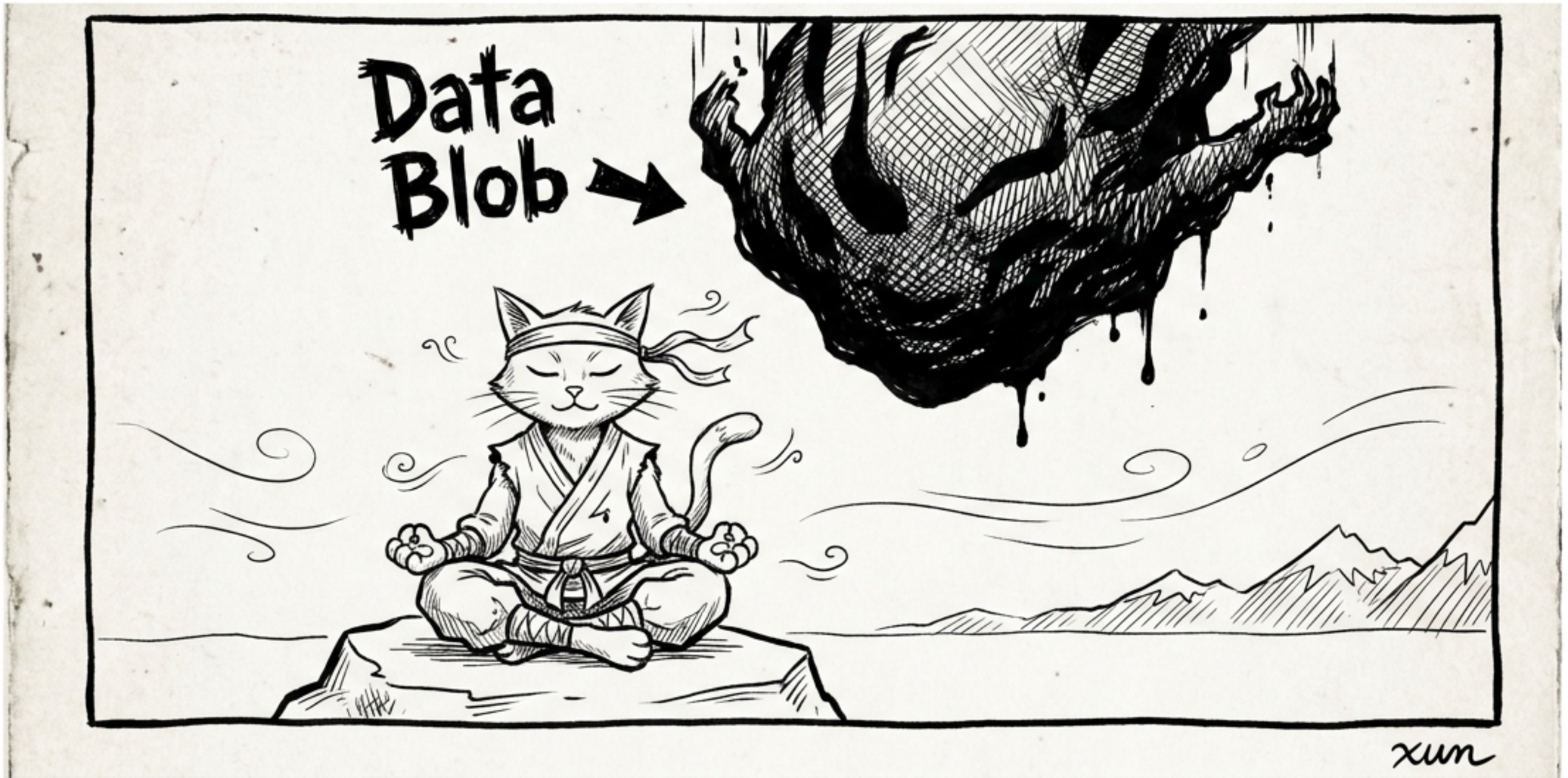
Mastering the flow of data with PeerDAS

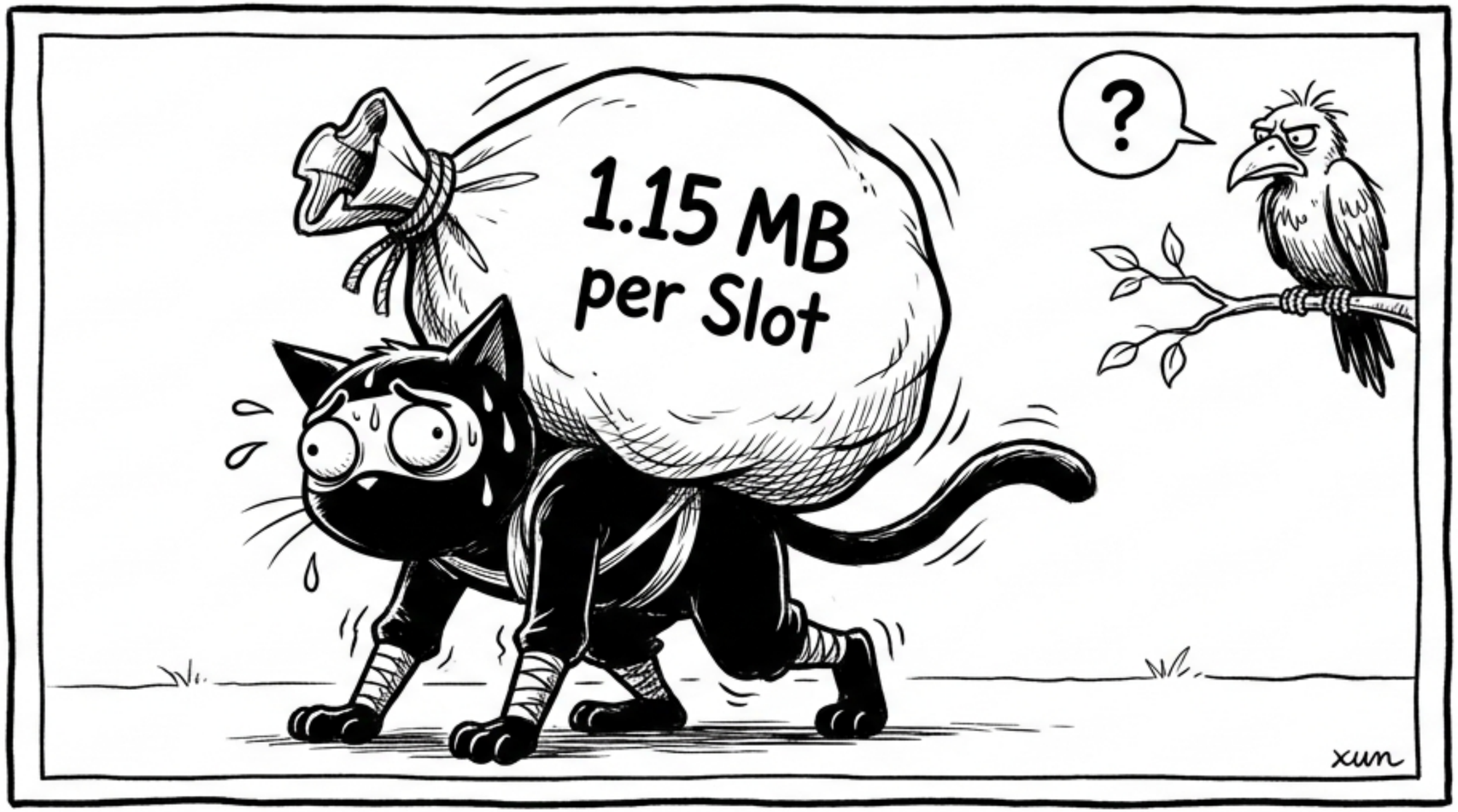
- The Fusaka upgrade introduces EIP-7594 (PeerDAS).
- It is the definitive martial art for **sc**aling Layer 2 data availability.



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The crushing weight of Data Obesity

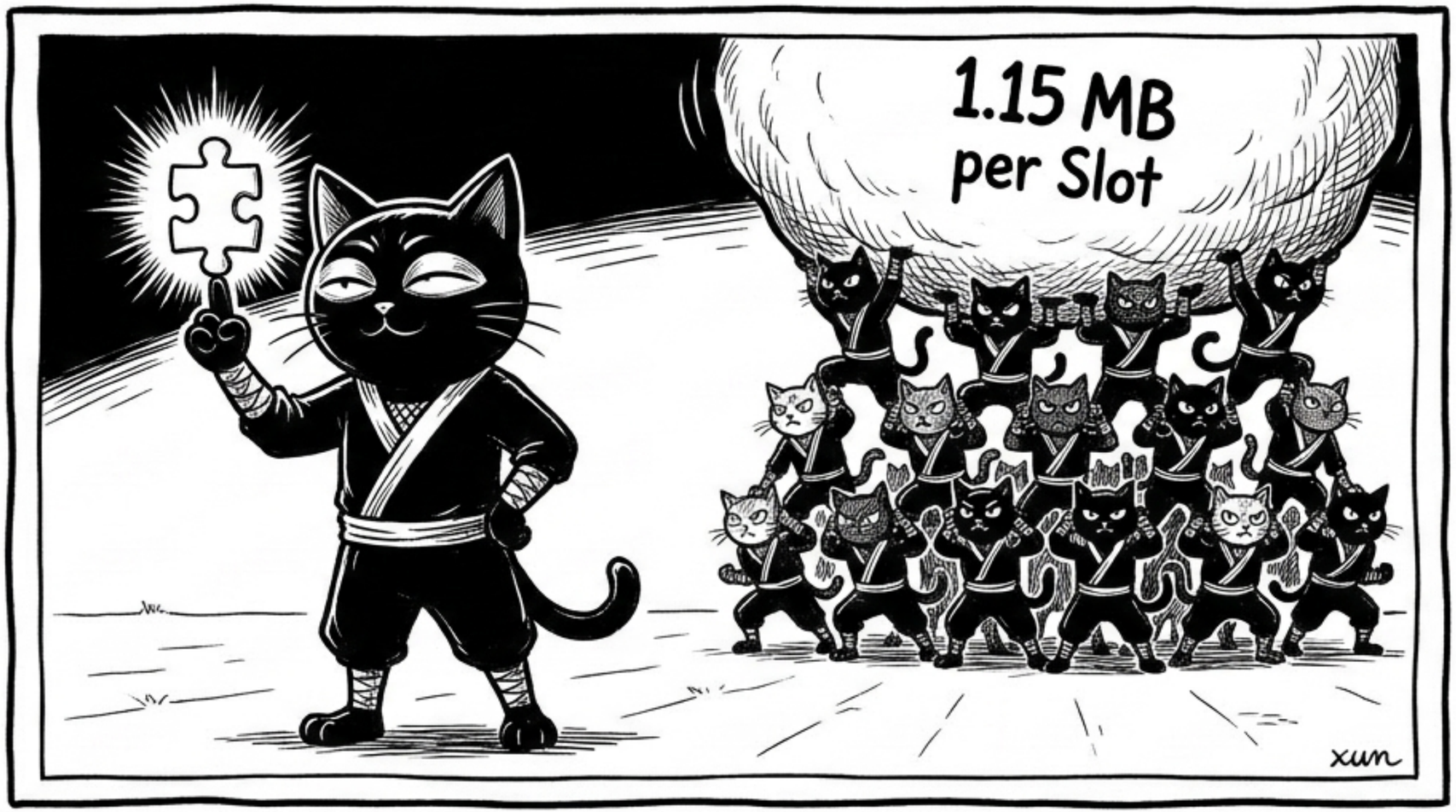
- Rollups send 128 KiB Blobs of compressed data to Ethereum.
- At 9 blobs per block, home stakers must download over 1 MB every 12 seconds.
- Forcing every node to carry everything destroys decentralization.



Gemini Notebook

The secret art of the decentralized division of labor

- PeerDAS (Peer Data Availability Sampling) breaks the barrier.
- Nodes no longer download the entire file.
- They mathematically guarantee the data exists by only carrying a microscopic fraction of it.



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Step 1: The Holographic Slice (1D Erasure Coding)

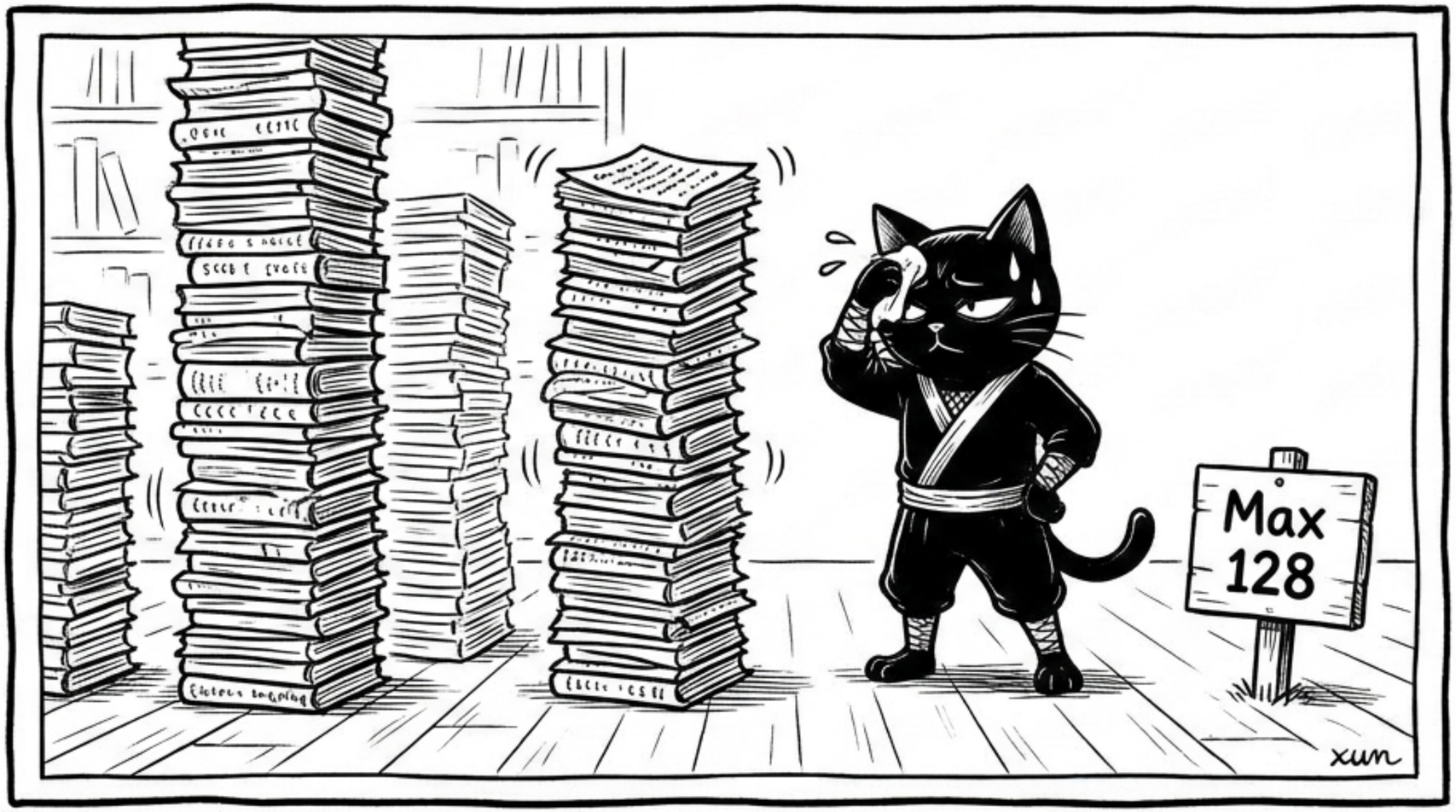
- Before sharing, data is mathematically stretched using Reed-Solomon coding.
- The data size is doubled (2x extension).
- The Magic: If you possess any 50% of the scattered pieces, you can reconstruct 100% of the original data.



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Step 2: Stacking the 128 columns

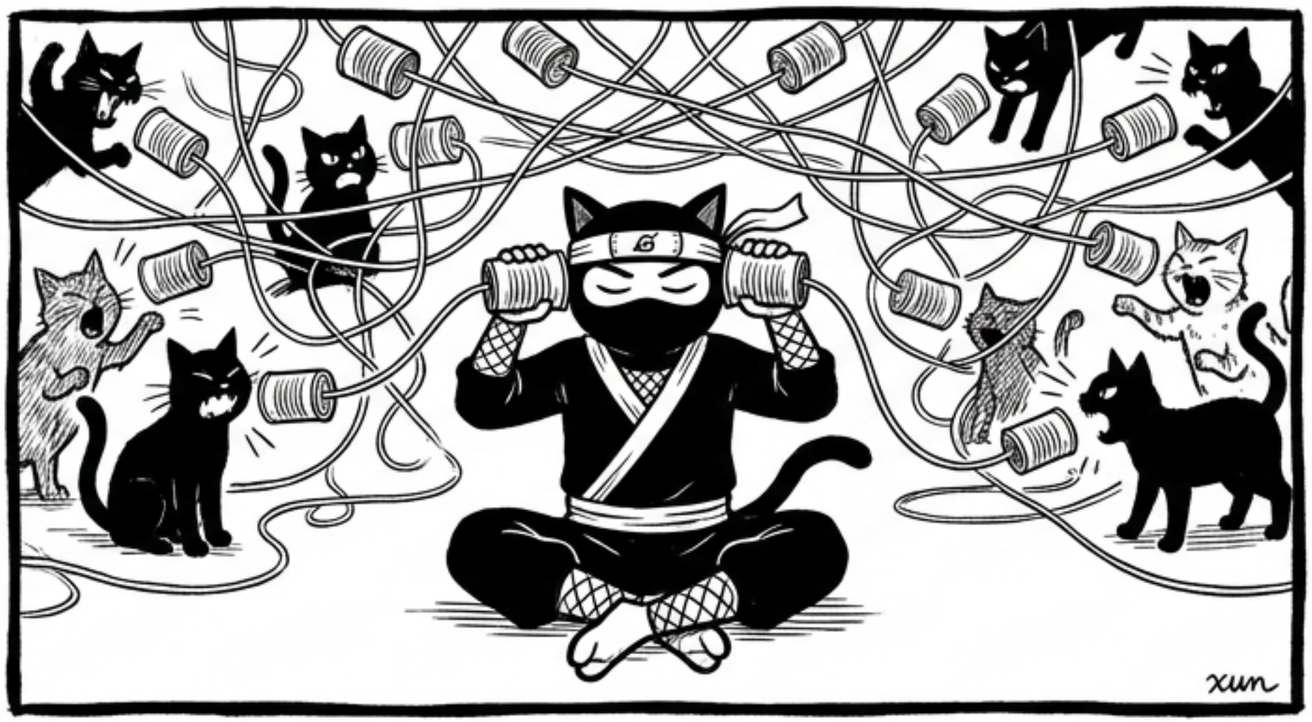
- The extended blob data is not shared randomly.
- It is structured into exactly 128 vertical Columns.
- These columns become the new foundational data unit of the network.



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Step 3: Tuning into specific clan frequencies

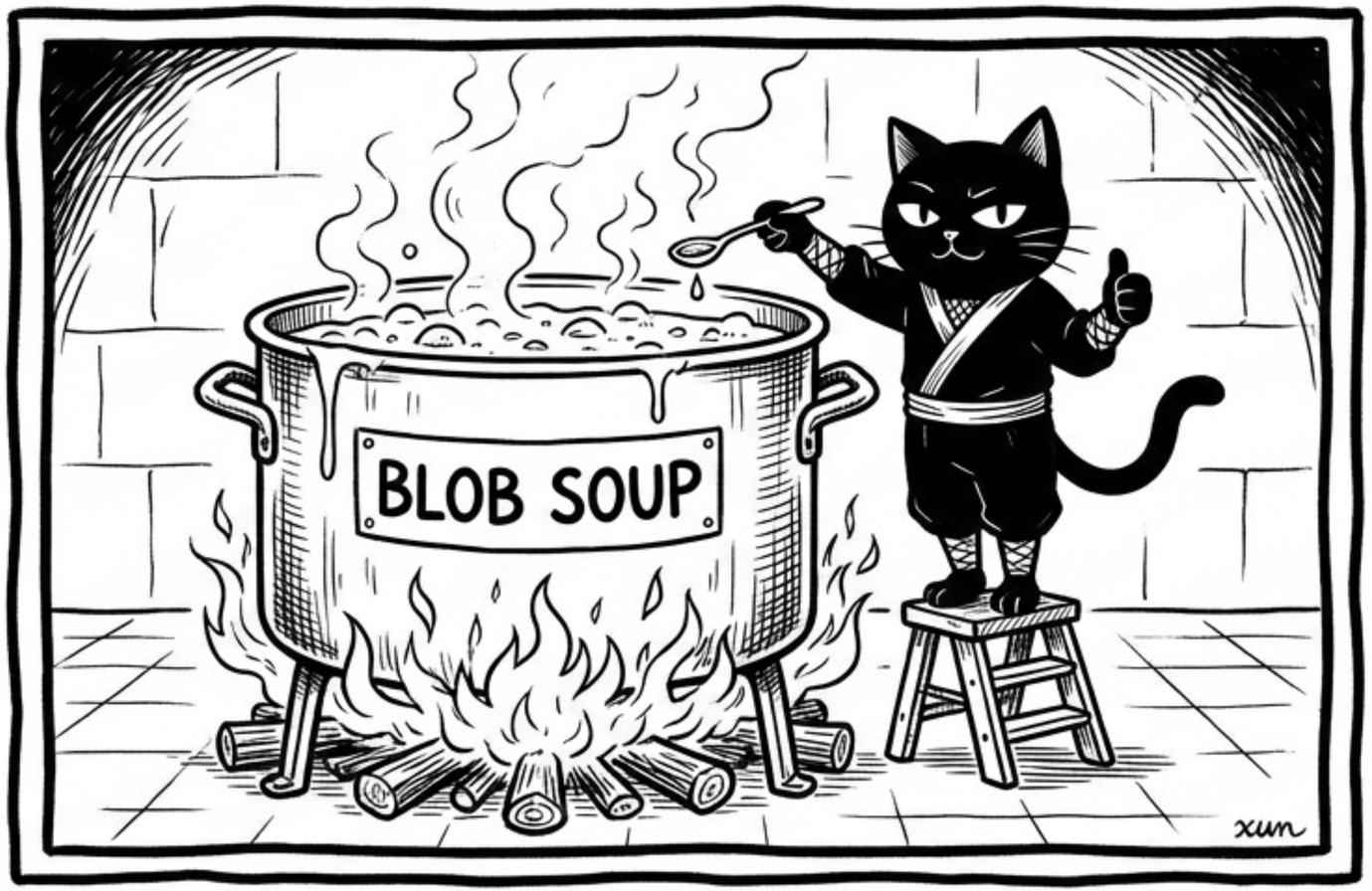
- The Ethereum network divides into dedicated **column subnets**.
- A home node **does not listen** to the **entire network**.
- It **subscribes** to a randomized, permanent **subset** (e.g., 8 out of 128 columns) based on its unique Node ID.



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Step 4: The probabilistic taste test

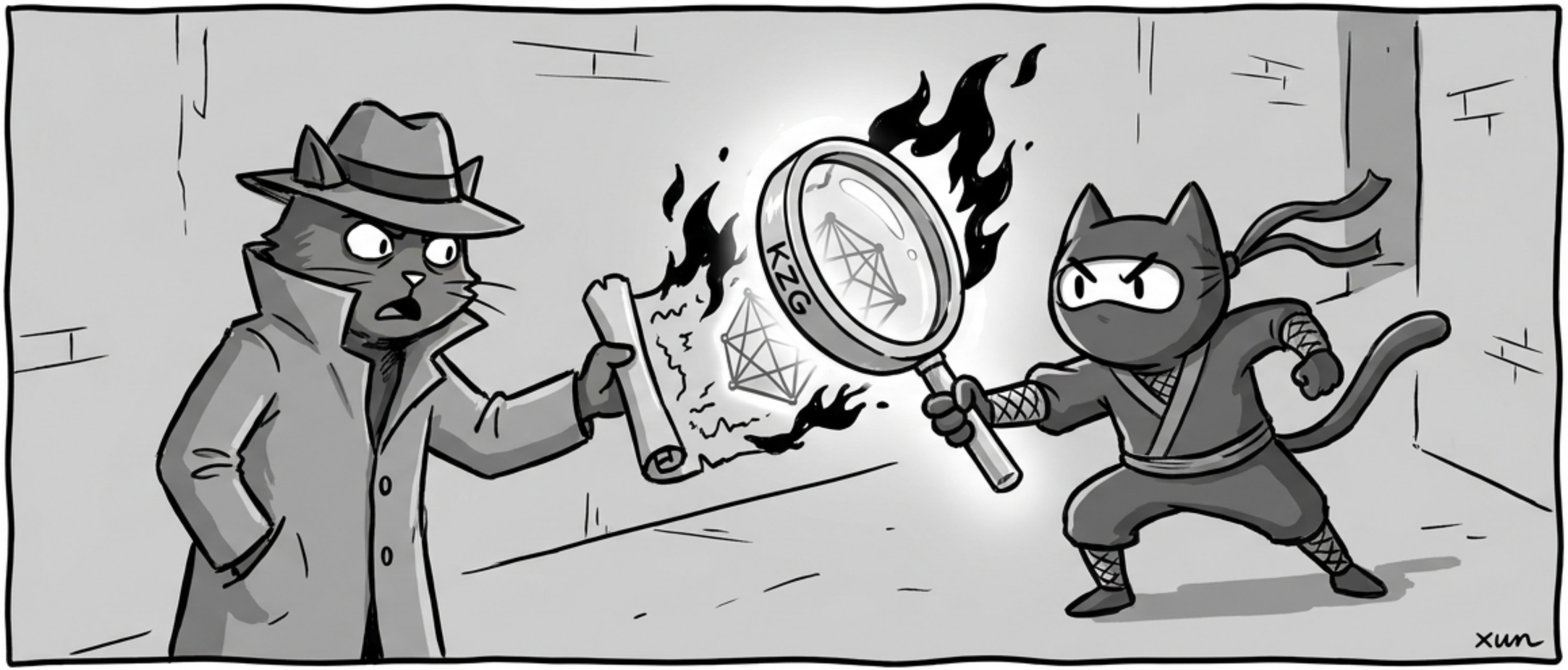
- You don’t need to drink 50 liters of soup to know if it’s salty.
- Nodes request **random**, tiny column samples from peers.
- By successfully tasting a few random drops, nodes gain statistical certainty that the entire blob is available.



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Step 5: The cryptographic seal of truth

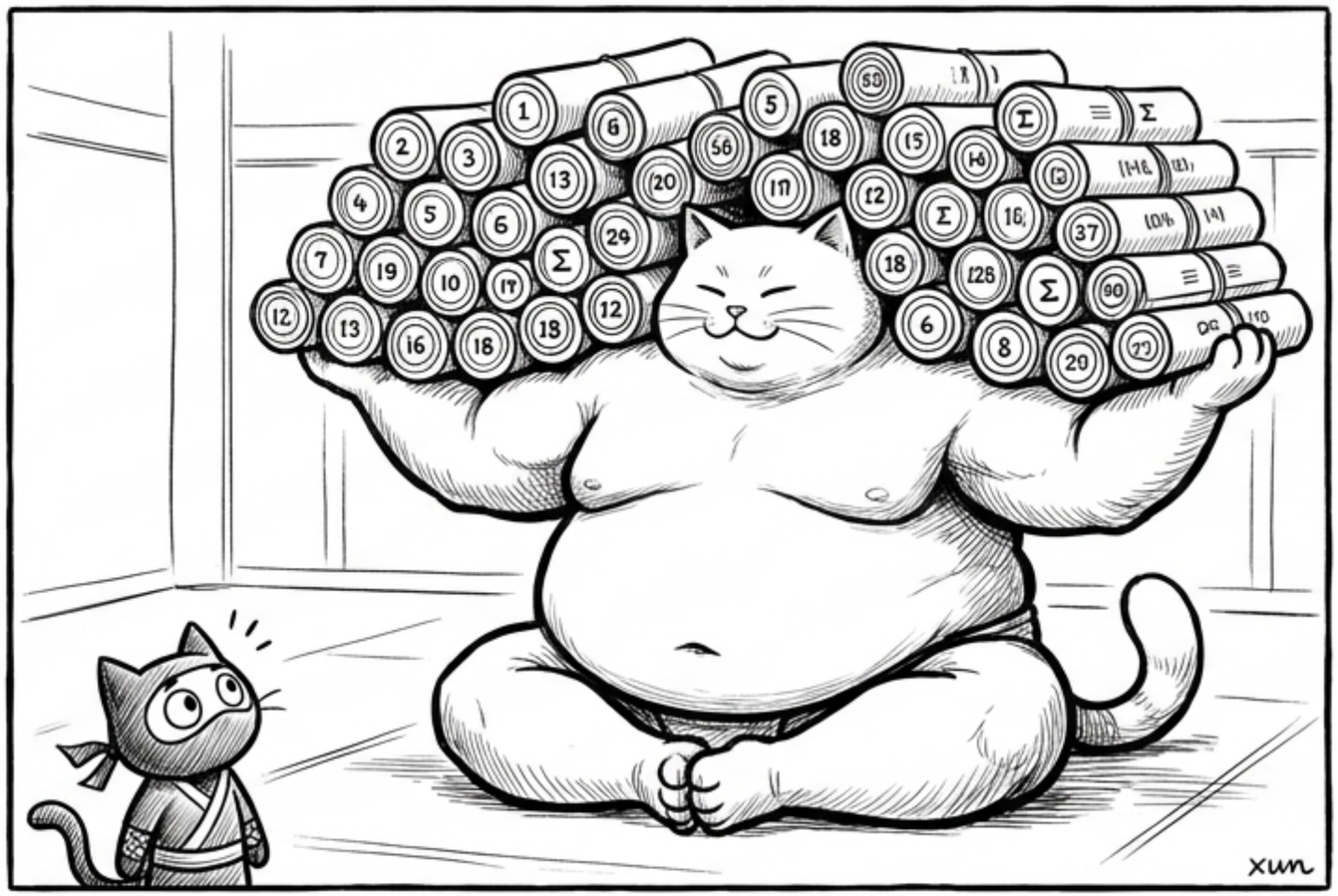
- KZG Cell Proofs allow any node to instantly verify a peer’s sample.
- The sample is checked against the main block’s mathematical commitment.
- Nodes never have to trust the peer serving the data.



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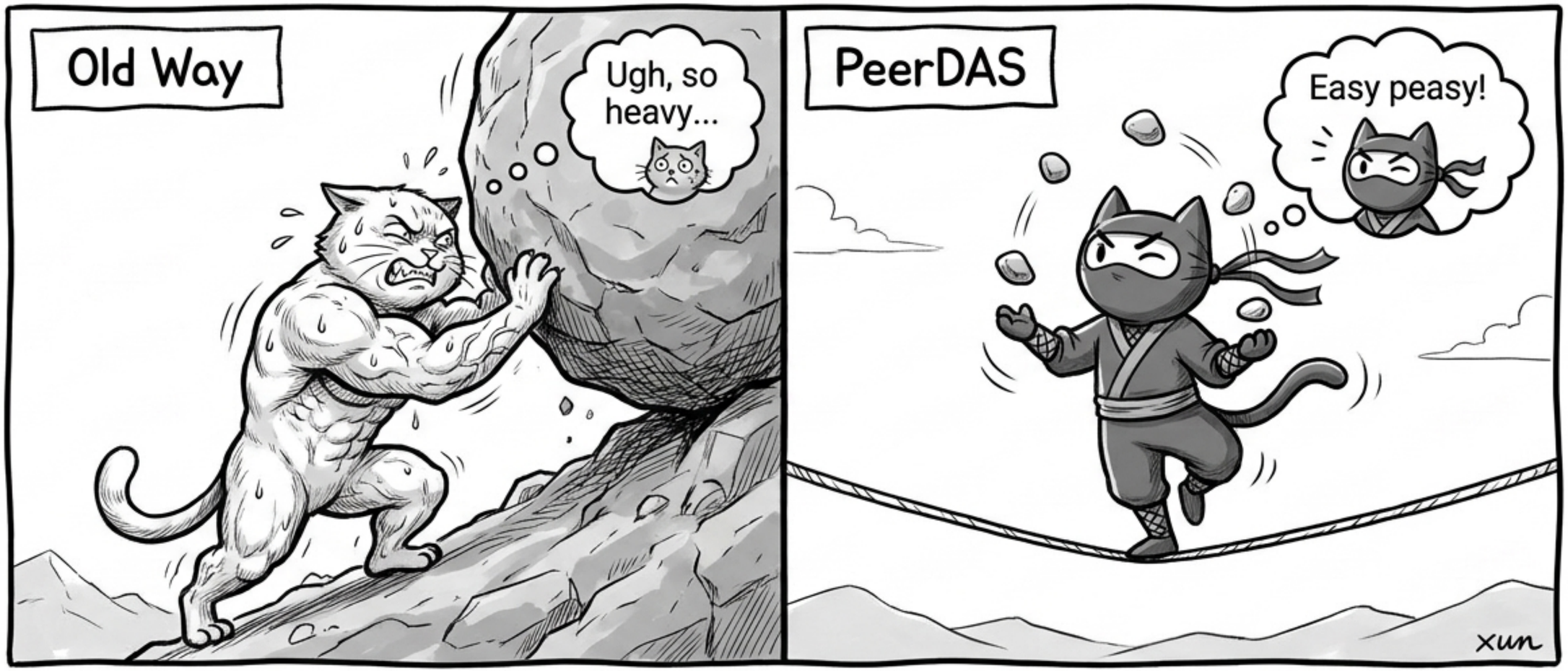
The safety net of the Supernodes

- While home nodes sample just 1/16th of the extended data...
- Validators with 4096+ ETH act as Supernodes.
- They custody all 128 columns, acting as the resilient backbone that guarantees data reconstruction is always possible.



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Brute force architecture vs. Ninja flow



Bandwidth:	Maximum strain (1 MB+/slot)	Minimal strain (~16 KiB/slot)
Storage:	Archiving all blobs	Custodying 4-8 specific columns
Verification:	Downloading the universe	Probabilistic sampling

Gemini Notebook

The lingering threat of the Mempool traffic jam

- While Consensus Layer verification is horizontally sharded, the Execution Layer blobpool currently is not.
- Nodes still **download full blobs initially** when they are submitted.

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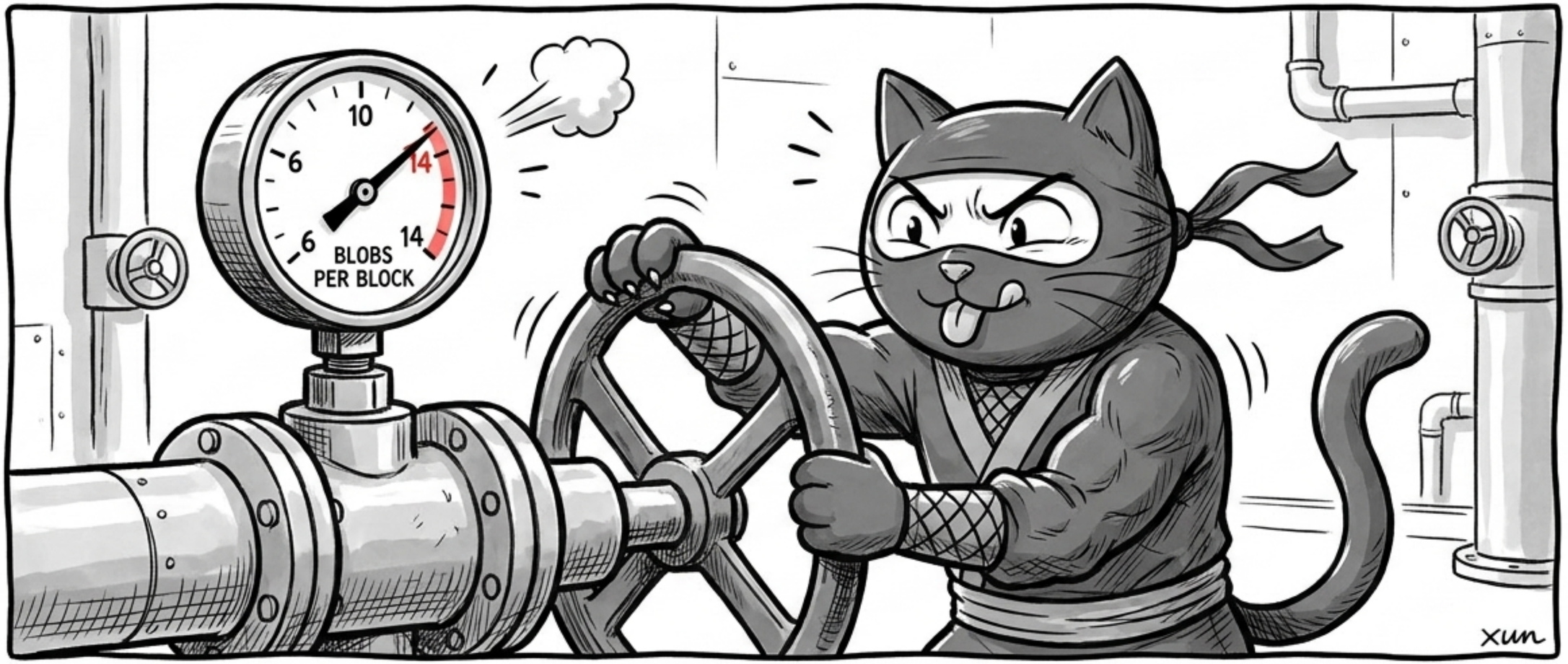
- This creates a potential DoS vulnerability that requires future vertical sharding solutions.



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Gradual mastery through BPO adjustments

- PeerDAS capacity is not maxed out on day one.
- Blob Parameter Only (BPO) forks (EIP-7892) are pre-programmed mini-upgrades.
- They gradually dial up the maximum blobs per block without requiring highly coordinated hard forks.



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The ultimate prize for the ecosystem

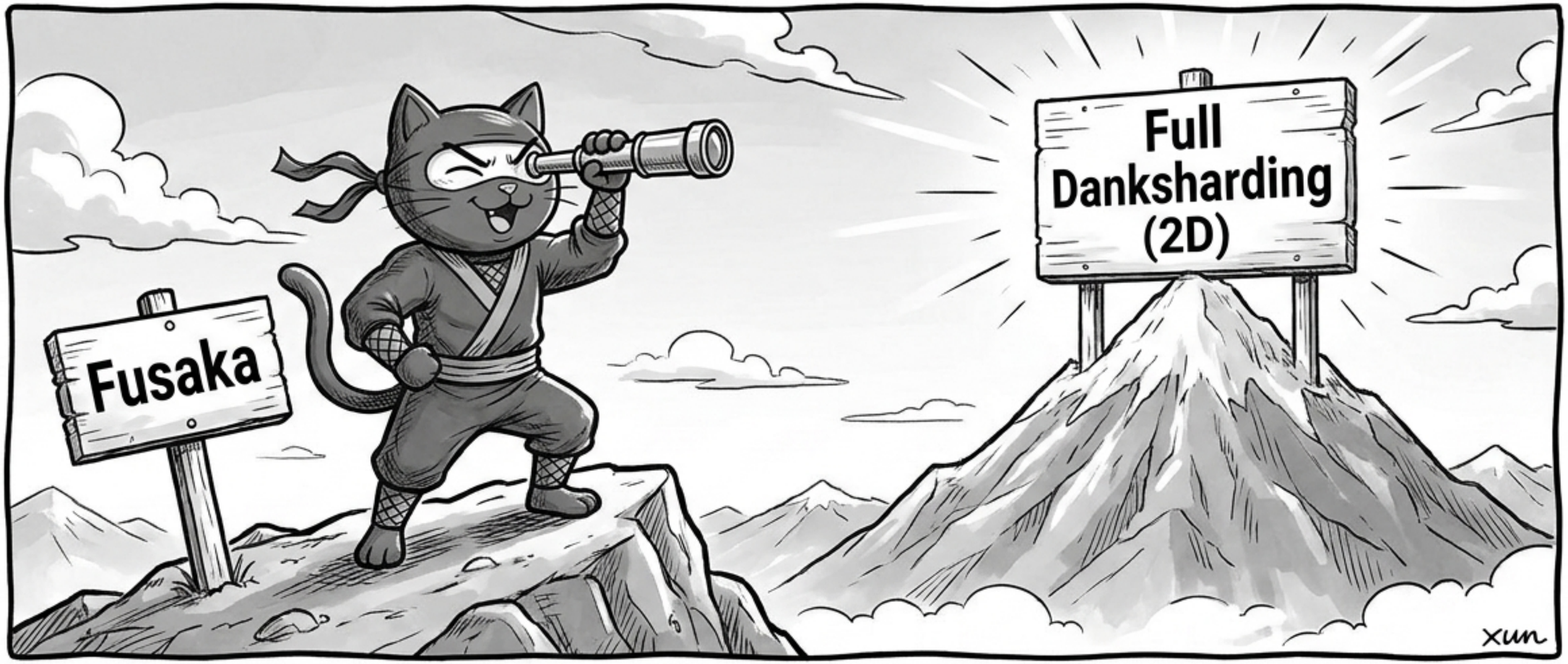
- By vastly increasing data availability capacity without crushing node operators, the supply of blockspace skyrockets.
- Layer 2 rollup fees drop by orders of magnitude.
- Ethereum secures its position as the ultimate, cost-effective settlement layer.



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The endgame of Ethereum scalability

- PeerDAS (1D sampling) is the critical unlock that proves the math works in production.
- It preserves decentralized home staking while opening the path toward the 64+ blob endgame.



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The network breathes easily

Data Available



xun

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