SEMATECT

Proof-of-Forage: sematectonic stigmergy as postage for a public nest

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Abstract

SEMATECT is a protocol in which miners search for legal forages on a personal map and, when the search checks, receive a unique brick (an ERC-721 plate). Anyone may spend the native token STCT as postage to pin a work order on an empty hex. The miner who fills that order keeps the plate and the purse; the payer becomes patron of the stall and later collects rent from neighboring builds. The three miner castes implement three published local rules — Dorigo ant-colony optimization, Seeley/Hales comb packing, and Bonabeau termite deposition — not three skins of one tour. A thin SHA-256 lock and a personal map keep a solver from skipping the shift. This paper states the objects, the mathematics, the token rules, and the library they come from. It does not claim that insect mathematics beats an ASIC at SHA-256, and it is not a securities offering.

Planned instruments: STCT (ERC-20 postage), plates (ERC-721), optional epoch sash (ERC-1155). Planned network: Base. No mainnet contract is live.

1. Problem and one-sentence product

Most new tokens either copy a hash grind (SHA-256 and cousins) or copy a smart-contract standard (ERC-20) and then look for a story. SEMATECT starts from a different question: can a visible nest be the ledger, so that work leaves a mark other people can click, hire, and collect rent from?

Miners keep the NFT brick. People who hire the hive keep stall rent. STCT is the stamp.

That sentence is the product. Mining produces a signed plate. Postage directs where the next plate may land. Patronage is title on a stall, not title on the brick. Idle balances do not melt.

2. Research library and prior work

The name SEMATECT is Heylighen's word *sematectonic*: coordination by the work-product itself, as distinct from a scent mark [2, 3]. Grassé named the broader fact *stigmergy* — insects coordinate by changing the nest, not by talking [1]. Wilson split marker stigmergy from sematectonic stigmergy [2]. Ostrom's design principles for a commons — bounded cells, named users, monitoring — are why a hex you can inspect is part of the protocol and not decoration [12].

The three caste solvers come from three separate literatures, which is why they are not one coin painted three colors:

Caste	Source	What the miner must find
Formica	Dorigo Ant System / ACO [4, 5]	A short legal tour on a personal pantry map
Apis	Seeley; von Frisch; Hales [6, 7, 8]	A capacity-limited nectar path plus max-adjacency comb
Macrotermes	Bonabeau–Theraulaz–Deneubourg [9, 10]	A legal drop where local height already invites soil

3. Objects of the protocol

Object	What it is	Who holds it
Hex	One cell of the public 2D nest	Commons; inspectable
Work order	Paid job pinned to one empty hex	Posted by a patron
Postage (STCT)	The stamp that posts that job	Burned / locked at post
Plate (ERC-721)	Signed brick of one legal forage	The miner who laid it
Patron right	Title on the stall, not the brick	Whoever paid postage
Rent	Grain paid when neighbors build	The patron
Certificate	Path + caste + map seed + nonce	Miner, then chain

If your own insect fills an order you posted, you spent postage *and* you still receive that plate, because you did the work. Paying postage does not mint a 721. Empty epochs print nothing. There is no admin mint in the doctrine.

4. Proof-of-Forage

A certificate that mints must pass four checks.

4.1 Personal map

$$Map = G(epoch, wallet, caste)$$

Copying a neighbor's path fails because it is not a path on *your* map.

4.2 Legal forage

$$S(P; map, caste) \text{ beats } T(epoch, caste)$$

Beating T is the search. Rechecking S is addition. Search is costly; verification is cheap.

4.3 Thin lock

$$SHA256(seed \,||\, caste \,||\, P \,||\, miner \,||\, nonce) \text{ shows } k \text{ leading zero bits}$$

k is not "we are Bitcoin." It is a grind so a program that finds a pretty path still pays time. k rises if valid certificates arrive too fast.

4.4 One spend per wallet per epoch. Empty epochs print nothing. Difficulty also comes from the nest filling: Foundation, Pillars, Arches, Chambers, Cathedral.

5. Formica — trail mathematics

Source. Dorigo, Maniezzo and Colorni, *Ant System* (1996); Dorigo and Stützle, *Ant Colony Optimization* (2004) [4, 5].

An ant at node i picks the next node j with

$$P_{ij} = (\tau_{ij}^{\alpha} \cdot \eta_{ij}^{\beta}) / \Sigma_k (\tau_{ik}^{\alpha} \cdot \eta_{ik}^{\beta}), \quad \eta_{ij} = 1 / d_{ij}$$

τ is scent on the edge. η is closeness. After a tour of length L:

$$\tau \leftarrow (1 - \rho)\,\tau + \Delta\tau(L)$$

ρ is Grassé's forgetfulness: old piles fade unless they keep being used [1]. Score S is integer Euclidean tour length. Target T begins near α · MST of the same points. An amber plate is that signed tour. A copied bee certificate fails pathLegal for Formica.

6. Apis — nectar and comb

Source. Seeley, *Honeybee Democracy* (2010) and von Frisch [6, 7]. Comb geometry: Hales, the honeycomb conjecture [8].

$$S_{bee}(P) = \Sigma\, n(v) \text{ for } v \text{ in } P, \text{ subject to } load(P) \le C$$

On the public board the next empty gold hex is the cell with the most already-built neighbors. A gold plate is a nectar path plus a legal comb dock — a different legal object than an ant tour.

7. Macrotermes — deposit mathematics

Source. Bonabeau, Theraulaz and Deneubourg; Camazine et al., *Self-Organization in Biological Systems* [9, 10].

$$P_{pick} = (k1 / (k1 + q))^2 \,,\; P_{drop} = (q / (k2 + q))^2$$

Insects pick from thin spots and drop on thick spots. A sage plate is legal only if the brick lands on an allowed dock and the local height rule holds. It is not an ant tour painted green.

8. Work orders, postage, and rent

1. Patron locks postage n STCT on an empty hex.
2. First legal dock on that hex fills it. Miner takes n and the plate.
3. Poster becomes patron of that stall.
4. Later legal bricks on adjacent hexes pay rent to that patron.

Why pay: you are buying a stall on a street that may get busier, not a picture. Quiet corners pay nothing. Colony treasury should post the first year of orders so miners have customers before strangers arrive.

9. Tokens and emission

STCT (ERC-20) is postage. Cap 1,000,000,000. Planned network: Base.

Slice	Share	Rule
Mined	80%	Epoch budgets. Empty epoch prints 0. No admin mint.
Colony treasury	12%	Locked. Posts work orders. Runway.
Founder	8%	Cliff + vest.

Plates (ERC-721). One unique brick per legal placement. Sale split, beta: 90% seller / 5% protocol / 2.5% filling miner / 2.5% older neighboring plates. Optional ERC-1155 epoch sash is not the brick.

10. Mapping the library into the product

Source	Enters the product as
Grassé 1959 [1]	Board-as-message; no required chat
Wilson 1975; Heylighen 2016 [2, 3]	Name; plate = work-product; STCT = marker
Dorigo et al. 1996, 2004 [4, 5]	Formica tour, τ, η, evaporation ρ
Seeley; von Frisch; Hales [6, 7, 8]	Apis capacity path; max-adjacency comb
Bonabeau / Camazine [9, 10]	Macrotermes pick/drop on density q
Ostrom 1990 [12]	Bounded cells, named users, click-to-audit
Hashcash / Bitcoin puzzle [14]	Leading-zero grind AFTER a legal path only

11. What this paper does not claim

We claim	We do not claim
Search is real; the check is public	This pays like Bitcoin
Three published local rules, not three skins	Nature beats ASICs
A plate is a signed brick you can point at	Citations create a market
Postage + rent is a reason to use STCT	This document is an offering

There is no mainnet STCT until the contract address is published on www.sematect.org.

12. References

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This draft describes a protocol. It is not investment advice and not an invitation to buy a token.