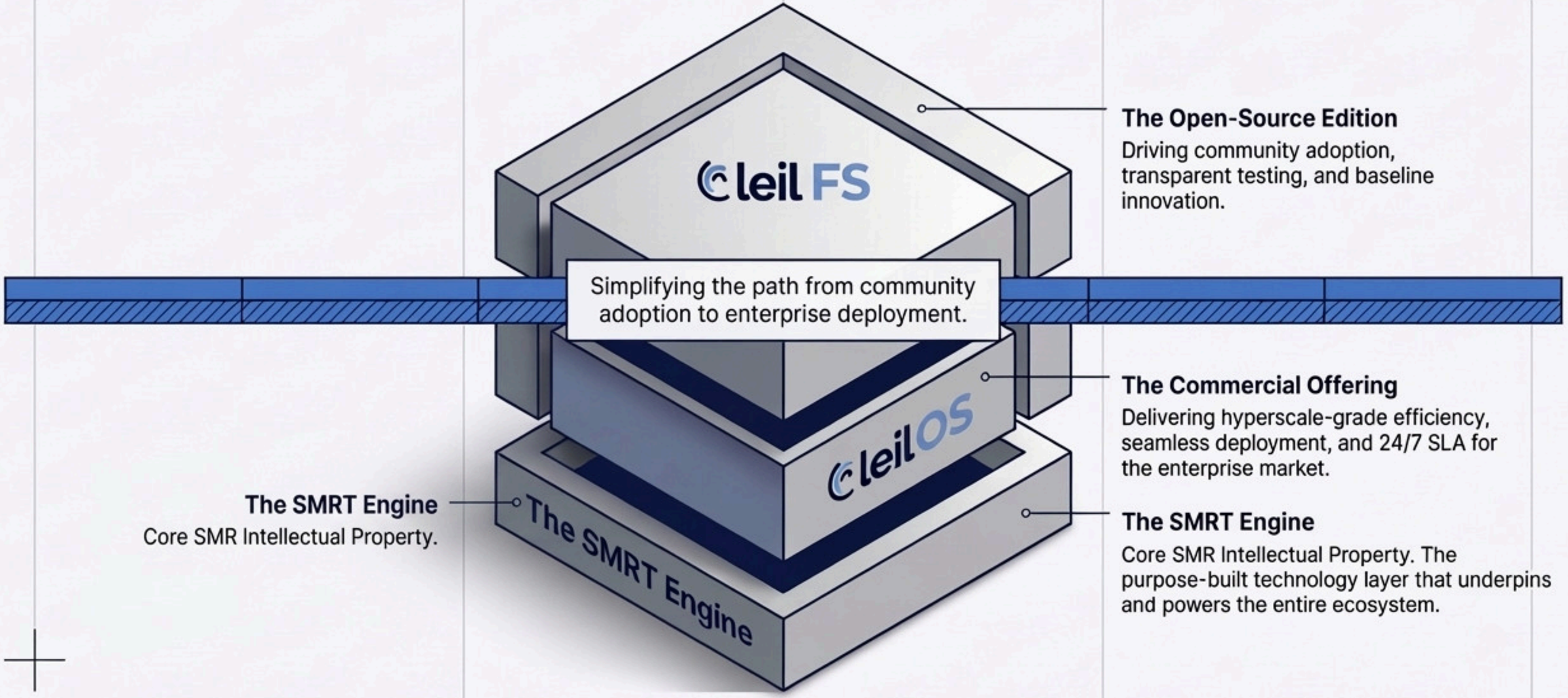
leil

Leil: HDD-Native Storage for the Exabyte Era

Press Briefing — April 1, 2026

Unified Brand, Unified Vision



The Open-Source Edition
Driving community adoption, transparent testing, and baseline innovation.

The Commercial Offering
Delivering hyperscale-grade efficiency, seamless deployment, and 24/7 SLA for the enterprise market.

The SMRT Engine
Core SMR Intellectual Property. The purpose-built technology layer that underpins and powers the entire ecosystem.

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Core SMR Intellectual Property.

The Briefing Manifest

From an Engineering Journey to an Enterprise Standard

The Origin Story

Leil was founded to solve the massive, growing disconnect between the economic realities of high-capacity HDDs and legacy software architectures inherently designed for flash.

Built by a team with deep, specialized expertise in parallel file systems and distributed storage ecosystems, Leil is engineered strictly for spinning media physics.

Comparison Matrix	Traditional	Leil Storage
Hardware Strategy	Fragmented, general-purpose boxes.	Purpose-Built HM-SMR drives (+20% capacity per disk).
Energy Footprint	Always spinning, high power waste.	Radically lower carbon footprint with software-controlled spin-down.
Pricing Model	Variable costs, punitive egress & retention fees.	Flat-rate, all-inclusive, radically transparent.

2022

Year Founded

Seed-Funded

Current Status

Distributed Storage

Core Engineering Pedigree

Tallinn, Estonia

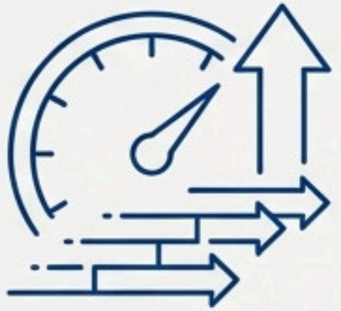
Global Headquarters

Making Every Byte on Every HDD Count

The 4 Pillars of the HDD-Native Philosophy

Extra Capacity

Unlocking exabyte-scale density via Host-Managed SMR.



Extra Performance

Intelligent zone management, sequential-optimized data flow, and precise Command Duration Limits (CDL).

Extra Longevity

Optimized drive lifespan via targeted Autonomous Drive Regeneration (Head Depopulation).

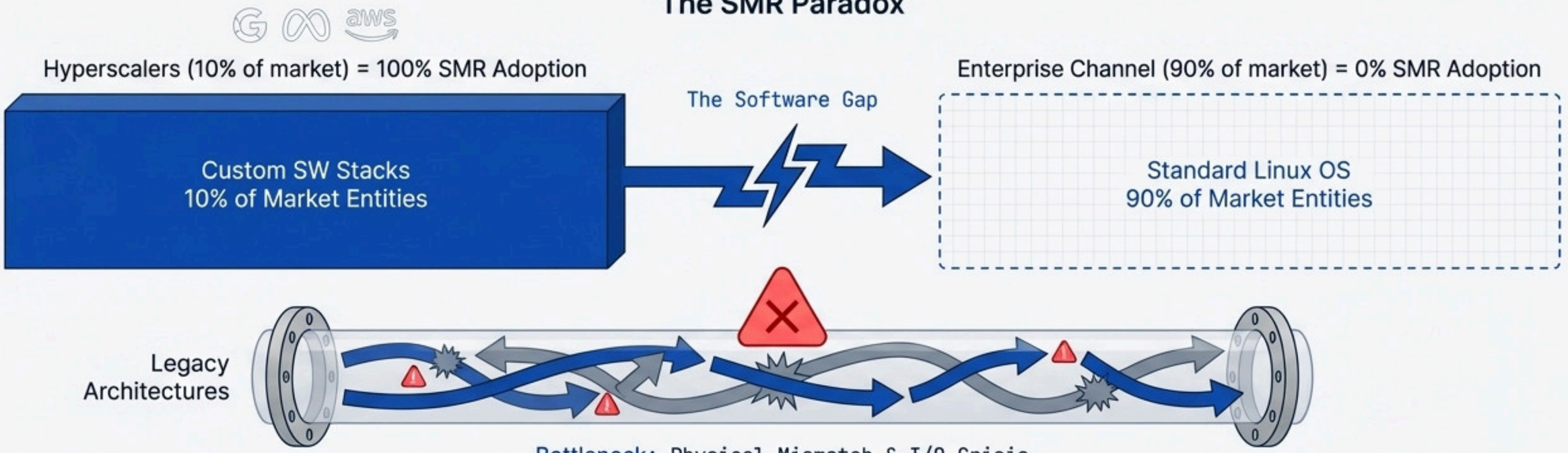
Sustainability

Extreme power efficiency via the Infinite Cold Engine (ICE).

Future-Proofed: Native Flash Support (HM-OP) Currently in Development.

The Storage Industry's Uncomfortable Truth

The SMR Paradox



Capacity vs. Performance Gap

HDDs scale to 32TB+, but legacy software treats modern physics like slow SSDs.

Cost Spiral

Stacks running on HDD hardware waste 30-60% of potential capacity economics without SMR support.

Scaling Complexity

Adding petabytes shouldn't require 6 months of tuning.

Management Overhead

Legacy parallel file systems demand specialized, PhD-level staff.

Hard Numbers, Not Hard Sells

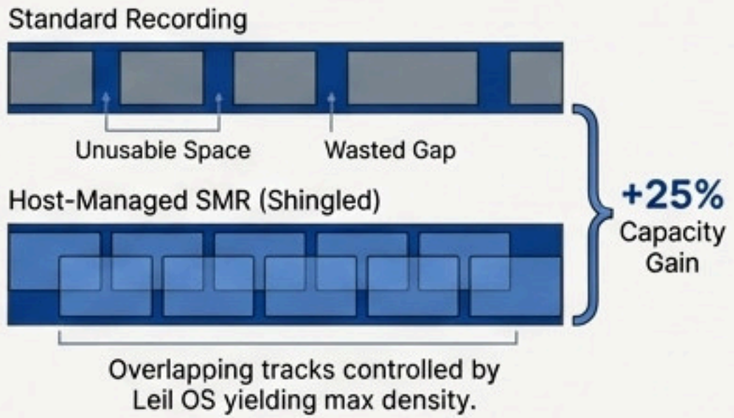
Purpose-Built from Line One.

Leil is not an afterthought or a retrofitted flash gateway. It is natively engineered for the precise physical realities of spinning media.

Multi-protocol support (POSIX, NFS, SMB/CIFS, S3) is embedded embedded directly into the core, eliminating the need for bolt-on architectural compromises.

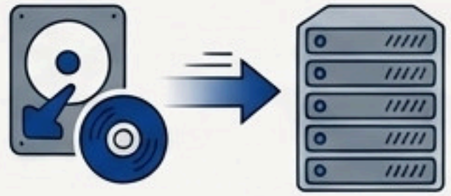
+25%

Usable Capacity Gain vs. generic SDS on identical hardware.



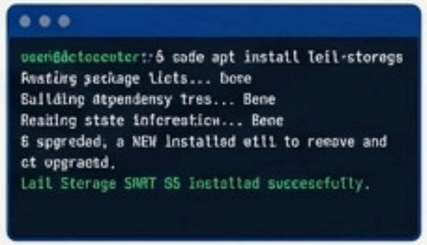
Tape-Level $/TB

Achieved without the crippling 45-minute retrieval latency penalty.



10-Minute Deployment

Hours, not weeks. Fully deployed via standard repository commands.



Where HDD-Native Outperforms the Status Quo

1

AI & HPC Warm Tier

Optimal $/TB bridge for Exabyte Training Libraries feeding NVMe.

2

Active Archive

Millisecond retrieval times vs. hours/days for traditional tape setups.

3

Enterprise Backup

Qualified with Veeam/Acronis. Immutable Copy-on-Write snapshots.

4

Media Post-Production

Optimized for 4K/8K sequential streams utilizing 64KiB blocks

5

On-Premises K8s

Native CSI driver and Operator for HCI deployments.

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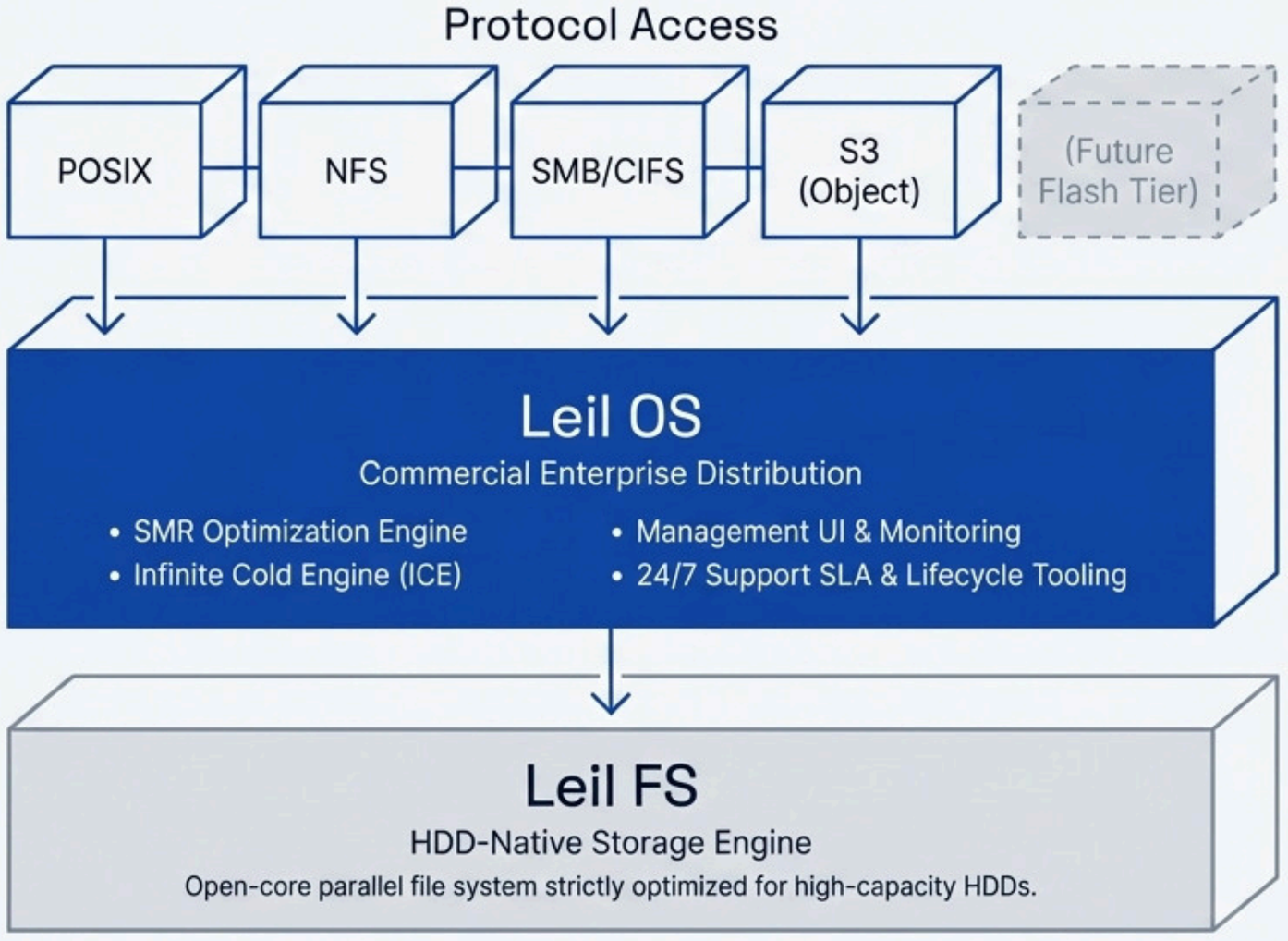
6

CCTV Storage

Perfectly tailored for infinite sequential writing and retention laws.

Qualified - Backup. Immutable Copy-on-Write snapshots.

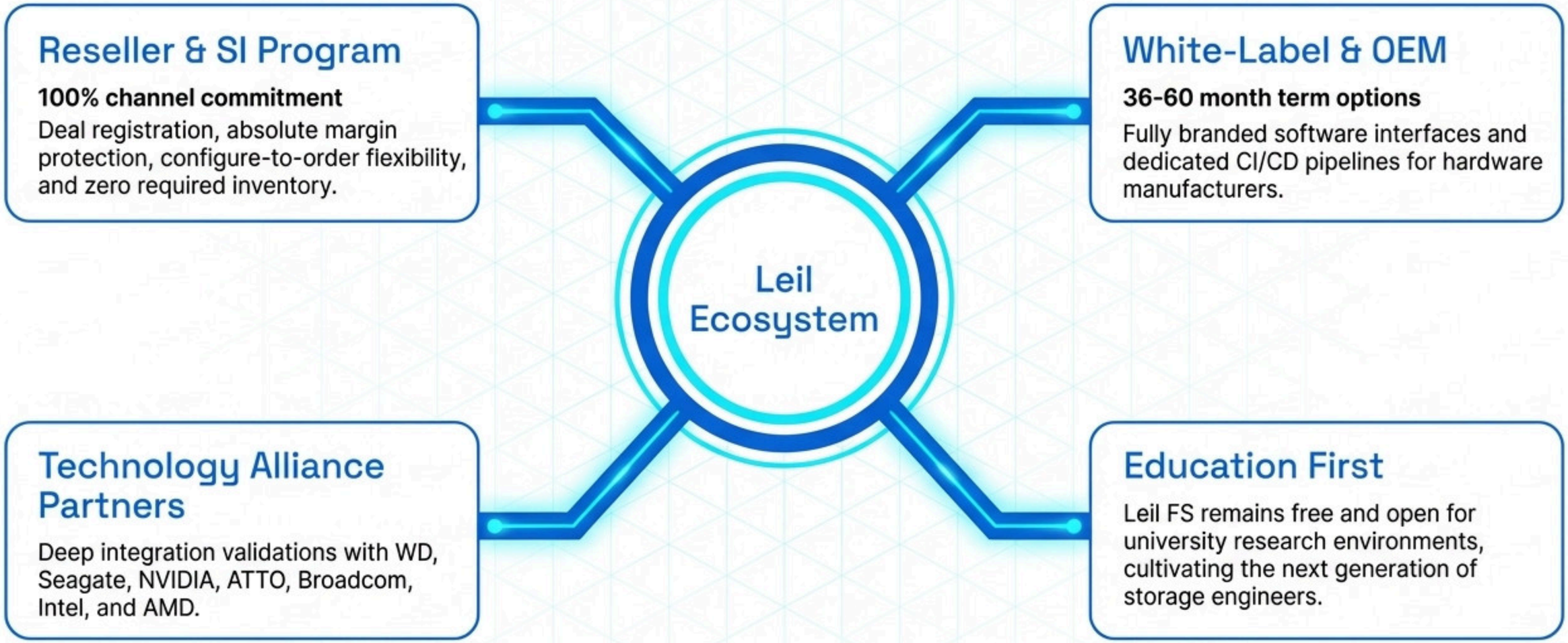
The Stack: Software + Appliance



Reference Architectures

From 2U servers to multi-PB JBOD enclosures. Every hardware dollar is maximized by the software extracting absolute HDD potential.

Channel-First Go-To-Market Mechanics



Predictable Exabyte Scaling and Absolute Data Sovereignty

The Economics of Scale

- **Standard:** Baseline optimization up to 1.5PB.
- **Advanced Green:** Power-efficient hardware up to 11.5PB.
- **Enterprise Green:** Maximum density & fast rebuild up to 19.5PB+.

OEM agreements feature a predictable 2% annual indexation + Euribor rate.

Zero Vendor Lock-in

Because Leil OS is built atop Leil FS, a free, open-source GPL-3.0 exit path is fundamentally guaranteed. The data always belongs to you.

From Cold Archives to Nearline & Warm Workloads

Cold — Warm/Nearline

Cold

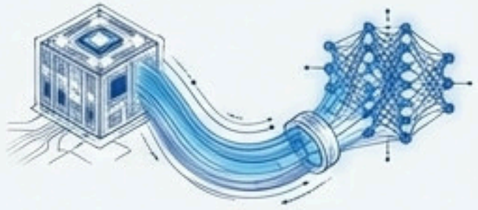
- Long-term regulatory archives
- National digital preservation
- Total tape replacement

Cool

- Media asset archives
- Genomics raw data
- Research data lakes

Nearline (The Missing Tier)

- AI Exabyte Training Library
- Video-on-demand origin storage
- Massive training data staging



Warm

- Enterprise file sharing at scale
- Active archives
- HPC environments

In Production: Real Deployments

National Broadcaster

Multi-PB video-on-demand origin storage. Leil OS simultaneously serves high-throughput streaming ingest and delivery without dropping frames.

Regional Hosting Leader

Enterprise file sharing platform supporting tens of thousands of users. Seamless integration with native client protocols entirely replacing legacy NAS.

Supercomputing Centers

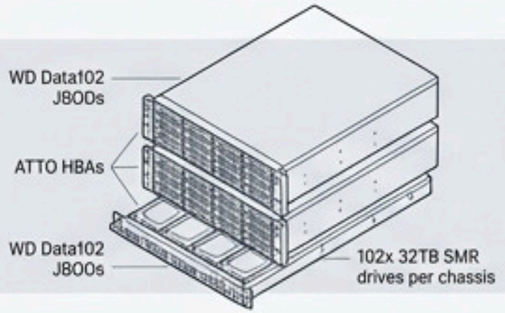
National archive projects executing long-term preservation of critical research data. Unified access leveraging both native POSIX and S3 architectures.

Autonomous Driving & AI

Research programs staging autonomous car telemetry datasets. Built specifically for cost-sensitive bulk storage feeding massive machine learning pipelines.

HARDWARE CONFIGURATION REFERENCE:

Small: 2U servers, 4PB usable capacity | Large: 1U head units + JBODs, scaling dynamically to multi-PB clusters.



Democratizing Hyperscale Storage Economics

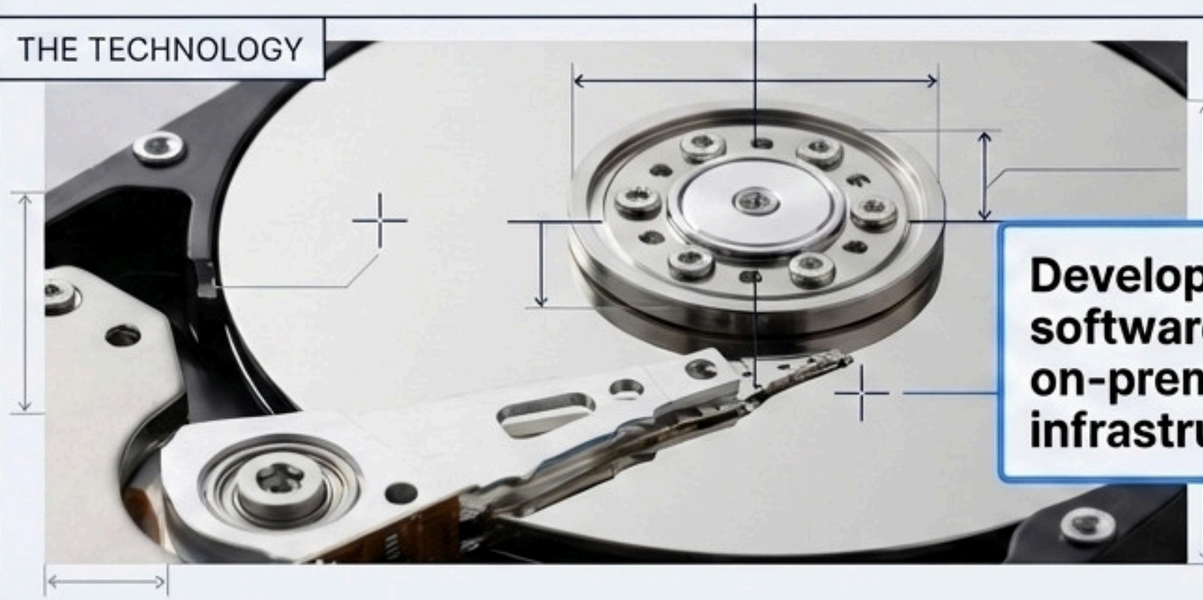
TOP ORIGIN

leil

Founded in 2022 by storage experts.

Invented and built in Estonia.

THE TECHNOLOGY



Developing HDD-Native™ software for large-scale, on-premises infrastructure.

THE IMPACT

Energy-Efficient.
Radically lowering the carbon footprint.

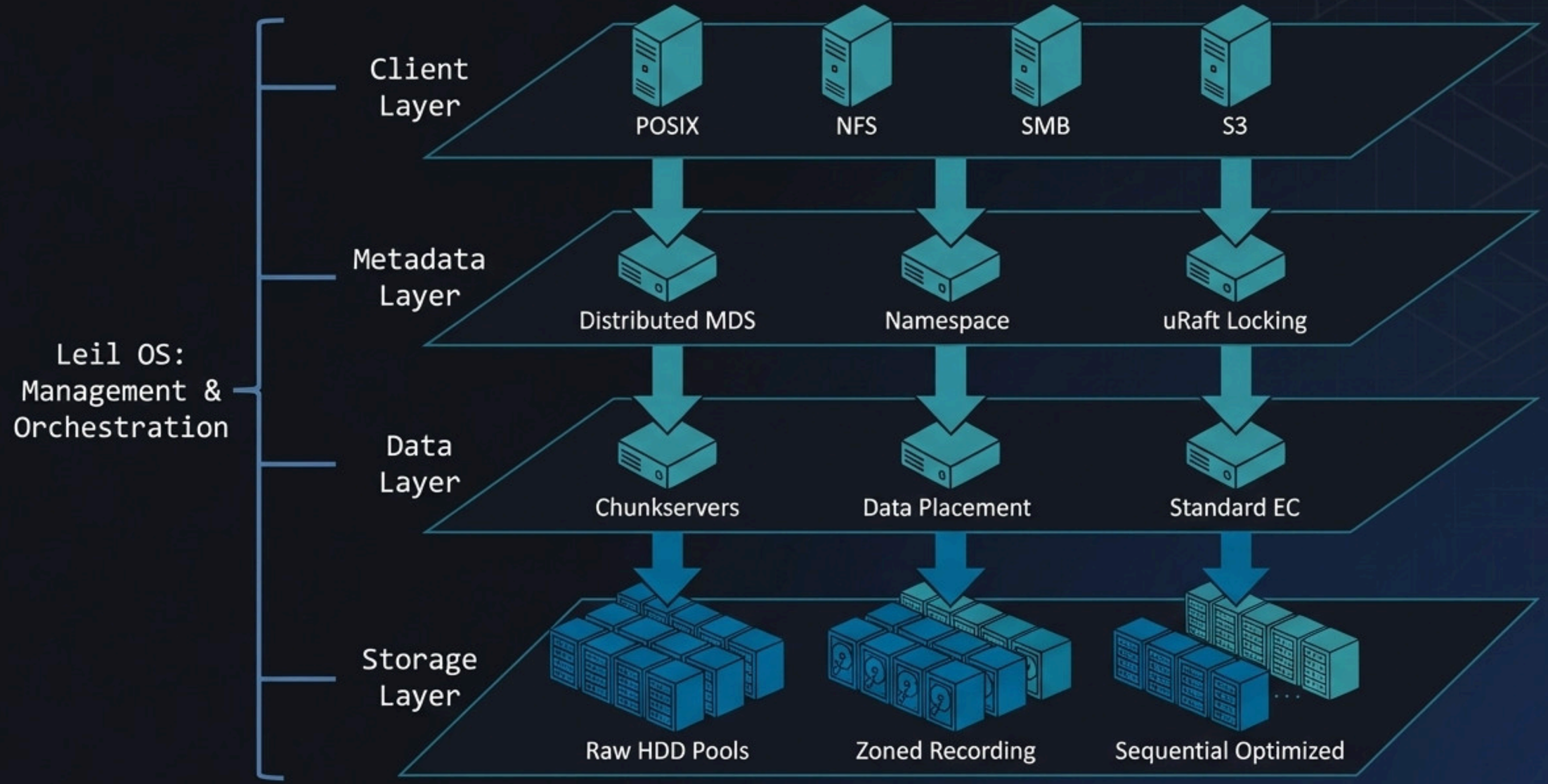
Cost-Effective.
Bringing hyperscale economics to the enterprise.

Scalable.
Exabyte-ready density.

Enabling data-intensive organizations to manage rapidly growing data volumes without added complexity.

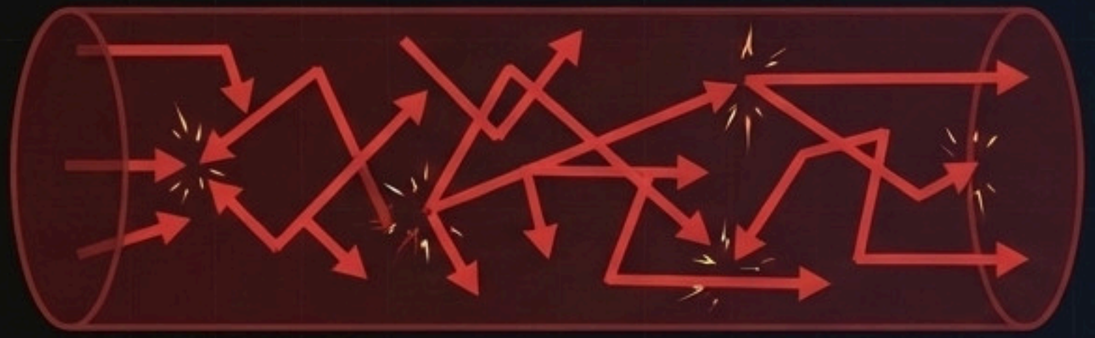
System.Agenda_

Leil FS Architecture



Why ‘HDD-Native’ Is Not Marketing

LEGACY BOTTLENECK

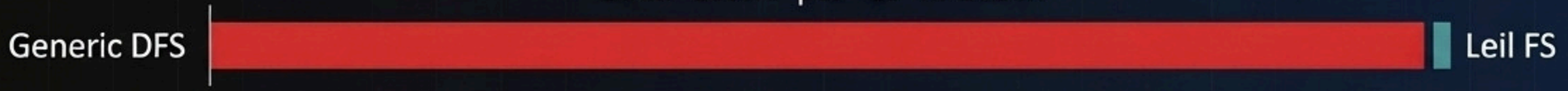


- Small random I/O applied to HDDs
- Excessive metadata lookups causing head seeks
- Write amplification from journaling
- Poor sequential bandwidth utilization

LEIL HDD-NATIVE

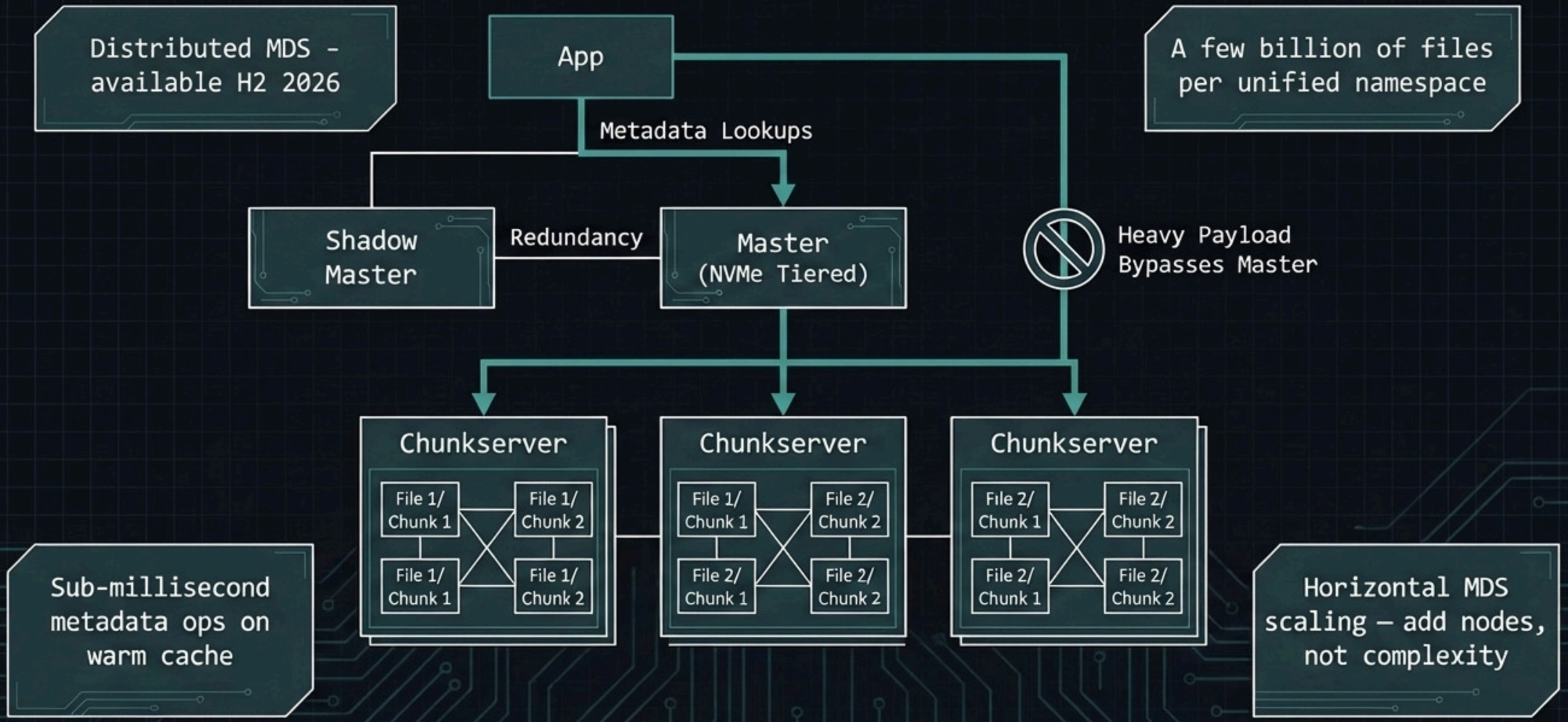
- Large sequential writes aligned to HDD geometry
- Batched metadata updates minimize seeks
- Write coalescing tuned for rotational media
- Zone-aware data placement

Seek Count per GB Written



Leil OS serializes writes into perfect streams,
unlocking 99.7% of theoretical maximum throughput.

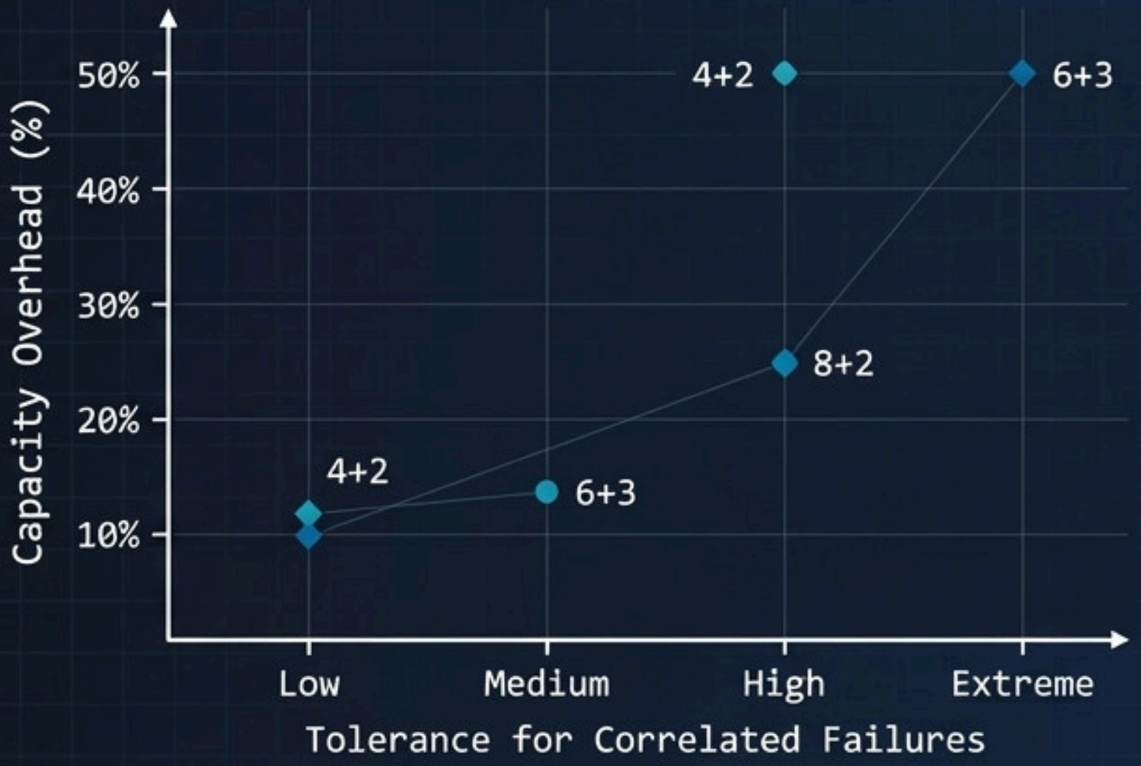
Distributed Metadata at Scale



Erasure Coding & Resilience

- Configurable EC profiles mathematically balancing capacity usage and data resilience.
- Replication mode for extreme latency-sensitive workloads.
- End-to-end CRC verification and automated scrubbing.
- Background rebuilds optimized to avoid saturating HDD bandwidth, preserving production I/O.

Rebuild without killing production performance.



Multi-Protocol, Native

POSIX: Full compliance, HPC-ready, parallel I/O.

NFS v3/v4: Enterprise file sharing, VMware datastores.

SMB/CIFS: Windows environments, end-user access.

S3: Object storage API, cloud-native apps.

NVMe-oF / RDMA: Future flash-accelerated tier.

Single namespace, multiple access methods — no gateways, no translation layers, no data silos.

Leil OS — Operations Without the Ops Burden

S: Sequential-Native (High-Density HDD)

Provides full-density data-condression monitoring and navarates comrortimd Level management mxcimes

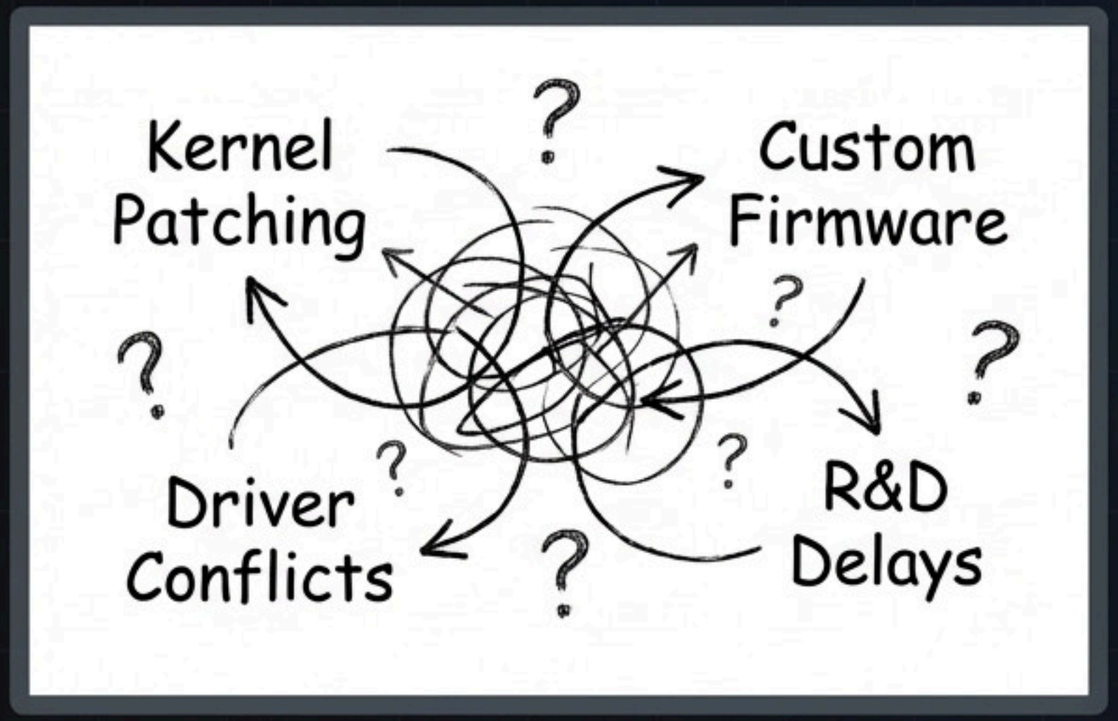
M: Managed-Hardware (Host-Managed SMR)

R: Regenerative (Autonomous Drive Regeneration)

T: Telemetry-driven predictive alerts

Deploy a multi-PB cluster in hours, manage it with a browser. No CLI-only administration.

From Engineering Project to “apt install”



The Old Way – Time to deploy: 6-12 months.

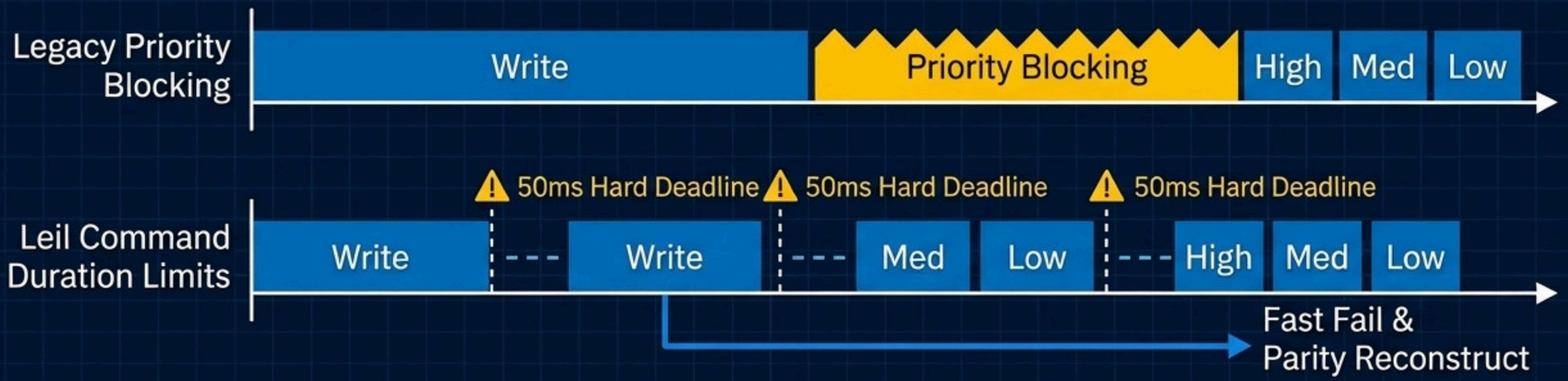
```
user@datacenter:~$ sudo apt install leil-storage

Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  leil-storage
0 upgraded, 1 newly installed, 0 to remove and 0 not
upgraded.
Need to get 24.5 MB of archives.
After this operation, 72.1 MB of additional disk space
will be used.
```

The Leil Way – Time to deploy: 10 minutes.

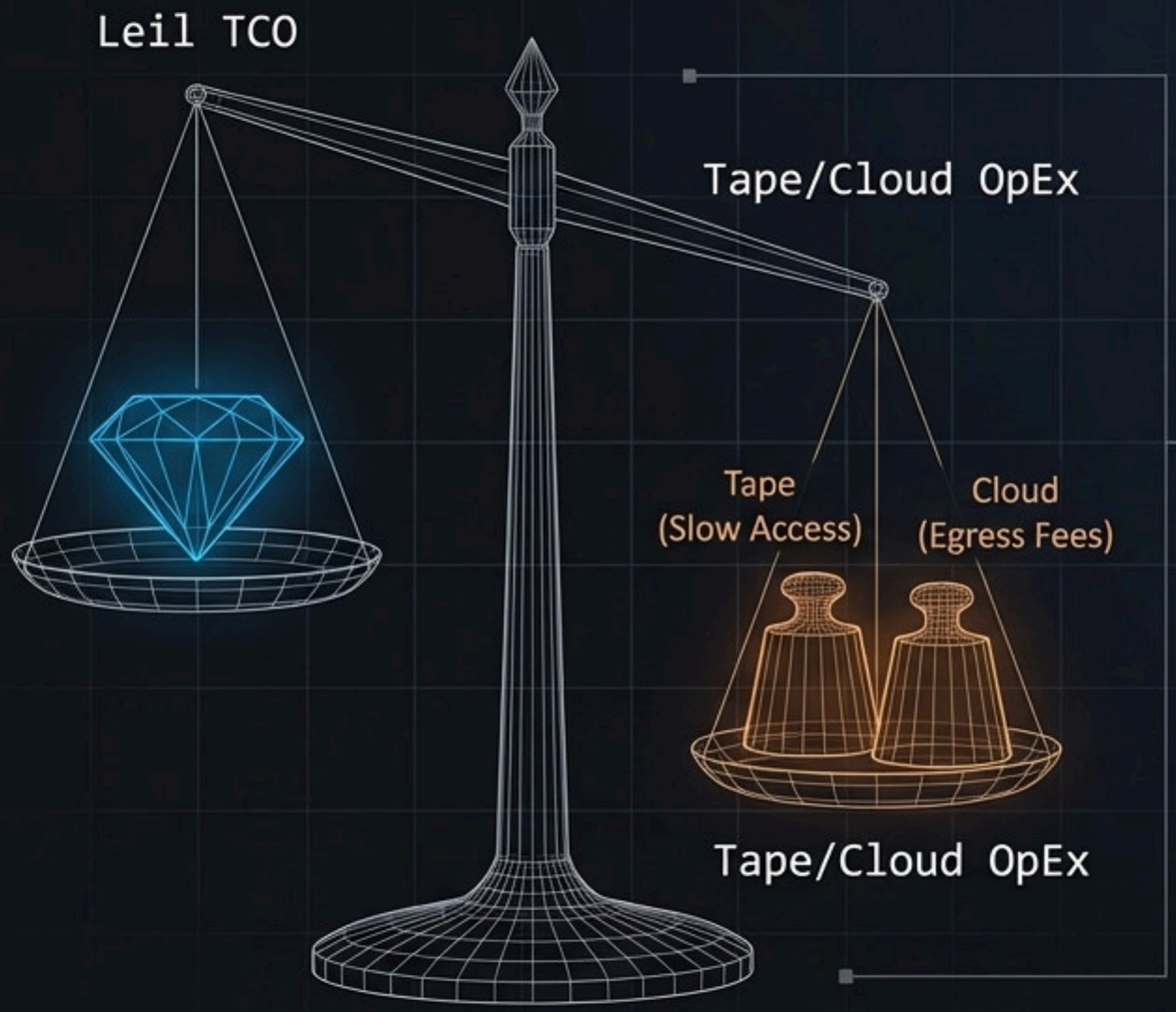
- Official repository inclusion across Debian, Ubuntu, Rocky Linux, and Fedora.
- Zero proprietary hardware lock-in.
- Tier 1: Community (Leil FS open-core) | Tier 2: Enterprise (Leil OS).

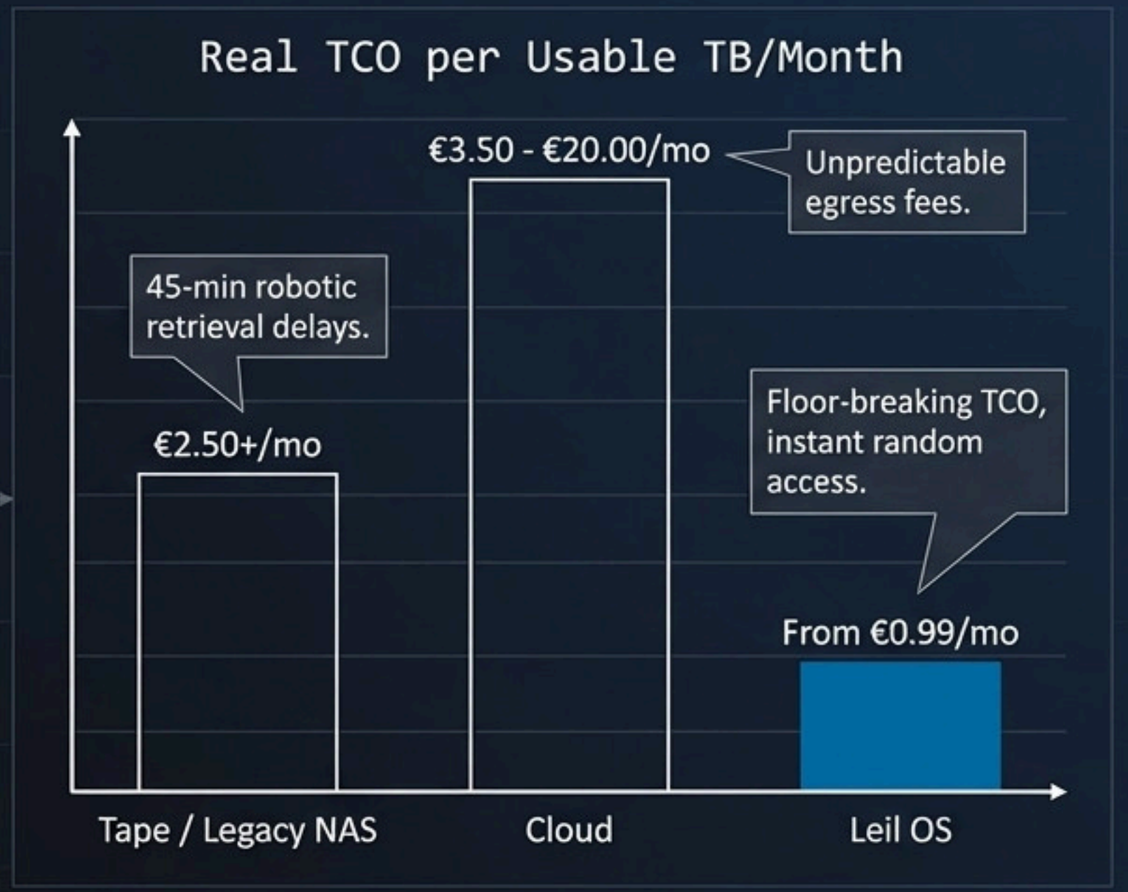
Solving Tail Latency via CDL



- **The Challenge**: Legacy priority blocking causes drives to hang on difficult sectors, ruining AI training runs.
- **The Solution**: SNIA Command Duration Limits (CDL). Host passes strict deadline hints to HDD firmware.
- **Fast Fail Logic**: If a drive misses the 50ms hard deadline, Leil instantly reconstructs from parity.

The 'Unbeatable TCO' Thesis





Eliminates the ‘SMR Tax’ by unlocking an extra **20% capacity** per disk purely through host-managed software, without dropping IOPS.

Hardware-Native, Vendor-Agnostic

Western Digital.

SEAGATE

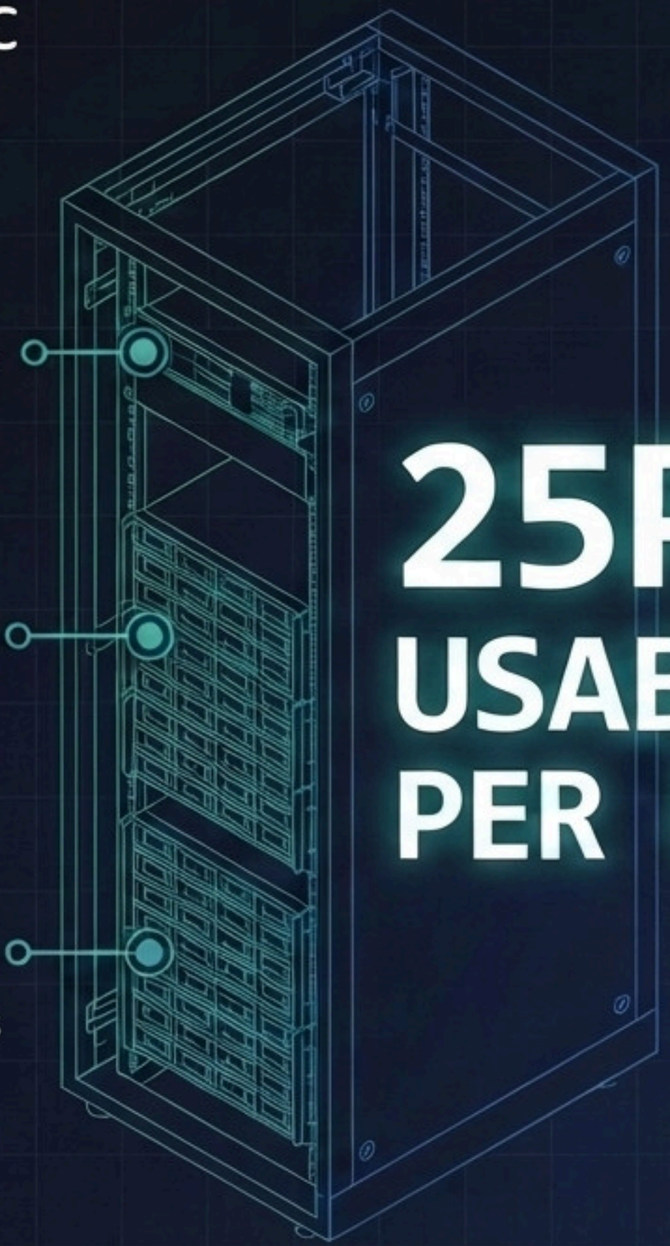
ATTO Technology

SNIA.

OCP

PCSS

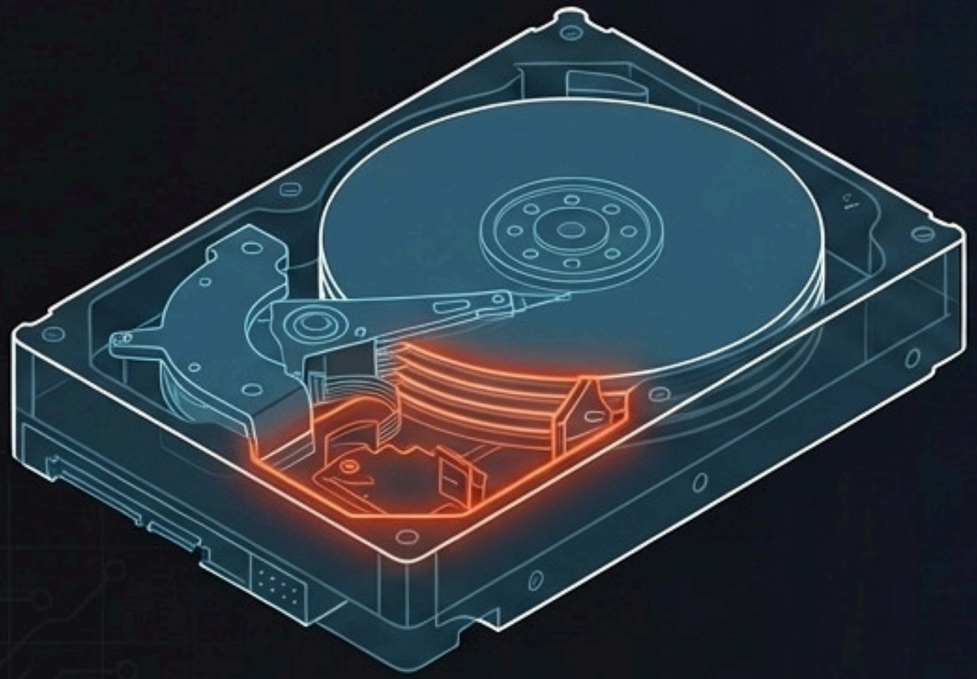
Strategic alignment and co-engineering with hardware leaders. Defining standards for HM-SMR adoption in the channel.



25PB+ USABLE PER RACK

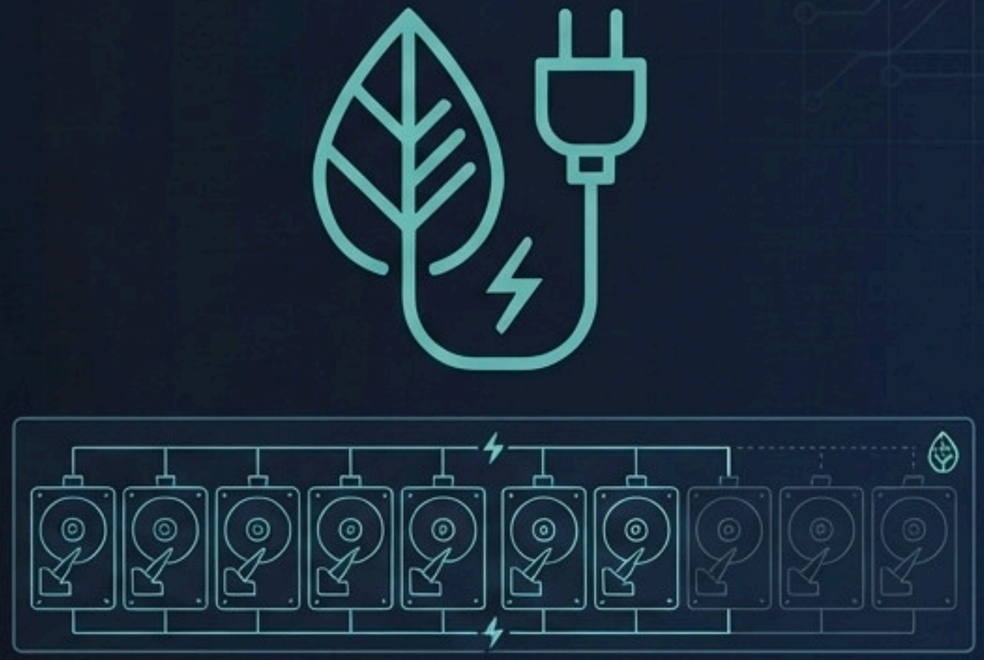
Hardware Autonomy: Head-Depop & ICE

Head Depopulation



Instead of failing a massive 32TB drive and triggering a 24h+ rebuild, Leil depopulates only the affected platter surface (~5% capacity loss). Zero-downtime recovery.

Infinite Cold Engine (ICE)



Software-controlled intelligent spin-down. 25% immediate energy reduction today, targeting 70% baseline reduction in the future.

The Flash Longevity Revolution (2027)

The Shift: Moving spare-block management from opaque SSD firmware to transparent host software (HM-OP).

The Impact: Graceful degradation logic extends lifespan from 5 to 7+ years, slashing failure-related TCO by 83%.

Demand the Math.

We publish our own models and test setups.
We encourage buyers to ask every vendor for the same transparency:

- [x] 1. Exact erasure coding schemes and failure envelopes, not just ‘overhead %’.
- [x] 2. Mathematical durability models (probability of data loss per PB-year).
- [x] 3. Proof of HM-SMR optimization (+20%) without dropping IOPS.