved to realize a future where Ethereum is a beacon of security, freedom, and integrity. Given the nature of our times, we believe that we must champion our cause in the most visible cultural arenas of our community, thereby diminishing the costs of inaction and harmonizing incentives within our ecosystem.

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