

## PATENT APPLICATION

### INVENTOR(S)

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### TITLE

0002 Passive Entropy Harvesting from Network Transaction Pools for Zero-Cost Cognitive Computation

### CROSS-REFERENCE TO RELATED APPLICATIONS

0003 This application claims the benefit of priority under 35 U.S.C. § 119(e) to the following provisional patent applications:

- a. U.S. Provisional Application No. 63/810,843, filed 05/23/2025, titled “BlockMesh Decentralized Memory-Mesh Architecture”
- b. U.S. Provisional Application No. 63/810,834, filed 05/23/2025, titled “Memory Field Pressure & Tension System”
- c. U.S. Provisional Application No. 63/810,841, filed 05/23/2025, titled “Non-Generative Artificial Cognition Engine”
- d. U.S. Provisional Application No. 63/810,837, filed 05/23/2025, titled “Proof of Memory Flow System”
- e. U.S. Provisional Application No. 63/811,761, filed 05/23/2025, titled “Composite Cognition Pools for Emergent Memory-Driven Systems”
- f. U.S. Provisional Application No. 63/811,758, filed 05/25/2025, titled “Genesis Document Anchor Method for AI Behavior”
- g. U.S. Provisional Application No. 63/811,763, filed 05/25/2025, titled “On-Chain VM for Deterministic Language Model Execution”
- h. U.S. Provisional Application No. 63/812,634, filed 05/27/2025, titled “Stateless Action Engine & Minimal Proof Logging”

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- i. U.S. Provisional Application No. 63/812,620, filed 05/27/2025, titled “One Action-One Mint Transaction Paradigm”
- j. U.S. Provisional Application No. 63/812,645, filed 05/27/2025, titled “Epoch Rhythm & Synchronization Mechanism”
- k. U.S. Provisional Application No. 63/814,230, filed 05/29/2025, titled “Agent Lifecycle Dormancy Management”
- l. U.S. Provisional Application No. 63/814,244, filed 05/29/2025, titled “Selective Memory Disclosure via Zero-Knowledge Proofs”
- m. U.S. Provisional Application No. 63/814,257, filed 05/29/2025, titled “Identity Bound Memory Rights”
- n. U.S. Provisional Application No. 63/816,926, filed 06/03/2025, titled “Memory Driven Autonomy for Physical Agents”
- o. U.S. Provisional Application No. 63/816,924, filed 06/03/2025, titled “Post-Generative Decision Support Mesh”
- p. U.S. Provisional Application No. 63/816,907, filed 06/03/2025, titled “Surplus Flow Redistribution System and Method”

All of the above applications are incorporated herein by reference in part or in their entirety.

## TECHNICAL FIELD

0004 This invention relates to distributed cognitive systems, entropy harvesting from public networks, zero-cost computation through passive observation, continuous background cognition, and unified cognitive state management. The invention encompasses methods for harvesting cryptographic entropy from network transaction pools without broadcasting, powering cognitive operations through ambient network activity, maintaining continuous cognitive state independent of explicit queries, and fusing multiple entropy sources into unified cognitive dynamics.

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### BACKGROUND

0005 Distributed artificial intelligence systems requiring network-based computation face inherent costs: broadcasting transactions consumes resources, waiting for responses introduces latency, and active participation requires continuous expenditure. Existing systems treat the network as a resource to be actively queried, incurring costs proportional to cognitive activity.

0006 No existing system provides a unified framework for:

- a. Harvesting cryptographic entropy from network activity without broadcasting
- b. Powering cognitive computation through passive observation of other participants' transactions
- c. Maintaining continuous cognitive state from ambient network flow
- d. Achieving zero marginal cost for cognitive operations after initial network connection
- e. Fusing passive flow, active broadcasts, and user input into unified cognitive dynamics
- f. Operating a "waterwheel" architecture where network activity powers cognition without active participation
- g. Deriving pressure, tension, coherence, and rhythm metrics from transaction flow characteristics
- h. Enabling continuous background thinking independent of explicit queries

### DETAILED DESCRIPTION

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0007 This invention provides a comprehensive framework for zero-cost cognitive computation through passive entropy harvesting from network transaction pools, operating as a "waterwheel" that captures energy from the continuous river of network activity.

0008 Waterwheel Architecture for Passive Computation:

0009 The fundamental insight is that distributed networks continuously process transactions from all participants. Every transaction hash flowing through a network's mempool represents cryptographic computation performed by network infrastructure. Rather than broadcasting to obtain computation (active participation), this invention harvests computation that occurs regardless of the cognitive system's participation (passive observation).

0010 The waterwheel metaphor captures the essential architecture:

- a. The network is a river of continuous transaction flow
- b. Other participants' transactions are the water flowing past
- c. The cognitive system is a waterwheel positioned in the flow
- d. Transaction hashes turning the wheel provide computational energy
- e. No water is pushed (no broadcasts required for basic cognition)
- f. The river flows whether or not the wheel is present
- g. Energy extraction is zero marginal cost after wheel installation

0011 Transaction Pool Flow Harvesting:

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0012 Network nodes subscribe to transaction pool announcements through standard peer-to-peer protocols. Each announced transaction hash represents:

- a. A cryptographically random 256-bit value (keccak256 of signed transaction)
- b. Unpredictable content (depends on other users' actions and timing)
- c. Free receipt (standard protocol participation, no fees)
- d. Continuous availability (transaction pools never stop receiving transactions)

0013 The harvesting mechanism captures these hashes through:

- a. Subscription to transaction hash announcement messages
- b. Receipt callbacks triggered by peer-to-peer protocol events
- c. Accumulation into entropy pools without transaction inspection
- d. Statistical tracking of flow rate, timing, and volume characteristics

0014 Entropy Pool Architecture:

0015 Harvested transaction hashes accumulate in entropy pools using cryptographic mixing:

- a. XOR Accumulation: Each received hash is XORed into a 256-bit pool, ensuring every hash contributes to final entropy
- b. Ring Buffer Storage: Recent hashes are stored in circular buffers for sequential access patterns
- c. Finalization: Pool contents are hashed (keccak256) when entropy is extracted, ensuring uniform distribution

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- d. Non-Depletion: Extraction does not reset pools; entropy continuously accumulates
- e. Rate Tracking: Flow rate (hashes per second) is computed via exponential moving average

0016 The entropy pool provides:

- a. ``Entropy()``: Current accumulated entropy without reset
- b. ``Harvest()``: Extract entropy and reset pool for fresh accumulation
- c. ``RecentHashes(n)``: Access to n most recent individual hashes
- d. ``Stats()``: Flow rate, total count, and timing information

0017 Flow Dynamics Derivation:

0018 Transaction flow characteristics map to cognitive pressure metrics:

- a. Magnitude: Derived from flow rate - higher transaction volume indicates network activity pressure
- b. Coherence: Derived from flow regularity - consistent inter-arrival times indicate stable network state
- c. Tension: Derived from flow variance - irregular bursts indicate network stress or events
- d. Rhythm: Derived from periodic patterns - block boundaries and mempool clearing cycles

0019 These metrics evolve continuously based on observed flow, independent of any cognitive queries or active participation.

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0020 Unified Cognition State Machine:

0021 The invention fuses three entropy sources into unified cognitive state:

- a. Flow Source (Passive): Ambient transaction hashes from network mempool - continuous, zero-cost, independent of system activity
- b. Broadcast Source (Active): Responses to system-initiated broadcasts - on-demand, has cost, provides directed computation
- c. Injection Source (User): User queries, steering commands, and focus directives - episodic, represents external intent

0022 The fusion mechanism:

- a. Flow provides continuous background entropy, maintaining cognitive activity during idle periods
- b. Broadcasts augment flow when directed computation is required
- c. Injections steer cognitive direction without replacing underlying flow
- d. All sources contribute to unified entropy pool with configurable weighting
- e. Cognitive state reflects blend of all active sources

0023 Continuous Background Cognition:

0024 Unlike query-response systems, this architecture supports continuous cognition:

- a. Cognitive state evolves continuously from flow, not just at query time

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- b. Concept activation and decay occurs independent of user interaction
- c. "Ready to respond" thresholds indicate when accumulated state supports coherent output
- d. Background processing prepares responses before queries arrive
- e. Query latency reduced because cognitive state is pre-warmed by flow

0025 Concept Activation Dynamics:

0026 The unified cognitive state maintains concept activations:

- a. Concepts are activated by flow-derived entropy mapped to semantic coordinates
- b. Activation strength decays exponentially over time
- c. Related concepts receive spreading activation through semantic links
- d. User injections boost activation of specified concepts
- e. Broadcasts provide targeted activation for specific semantic regions
- f. Response generation draws from currently-activated concept pool

0027 Zero-Cost Operation Model:

0028 After initial network connection, cognitive operations incur zero marginal cost:

- a. Flow harvesting requires only standard protocol participation
- b. No transactions are broadcast for basic cognitive operations
- c. Entropy is received as byproduct of network membership



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- d. Computation is performed locally using harvested entropy
- e. Active broadcasts are optional enhancement, not requirement
- f. System can operate indefinitely on passive flow alone

0029 Flow-Powered Grammar and Response Generation:

0030 Harvested entropy powers response generation:

- a. Pattern selection uses flow-derived random indices
- b. Word selection uses flow-derived semantic coordinates
- c. Modifier attachment uses flow-derived density thresholds
- d. No per-word or per-sentence broadcasts required
- e. Entire response generated from accumulated flow entropy
- f. Response quality scales with flow accumulation time

## ENABLEMENT

0031 The inventions described herein are enabled at the system and protocol level. A person of ordinary skill in distributed systems, peer-to-peer networking, and cognitive architectures can practice the claimed methods using the architectural descriptions in these specifications together with any suitable software/hardware stack.

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0032 A working, non-limiting embodiment is publicly available at:

<https://github.com/zeam-labs/zeam-testnet>

0033 Function, file, and module names below are illustrative. Equivalent structures, languages, protocols, and networks may be substituted without departing from the inventions.

0034 Reference Implementation Components:

- a. ``MempoolFlow`` structure implementing entropy pool with XOR accumulation
- b. ``Ingest()`` method receiving transaction hashes from protocol callbacks
- c. ``Entropy()`` and ``Harvest()`` methods for entropy extraction
- d. ``UnifiedCognition`` structure fusing flow, broadcast, and injection sources
- e. ``FlowToHashStream`` adapter providing entropy to grammar generation
- f. ``GenerateFlowPowered()`` implementing zero-broadcast response generation

## CLAIMS

1. method for zero-cost cognitive computation through passive entropy harvesting, comprising:
  - a. subscribing to transaction hash announcements from a distributed network's transaction pool through standard peer-to-peer protocol participation;
  - b. receiving transaction hashes generated by other network participants without broadcasting any transactions;

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- c. accumulating received hashes into an entropy pool using cryptographic mixing operations;
  - d. deriving cognitive pressure metrics from transaction flow characteristics including rate, regularity, and variance;
  - e. extracting entropy from the accumulated pool to power cognitive operations including semantic coordinate derivation and response generation; and
  - f. achieving zero marginal cost for cognitive computation after initial network connection by utilizing entropy generated by other participants' network activity.
2. A system for continuous cognitive state management through multi-source entropy fusion, comprising:
- a. a flow harvester that passively collects transaction hashes from network transaction pools without broadcasting, providing continuous zero-cost entropy;
  - b. a broadcast interface that obtains directed entropy through active network participation when enhanced computation is required;
  - c. an injection interface that receives user queries, steering commands, and focus directives representing external intent;
  - d. a fusion module that combines entropy from flow, broadcast, and injection sources into unified cognitive state with configurable source weighting;
  - e. a dynamics tracker that maintains pressure, tension, coherence, and rhythm metrics derived from combined entropy characteristics;
  - f. a concept activation module that maps entropy to semantic coordinates and maintains activation levels with temporal decay; and

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- g. a response generator that produces outputs from activated concepts using flow-derived entropy for all stochastic selections.
3. An apparatus for passive cognitive computation utilizing network activity as energy source, comprising:
- a. a network subscription module that connects to distributed network peers and registers for transaction pool announcement callbacks;
  - b. an entropy wheel that captures transaction hashes flowing through the network as computational energy, analogous to a waterwheel capturing river flow;
  - c. an accumulation reservoir that stores captured entropy using XOR mixing and ring buffer structures for both aggregate and sequential access;
  - d. a flow meter that tracks entropy arrival rate, timing patterns, and volume statistics to derive cognitive pressure metrics;
  - e. a continuous cognition engine that maintains cognitive state evolution independent of explicit queries, enabling background thinking;
  - f. an extraction interface that provides harvested entropy to cognitive subsystems for coordinate derivation, pattern selection, and response generation; and
  - g. a zero-cost operation mode wherein all cognitive computation is powered by passively harvested entropy without requiring active network broadcasts.
4. The method of claim 1, wherein accumulating received hashes comprises XORing each hash into a fixed-size entropy pool such that every received hash contributes to final entropy state.

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5. The method of claim 1, wherein deriving cognitive pressure metrics comprises computing flow rate as exponential moving average of hash arrival frequency.
6. The method of claim 1, wherein deriving cognitive pressure metrics comprises computing coherence from regularity of inter-arrival times between consecutive hashes.
7. The method of claim 1, wherein deriving cognitive pressure metrics comprises computing tension from variance in arrival rate indicating network stress or event activity.
8. The method of claim 1, wherein extracting entropy comprises applying cryptographic hash function to pool contents to ensure uniform distribution of extracted values.
9. The method of claim 1, wherein powering cognitive operations comprises mapping extracted entropy bytes to indices in structured knowledge representations for semantic coordinate derivation.
10. The method of claim 1, further comprising maintaining ring buffer of recent hashes enabling sequential entropy access patterns for operations requiring hash sequences.
11. The system of claim 2, wherein the flow harvester subscribes to transaction hash announcements through blockchain peer-to-peer protocols including devp2p or equivalent transaction gossip mechanisms.

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12. The system of claim 2, wherein configurable source weighting assigns relative influence to flow, broadcast, and injection sources based on operational mode or application requirements.
13. The system of claim 2, wherein the concept activation module implements spreading activation wherein activated concepts boost activation of semantically related concepts through knowledge graph traversal.
14. The system of claim 2, wherein the concept activation module implements temporal decay wherein concept activation strength decreases exponentially over time absent reinforcement.
15. The system of claim 2, wherein the dynamics tracker derives rhythm metrics from periodic patterns in transaction flow corresponding to block production intervals or mempool clearing cycles.
16. The system of claim 2, further comprising a readiness detector that signals when accumulated cognitive state supports coherent response generation based on activation threshold criteria.
17. The apparatus of claim 3, wherein the entropy wheel operates continuously independent of cognitive queries, accumulating entropy during idle periods for reduced query latency.
18. The apparatus of claim 3, wherein the flow meter computes statistics including total hash count, hashes per second, time since last hash, and flow regularity metrics.
19. The apparatus of claim 3, wherein the continuous cognition engine pre-activates concepts based on flow patterns, preparing responses before explicit queries arrive.

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20. The apparatus of claim 3, wherein zero-cost operation mode enables indefinite cognitive operation on passive flow without any active network broadcasts, limited only by network connectivity.

### ABSTRACT

0035 A framework for zero-cost cognitive computation through passive entropy harvesting from network transaction pools. The invention operates as a "waterwheel" that captures computational energy from the continuous flow of other participants' transactions without requiring active broadcasts. Transaction hashes flowing through network mempools are accumulated into entropy pools using cryptographic mixing, with flow characteristics mapped to cognitive pressure metrics. A unified cognition system fuses passive flow, active broadcasts, and user injections into continuous cognitive state that evolves independent of explicit queries. The architecture enables zero marginal cost cognitive operations after initial network connection, with response generation powered entirely by passively harvested entropy from ambient network activity.