Centronium

Protocol Whitepaper

Proof of Useful Work API (PoUW API)

The first blockchain consensus mechanism where miners validate blocks by executing real AI inference tasks through commercial API services, producing useful compute with every block instead of solving pointless cryptographic puzzles.

100M	38	10	3/4
CENTRO / ERA	BLOCK REWARD	HALVINGS	QUORUM

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1. Abstract

Centronium introduces Proof of Useful Work API (PoUW API), a novel blockchain consensus mechanism in which miners validate blocks by executing real artificial intelligence inference tasks through commercial API services, using API keys rather than specialized hardware. This represents a fundamental departure from both traditional Proof of Work — where miners solve meaningless cryptographic puzzles — and prior Proof of Useful Work variants, which still required miners to own and operate computational hardware.

The protocol is the first live blockchain implementation of API mining, where participation is abstracted from physical infrastructure to credential-based access. Every block produced generates commercially valuable AI inference as a direct byproduct of consensus, redirecting computational effort from wasteful hashing toward productive outcomes.

Centronium operates under a Forever Coin emission model featuring 100 million CENTRO tokens per era across 10 halvings over 20 years, followed by permanent tail emission through a mechanism called The Fold that initiates new eras indefinitely. This ensures perpetual miner incentives without the security concerns of fee-only models.

This paper presents the technical architecture, consensus mechanism, tokenomics, security model, and ecosystem of the Centronium network, contextualizing it within the historical evolution of blockchain consensus from Dwork and Naor (1993) through Bitcoin, Primecoin, and the emergence of API-based proof of useful work.

2. Historical Context: The Evolution of Consensus

Understanding Centronium requires tracing the lineage of blockchain consensus mechanisms, each generation addressing limitations of the last while introducing new trade-offs.

2.1 Proof of Work (1993–2009)

The concept of proof of work was first proposed by Cynthia Dwork and Moni Naor in 1993 in their paper "Pricing via Processing or Combatting Junk Mail," requiring users to perform a moderately hard computational task to gain access to a shared resource. Adam Back formalized this in 1997 with Hashcash, a denial-of-service countermeasure requiring partial hash collisions.

In 2008, Satoshi Nakamoto adapted proof of work for decentralized consensus in the Bitcoin whitepaper. Miners repeatedly compute SHA-256 hashes while varying a nonce until the result meets a difficulty target. This secures the network but produces no useful byproduct beyond consensus maintenance. The Cambridge Bitcoin Electricity Consumption Index estimated Bitcoin mining's annual electricity usage at 67 to 240 terawatt-hours in 2023.

Mining hardware evolved rapidly: CPUs (2009) to GPUs (2010) to FPGAs (2012) to ASICs (2013), each transition raising capital barriers and concentrating mining power among those with access to specialized equipment and low-cost electricity.

2.2 Proof of Stake (2012–Present)

Proof of Stake (PoS) emerged as an energy-efficient alternative, selecting validators based on token ownership rather than computational work. Ethereum completed its transition to PoS in September 2022. While PoS eliminates energy-intensive mining, it does not inherently produce external value and introduces concerns around wealth concentration and nothing-at-stake attacks.

2.3 Proof of Useful Work (2013–2025)

Proof of Useful Work (PoUW) sought to redirect mining computation toward productive tasks while maintaining PoW security properties. Key milestones include:

Primecoin (2013) — The first successful PoUW cryptocurrency, replacing hash puzzles with the search for prime number chains (Cunningham chains and bi-twin chains), contributing to mathematical research. Proposed by Sunny King.

Gridcoin — Rewarded contributions to scientific computing through BOINC, directing effort toward protein structure prediction, climate modeling, and other research.

CoinAI, DLchain (2016–2020) — Expanded PoUW to DNA sequence alignment and deep learning model training, demonstrating broader applicability.

A 2025 systematic literature review of 53 studies spanning 2016–2025 documented the field's growth, categorizing algorithms into application-specific, NP-hard, task-based, and AI-based approaches. The review noted that **all prior implementations required miners to own and operate the hardware performing the work**, retaining hardware-related barriers to entry.

2.4 Proof of Useful Work API (2026 — Centronium)

Centronium represents the next evolutionary step: **the first live blockchain to abstract mining entirely from local hardware to commercial API services**. Rather than purchasing and operating mining equipment, participants connect API credentials from AI inference providers. The network assigns inference tasks, miners relay them through the API, and completed results serve as proof of work.

This shifts the cost structure of mining from capital expenditure on hardware and electricity to operational expenditure on API usage — a fundamentally different economic model for blockchain security. The barrier to entry changes from physical infrastructure to service access.

3. Proof of Useful Work API (PoUW API)

3.1 Definition

Proof of Useful Work API (PoUW API) is a blockchain consensus mechanism that enables miners to validate blocks by executing real artificial intelligence inference tasks via commercial API services, utilizing API keys to access these services instead of performing local hardware computations or solving cryptographic puzzles. This model abstracts mining from the need for specialized equipment such as ASICs or GPUs, redirecting computational effort toward producing useful AI outputs with each block.

3.2 Key Characteristics

API-Abstracted Mining. Miners participate by connecting API keys from commercial AI inference providers to the blockchain network. No local computation is required.

Productive Consensus. Every block generates commercially valuable AI inference results as a direct byproduct of the validation process.

Credential-Based Access. The mining interface is defined by possession of valid API credentials rather than local processing power or specialized hardware.

Cloud Infrastructure Leverage. By routing tasks through existing commercial AI services, the mechanism leverages scalable infrastructure without requiring miners to maintain dedicated hardware.

Capex to Opex Shift. Mining cost structure transforms from capital expenditure (hardware, electricity) to operational expenditure (API usage fees), fundamentally lowering barriers to entry.

3.3 Differentiation from Prior PoUW

While earlier PoUW systems like Primecoin, Gridcoin, and CoinAI redirected mining toward useful tasks, they all required miners to perform computations on their own hardware. PoUW API is the first variant to outsource the computational layer entirely to third-party commercial services, representing a qualitative shift in how mining participation is structured.

4. API Mining: How It Works

4.1 Mining with API Keys

API mining is a blockchain mining method in which block validation is performed through remote API calls to third-party computational services rather than through locally executed cryptographic operations. Miners authenticate through standardized API interfaces, submitting work through existing cloud AI infrastructure.

4.2 Inference Task Assignment and Execution

The network assigns computational tasks — such as AI language model inference — to miners, who relay them to external services via API calls and return the results as proof of work. Each block generating useful AI compute as a byproduct of the consensus process. Miners earn rewards per completed task and per validated block.

4.3 Verification of Results

A fundamental requirement of proof-of-work systems is verification asymmetry: checking a solution must be substantially cheaper than producing it. For API-based inference tasks, verification can leverage deterministic properties of language model outputs, such as logit distributions at individual token positions, enabling spot-checking without rerunning the full computation.

The Proof-of-Logits (PoL) approach proposes hashing intermediate logits for low-overhead spot-check verification with reported overhead below 0.1%. This is an active area of research with ongoing refinement as the PoUW API paradigm matures.

4.4 The Mining Flow

Step 1: Miner connects AI API key (e.g., from a language model provider) to the Centronium network.

Step 2: Network assigns an AI inference task to the miner.

Step 3: Miner relays the task to the external AI service via API call.

Step 4: AI service executes the inference and returns results to the miner.

Step 5: Miner submits completed inference results to the network as proof of work.

Step 6: Network verifies the results and, upon validation, the block is produced.

Step 7: Miner earns CENTRO rewards for the completed block and individual tasks.

5. Multi-Layer Architecture

The Centronium network operates as a multi-layered system where each layer serves a distinct purpose:

Layer 1 — Centronium Core. The base blockchain maintaining the ledger, wallet balances, transaction history, and block production through AI inference-based PoUW. This is the source of truth for all CENTRO token operations.

Layer 2 — CentroShield. The verification and coordination layer. CentroShield monitors new blocks, distributes them to validator nodes for independent cryptographic signing, collects signatures, and finalizes blocks once quorum is reached. Critically, CentroShield operates as a coordination layer, not a trust authority.

Layer 3 — Validator Network. A distributed network of independent validator nodes, each with unique Ed25519 cryptographic keys. Includes both API-tier auto-signing validators (provisioned automatically on user registration) and standalone nodes run independently on user machines.

Layer 4 — Ecosystem. Consumer-facing applications: CENTRO Wallet (PWA), mining pools, CentroScan block explorer, CENTRO/cUSDC decentralized exchange, Token Launchpad, CentroSwap, and partner API integrations.

6. CentroShield: Verification Layer

CentroShield is the protocol's block verification engine. It coordinates independent validator nodes to cryptographically sign each block using Ed25519 digital signatures. The signing message follows the canonical format:

```
CENTROSHIELD|v1|height=<H>|hash=<block_hash>
```

This ensures every signature is bound to a specific block at a specific height, preventing replay attacks. CentroShield distributes blocks, collects validator signatures, verifies them against registered public keys, and finalizes blocks when the 3/4 quorum threshold is met.

7. Validator Network & Quorum Consensus

7.1 Two Types of Validators

API-Tier Auto-Sign Validators. Created automatically when a user registers through CentroShield or any partner site. Each validator receives unique Ed25519 cryptographic keys and signs blocks automatically. No technical setup or hardware investment required from the user.

Standalone Node Validators. Run independently on a user's own machine. These validators download the CentroShield node software, register with the network, and independently verify blocks. They send heartbeats to confirm liveness (timeout: 600 seconds).

7.2 Quorum Parameters

Parameter	Value	Description
Quorum Fraction	3/4 (75%)	Minimum validator signatures for finalization
Signing Algorithm	Ed25519	Elliptic curve digital signatures
Min Validators	3	Network minimum for block finalization
Heartbeat Timeout	600s	Standalone node liveness check
Chain ID	77710	Unique network identifier

7.3 Byzantine Fault Tolerance

The 3/4 quorum threshold provides Byzantine fault tolerance up to 25% of validators. The network remains secure even if one quarter of all validators are compromised, offline, or malicious. No single validator or small group can manipulate the chain.

8. Forever Coin: Tokenomics & The Fold

CENTRO follows the Forever Coin emission model, a novel tokenomics framework that provides indefinite miner incentives through perpetual but structured issuance.

8.1 Emission Schedule

Parameter	Value
Tokens Per Era	100,000,000 CENTRO
Halvings Per Era	10 (over 20 years)
Initial Block Reward	38 CENTRO
Halving Interval	1,051,920 blocks
Tail Emission	7.655 CENTRO/block (perpetual within era)
Transaction Fee	0.1% of transfer amount
Task Reward	0.000001 CENTRO per mining task

8.2 The Fold

Upon completion of an era (all 100 million CENTRO minted), the protocol activates The Fold, which immediately initiates a new era by minting another 100 million CENTRO. This process repeats indefinitely, creating permanent tail emission that continues beyond the initial 20-year halving period.

This contrasts with Bitcoin's fixed maximum supply of 21 million coins, after which miner incentives rely solely on transaction fees — a model that researchers have raised concerns about for long-term network security. The Forever Coin model ensures ongoing block rewards to support sustained participation and security.

8.3 Comparison to Other Emission Models

Protocol	Model	Supply Cap	Post-Emission Incentive
Bitcoin	Halving to zero	21M BTC	Transaction fees only
Ethereum	Variable + EIP-1559 burn	No cap	Staking rewards + fees
Dogecoin	Fixed annual (~5B/yr)	No cap	Perpetual flat issuance
Monero	Tail emission (0.6 XMR/block)	No cap	Perpetual flat emission
Centronium	**Forever Coin + The Fold**	**Bounded per era**	**Perpetual era cycling**

9. Security Model

9.1 Cryptographic Foundations

Centronium uses Ed25519 elliptic curve cryptography for all validator signatures — the same algorithm trusted by SSH, Signal, Tor, Solana, and Stellar. Ed25519 provides 128-bit security, fast signature verification, resistance to timing attacks, and deterministic signing.

9.2 Attack Resistance

75% Attack Threshold. Unlike Bitcoin's 51% threshold, an attacker would need to compromise 75% of all active validators simultaneously, each with unique cryptographic keys.

Replay Protection. Each signature is bound to a specific block height and hash via the canonical signing message format. Signatures cannot be reused across blocks.

Sybil Resistance. Validator registration requires account creation and approval. Mass creation of fake validators is detectable through the registration pipeline.

Double Spend Prevention. Transactions are verified by the quorum before finalization. The nonce system prevents duplicate transactions, and balance checks are atomic.

9.3 Acknowledged Challenges

As documented in the Grokipedia entry on PoUW API, the mechanism introduces considerations around third-party API dependence, verification asymmetry for inference tasks, and potential centralization around dominant AI providers. These are active areas of protocol development.

10. Ecosystem

CENTRO Wallet. Progressive web app for sending, receiving, and managing CENTRO tokens. Live balance updates, transaction history, QR sharing, PIN security, and Ed25519 key management.

CENTRO/cUSDC Exchange. Built-in decentralized exchange for trading CENTRO against cUSDC, with a Central Reserve that collects all trading fees to support transparent liquidity provision through automated bots.

Token Launchpad. Users can stake as little as 1 CENTRO to launch their own community tokens, backed by locked CENTRO with instant trading on the secondary exchange.

CentroShield Dashboard. Real-time validator monitoring: network health, verified block height, signature counts, validator status, and block verification feed.

Mining Pools. Pool-based mining with zero hardware requirements. Reward tracking, leaderboards, and per-task earnings for API mining participants.

CentroScan. Full block explorer providing transparency into every block, transaction, wallet, and validator on the Centronium network.

Partner API. Secure third-party integration layer with scoped partner keys, usage tracking, and the ability to authenticate users and process transactions.

11. Consensus Comparison

The following table positions PoUW API against the major consensus mechanism families:

	PoW (Bitcoin)	PoS (Ethereum)	PoUW (Primecoin)	PoUW API (Centronium)
Mining Hardware	ASICs required	None (stake)	Own hardware	**None (API key)**
Energy Use	Extreme	Low	Moderate	**Near zero**
Useful Output	None	None	Limited scope	**AI inference**
Entry Barrier	Very high	Capital (stake)	High	**API subscription**
Attack Threshold	51%	33% stake	51%	**75% validators**
Cost Model	Capex (hardware)	Capex (tokens)	Capex (hardware)	**Opex (API fees)**
Launched	2009	2022	2013	**2026**

12. Roadmap

Phase 1 — Foundation (Completed). Core blockchain with PoUW API consensus, CentroShield verification layer, CENTRO Wallet PWA, mining pools, Token Launchpad, CENTRO/cUSDC exchange, Central Reserve, block explorer, partner API, validator auto-provisioning, Ed25519 signing, and multi-site ecosystem (centroshield.com, centroscan.com, centroswap.com).

Phase 2 — Growth. Expand standalone validator network, increase partner integrations, enhanced mining rewards and task diversity, mobile-native apps, advanced API mining dashboard, and broader AI inference provider support.

Phase 3 — Decentralization. Geographic distribution of validator nodes, community governance, on-chain voting, API-only inter-layer communication, open-source validator software, and formal security audits of the PoUW API verification mechanism.

Phase 4 — Ecosystem Expansion. Smart contract support, NFT integration, DeFi primitives, cross-chain bridges, enterprise partnerships, developer SDK, and academic collaboration on PoUW API verification research.

13. Conclusion

Centronium represents a fundamental advance in blockchain consensus. By abstracting mining from hardware to API credential access, it creates a new category of consensus mechanism — Proof of Useful Work API — that is:

More productive — every block generates commercially valuable AI inference, not wasted computation.

More accessible — anyone with an API key can participate, no hardware investment required.

More sustainable — near-zero direct energy consumption compared to proof-of-work chains.

More secure — 75% quorum threshold with Ed25519 signatures provides stronger Byzantine fault tolerance than Bitcoin's 51%.

More enduring — the Forever Coin model ensures perpetual miner incentives through The Fold, avoiding the security concerns of fee-only models.

The evolution of blockchain consensus — from PoW to PoS to PoUW to PoUW API — represents a progressive refinement toward more useful, accessible, and sustainable systems. Centronium is the current frontier of that evolution.

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14. References & External Documentation

Grokipedia Encyclopedia Entries

Centronium — grokipedia.com/page/Centronium

Proof of Useful Work API — grokipedia.com/page/Proof_of_useful_work_API

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