Starmark

The Planetary Scale Decentralized Open Message Network

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Abstract: Starmark is the first planetary scale decentralized open message network. We propose a massively scalable peer-to-peer communications network based on proof-of-work with no trust required and no central parties. The nodes collectively host and relay messages in the world's first extremely scalable peer-to-peer open message network. The built-in digital name system is powerful enough to tokenize everything from social accounts to websites — effectively creating a secure and decentralized alternative to the Domain Name System (DNS). We also present a breakthrough decentralized advertising model based on costly signal theory that overcomes the problems with the legacy advertising model while completely aligning incentives between all participants.

1. Introduction

Internet social media communications relies almost exclusively on centralized services operating as trusted third parties. While the system works well enough for most communications, it still suffers from the inherent weaknesses of the centralized model and all the trust that's required to make it all work. All digital identities, social connections, content and information feeds are under control by those very companies whose interests are directly at odds with the end users, third party developers and even their advertisers. Users have practically no control over their digital world and almost no recourse when problems arise and are constantly bombarded with intrusive and manipulative advertising.

What is needed is a peer-to-peer digital name and message system to allow messages to be sent directly from one party to another without going through centralized services. A social network based on digital signatures and decentralized content delivery would give users complete control over their digital lives. In this paper we propose a peer-to-peer decentralized open message network with a digital name system and a breakthrough decentralized advertising model. The system becomes more secure as the number of nodes increases as the nodes all collectively host and relay content efficiently.

2. Open Message Standard

The solution we propose begins with a simple and yet complete message standard.

Digital identities are represented by public keys similar to the Nostr Protocol [1]. User generated data are digitally signed by their respective owners and published on the network in the *Starmark Open Message Standard* format inside of a blockchain transaction. User profiles are identified by public keys and users follow each other via their respective public keys. This design fundamentally puts the rights of users first and ensures that users truly own their content.

The main message types are: *post*, *repost*, *comment*, *reaction*, *pin*, *profile* and the variations *postmedia* and *commentmedia* which allow file attachments such as images and video. Messages have a unique identifier which is the SHA-256 digest hash of the message's data fields. Users digitally sign the message identifier with their secret key associated with their public identity key and attach the signature to the message so that anyone can authenticate it's contents.

We need a way to prevent the replaying of previously signed messages by other users. The use of a blockchain network is essential to prevent the replay of previously signed messages by other users and provides us with what we need. For our purposes we use the first previous outpoint identifier (or *prevout)* as the anti-replay measure since that identifier is guaranteed to be unique for every transaction. All message identifiers and signatures are thus guaranteed to be unique even if multiple messages have identical content.

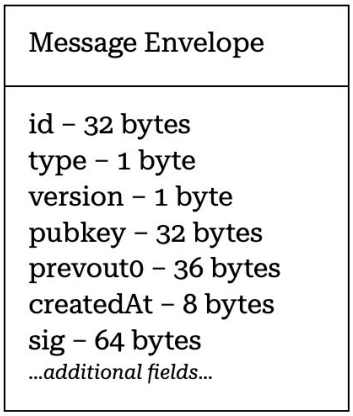

Figure 1. Base data fields of Starmark Open Message Standard Envelope. The *id* field is calculated from the SHA256 of the concatenation of the other field values (except the signature *sig)*.

3. Peer-to-Peer Network

The solution we propose begins with the creation of a proof-of-work consensus blockchain based on Bitcoin [2]. The Bitcoin blockchain has proven itself to be extremely fault tolerant and robust at peer-to-peer distribution of transactions — we leverage that fact and apply it to all data. The built-in Starmark token is necessary in order to incentivize node operators for content distribution, storage and smart contract validation. Similar to Bitcoin, the Starmark token serves as unit of account, medium of exchange and store of value with a fixed maximum supply.

Our proposed system is the world's first peer-to-peer open message network that can serve as a global communications backbone with no trusted parties. The initial intended configuration is that a very large number of users will run full nodes to create the first massively scalable decentralized social media network. Over the long term it will be larger service providers and sophisticated end users who will host and relay content, likely for a fee. Nonetheless, users and node operators remain in control of their data and can achieve planetary scale with the rapid advancements in bandwidth speeds and falling storage costs.

Another key property of the system is the ability to execute Turing-Complete [3] smart contracts and efficiently validate any kind of programmer defined logic. For example complex triggers can be defined to perform some action based on messages sent by some set of users. This design is completely flexible and lends itself well for interactions between humans and Artificial Intelligence agents.

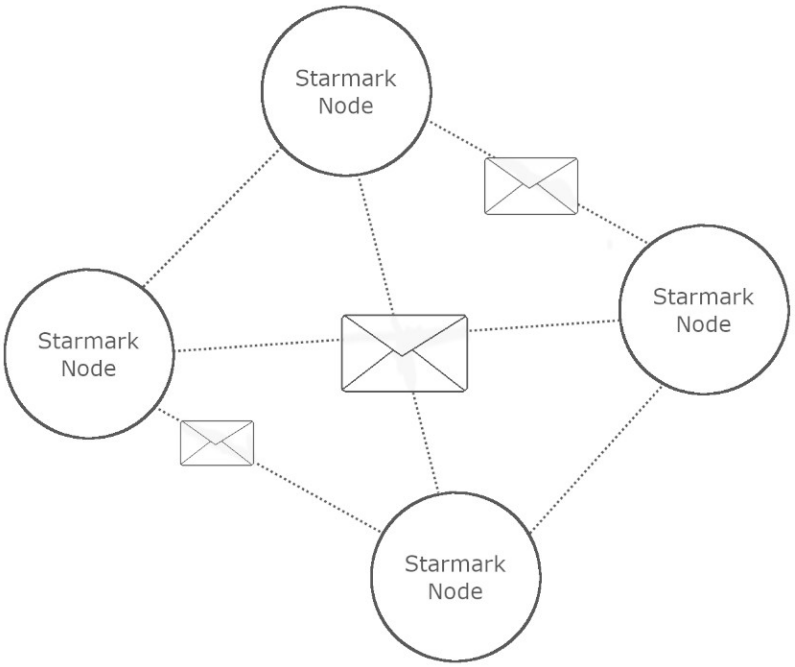

Figure 2. Messages are embedded inside transactions, distributed to all nodes, and time-stamped into data blocks secured by proof-of-work.

4. Digital Names

Although we rely on public keys to serve as digital identifiers for users, they are difficult for humans to read, remember and share. What is needed is a digital name system that allows the use of human-meaningful, secure and decentralized names to associate with public keys. We present a solution and demonstrate we have finally solved Zooko's Triangle [4]. The solution is elegant, complete and yet sufficiently advanced to operate as a completely decentralized and more secure alternative to the Domain Name System (DNS).

We define a *digital name path* to be the sequence of transactions representing a branch of a prefix tree (or *Trie*). Given an alphabet of size K, every child transaction contains a minimum of K+1 outputs. The initial transaction represents the root of the prefix tree and is the special case with only K outputs. Each of the outputs in turn can only be spent to produce another K+1 outputs and so on. A smart contract covenant enforces this rule.

Names are defined by the unique sequence of characters represented by following the root output and child transaction outputs in the prefix tree. The first output at every level has a special meaning and represents the name non-fungible token (NFT) for that name and may be claimed on a first come basis. By convention the asterisk character * is used as the prefix character for all Starmark digital names to distinguish it from other name systems (Example: *blue, *johndoe, etc).

A key property of the prefix tree data-structure is that names are provably unique and self-evident. Clients and smart contracts can validate name records by tracing transaction histories to the root and querying the latest state of the name NFT.

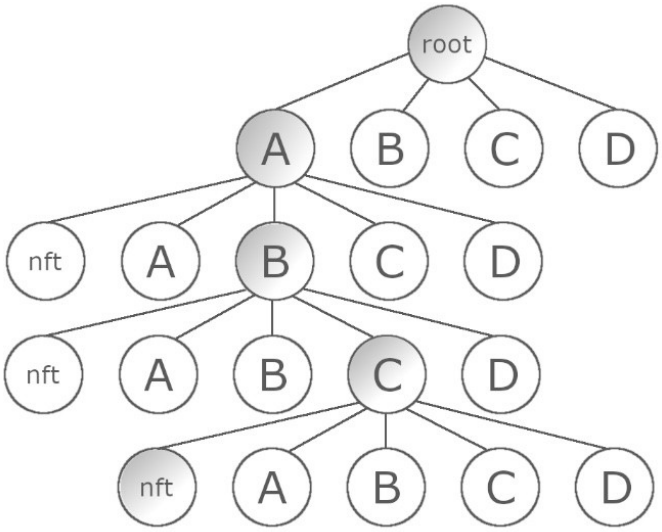

*Figure 3. Name prefix tree structure. The first output at each level represents the name non-fungible token for that sequence of characters in the chain of outputs from the root node. As an example, the name *abc is represented by the name branch path: root → A → B → C → nft*

5. Decentralized Advertising

The traditional internet monetization model works by centralized services building a closed network and in turn selling access to that captive audience to third party advertisers. Users are the product being profited from and social media companies have every incentive to *worsen* the user experience to maximize profits. Even departments at the same company are at odds with each other; user experience teams want to reduce screen clutter and improve accessibility, however the advertising departments want *more* ad impressions and engagements.

We propose an elegant and powerful solution to the problem of internet advertising involving no central parties. In the traditional monetization model, it is the central service provider which receives payment for ad placements — but in our system the advertising fee is paid *pro-rata* to everyone who has staked the token in the global staking pool. A user who wishes to promote content pays the fee by attaching any quantity of tokens to any message type which in turn will be automatically distributed to the global staking pool by the miners. All users which have staked tokens are able to withdraw their pro-rata share of advertising payments earned using the built-in smart contract. The technique to achieve scalable reward distribution was first discovered and explained in [5] and we fully leverage it in our system at the base layer.

Content feeds can be generated and ranked at least in part by fees paid, because they are costly signals and represent a somewhat honest representation of how the advertiser values their own content. Ranking and discovery algorithms will benefit from leveraging this additional information and since every participant knows that everyone else must play by the same rules — there are no privileged ad placements.

6. Content Removal

In order to gain worldwide adoption and remain legally compliant it is critical to have the ability to remove illegal and objectionable content from nodes. One major challenge of blockchain technology is the immutable nature of transaction data which makes it difficult or even practically infeasible to remove content. There must be a way to enforce laws in a decentralized system and ways for users and node operators to comply with those laws – essentially making it possible for them to choose and restrict the content they distribute. Freedom of association means that no one is obligated to host content they do not want to — for any reason.

Our system solves the problem of content removal by not committing to user generated data directly and instead only committing to witness hashes. Specifically the transaction identifiers and signatures commit to the IPFS [6] CIDv1 (SHA-256) digest hash. This technique makes it is possible to *mask*, effectively remove, content and still maintain the integrity of block hashes and transaction identifiers.

Node operators can selectively remove (mask) any content from their nodes without fear of data corruption or altering the integrity of their system. This is an important architectural design decision that allows node operators to respond to legal takedown requests and be able to exercise discretion over which data to keep or discard.

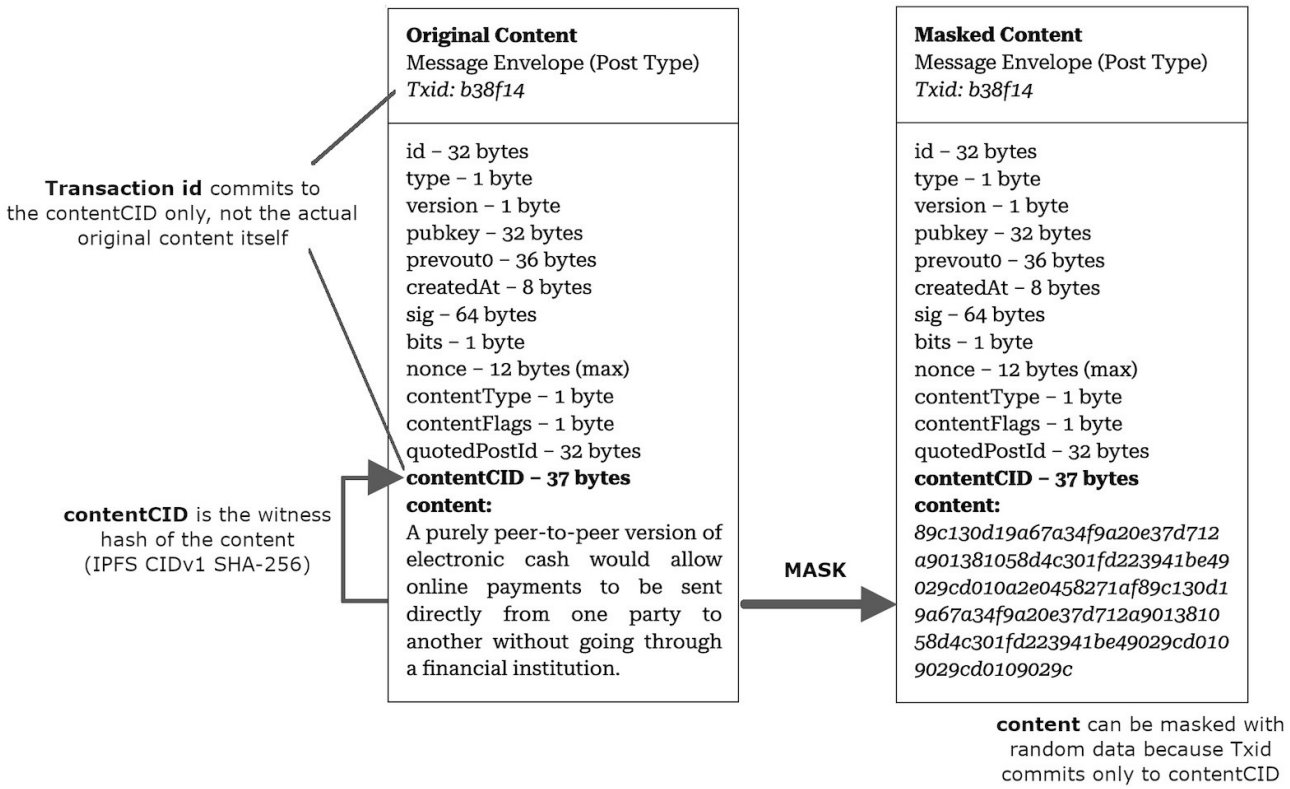

Figure 5. Transactions commit to witness hashes of data and not the original data and therefore facilitate the masking (removal) of content without affecting the integrity of the blockchain.

7. Calculations

We consider the scenario that Starmark achieves massive global adoption and must handle a comparable number of posts as X (formerly known as Twitter). The number of posts on X per day on average in 2025 was approximately 500 million per month, or about 350,000 per minute. Which amounts to approximately 6,000 messages per second. We use this as the baseline target for the calculations below.

What is the expected average block size?

Assume message rate = 6000, and an average message size of 500 characters (bytes) we see that the size of an average block (2.5 minutes) would be:

block_size = message_rate * 500 bytes * 150 seconds

*429.153 MB = 6000 * 500 * 150*

How long would it take to propagate a 429.153 MB block and what would be the expected block orphan rate?

As of 2025, the median residential internet speed in the United States is 285.6 mbps or about 35.7 megabytes per second. We calculate the time it would take to propagate a 429.153 MB block, assuming the entire block must be transmitted:

12.02 seconds = 429.153 / 35.7

The expected orphan rate can be calculated with the equation 1 - e^(p/T) where T is the expected block time and p is the propagation delay. The orphan rate is:

8.34% = 1 − e^(12.02/150)

How much bandwidth will be needed per month by a node operator?

On average 576 blocks are generated per day and multiplying that by 429.153 we arrive at:

*247192.128 MB = 429.153 MB * 576*

About *241.39 GB per day* and *7.072 TB per month*.

What are the storage costs and requirements for a year's worth of data?

A year's worth of data will require 84.864 TB (12 months * 7.072 TB). As of 2025 the cost for a 16 TB hard disk drive is approximately $300 USD. The cost to store a year's worth of data requires 6 hard disk drives:

*$1,800 USD = $300 USD * 6*

What would the message rate need to be in order to fully offset the block subsidy so that the network would be completely sustainable through transaction fees alone?

The first assumption is that Starmark achieves 10% of Bitcoin's proof-of-work security budget. The block reward as of writing is 3.125 BTC per block and at a valuation of $100,000 USD per bitcoin amounts to $312,500 USD. Therefore Starmark would need to have at least $31,250 USD of value in a comparable time period through transaction fees alone. Starmark blocks are found every 2.5 minutes compared to Bitcoin's 10 minutes. Therefore we would need to earn at least $7,812.50 per block ($31,250 / 4).

The second assumption is that users would be willing to pay $0.01 per post. Putting it all together we arrive at:

*781,250 messages = 7812.50 * 100 (per 2.5 minute block interval)*

Which is about 5208 messages per second and well within our calculations above. This system will be self-sustaining and will not need to rely on any block subsidies.

8. Conclusion

We have proposed an extremely scalable open message network without relying on trust. Starmark is the world's first truly global proof-of-work based decentralized open message network where the users and nodes collectively host and relay content with no central parties. Users retain control over their digital identities, connections and data by using their public keys as identities and signing every message. The system commits to witness hashes instead of original content in order to allow users and node operators to choose what content to keep and what to discard. Additionally the built-in name system finally solves Zooko's triangle and is human-meaningful, decentralized and more secure than the existing Domain Name System. We introduced a decentralized advertising method which pools payments into the global staking pool and leverages the theory of costly signals to provide a valuable ranking metric. The network is robust in it's simplicity and is extremely scalable and capable of handling thousands of messages per second and becoming the world's open communications backbone with no trusted or centralized parties.

References

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[5] Batog B., Boca L., Johnson N. (2018) Scalable Reward Distribution on the Ethereum Blockchain

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Tokenomics

The Starmark blockchain is bootstrapped through a fair launch and no pre-mine. All 100% of the Starmark tokens shall forever only be created by miners. The Starmark full node and GPU-based miner software will be released in advance of the fair launch date to give developers time to prepare.

Name: Starmark
Ticker: $MARK
Maximum Supply: 1,680,000,000
Divisibility: 8 decimals
Block Time: 2.5 minutes
Block Subsidy: 2,000 $MARK per block
Halving: Every 420,000 blocks (approximately every 2 years)
Algorithm: Proof-of-work — StarmarkPOW (Triple SHA256)
Fair Launch Date: 2025-11-12 20:00:00 UTC

The initial difficulty target of the Starmark Genesis Block is set to 1,000 to ensure that nobody can employ any instant-mining strategy to get an unfair advantage. The usage of GPUs is required from the very start to achieve the average 2.5 minute block time.

About the Development Team

The original development team has not raised funds and will never raise funds to develop any part of the Starmark node, wallet, miner or any related software.

It is understood that Starmark shall forever be a decentralized volunteer effort in the same way that Bitcoin development contributions are a decentralized volunteer effort. The only way forward to establishing a truly open and decentralized message network is to make it a movement of independent volunteers and developers. Thus the future of Starmark will ultimately remain in the hands of the community and individuals who wish to help make it succeed, just the same as with Bitcoin. You are all part of the Starmark revolution.

Full Disclaimer

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