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Hardware Spec: 1 MW-Equivalent Data Centre

Jam-enabled vs. conventional India greenfield build — pre-BOM engineering narrative

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Reference architecture (not a construction drawing) comparing the rack-level infrastructure required to deliver the same 1 MW-equivalent workload with and without Jam in an India greenfield data-centre context. Now includes Hardware Delta v2: a backup-tier best-case point that reflects the live April 2026 100× rsync comparator.

Executive Definition

This memo treats "1 MW output" as 1 MW-equivalent IT service output: the same storage, compute, network, and inference workload a conventional 1,000 kW IT-load hall would serve. The Jam case is not a 1,000 kW electrical load; it is the same workload delivered with roughly 720 kW IT draw because Jam reduces the hardware and energy required to serve it.

Headline Delta — Conservative (3.6×) Case

Without Jam: 1,000 kW IT load, ~1,400 kW facility draw at PUE 1.40, ~28 racks, USD $14–17M rack-level CapEx, ~250 kWh usable LFP battery bank.

With Jam (conservative): ~720 kW IT load for the same service output, ~958 kW facility draw at PUE 1.33, ~14 racks, USD $8–10M rack-level CapEx, ~180 kWh usable VRLA lead-acid battery bank.

Result: ~442 kW lower facility demand, ~3.87 GWh/year avoided, roughly USD $6–7M lower rack-level CapEx, and a smaller UPS/battery/generator envelope.

Hardware Delta v2 — Backup-Tier Best Case (100× rsync)

April 2026 live test on a backup workload showed Jam delivering ~100× compression vs an rsync comparator. Where the workload is a backup-tier corpus (cold or warm-cold replication, snapshot consolidation, archival ingest), the Jam case compresses to a much smaller footprint than the conservative 3.6× line allows. The table below records both points so engineering and procurement can scope the same site against either bound, depending on workload mix.

Dimension	Conventional 1 MW	Jam — Conservative (3.6×)	Jam — Backup-Tier Best Case (100×)
Racks	~28	~14	~1
IT load	1,000 kW	~720 kW	~70 kW
Facility draw	~1,400 kW	~958 kW	~100 kW
Rack-level CapEx (USD)	$14–17M	$8–10M	$1–2M
Battery bank (usable)	~250 kWh LFP	~180 kWh VRLA	~18 kWh VRLA
Annual energy	~12.26 GWh/yr	~8.39 GWh/yr	~0.88 GWh/yr
Workload applicability	All workloads	Mixed enterprise (3.6× typical)	Backup tier only (April 2026 live test corpus)

The backup-tier line is a workload-specific bound, not a universal claim. Mixed enterprise workloads should still be sized against the conservative 3.6× line. The 100× figure is the April 2026 live test (123 GB → 1.18 GB; recording at videopress.com/v/w4Z0jvUC).

1. Design Basis

This is a reference architecture, not a construction drawing. It compares the rack-level infrastructure needed to deliver the same 1 MW-equivalent workload with and without Jam in an India greenfield data-centre context.

- Geography: India greenfield site; state-by-state power, fire, and permitting requirements still apply.
- Workload mix: storage, compute, databases, backup/replication, and AI inference/training.
- Battery runtime: 15 minutes to generator start/stabilisation, not long-duration energy storage.
- Redundancy: Tier III-like N+1 power/cooling intent; formal certification requires independent review.
- Battery sizing: usable kWh shown. Nominal installed capacity must include depth-of-discharge, ageing, temperature, and UPS-efficiency margins.
- Cost boundary: rack-level build only. Excludes land, shell, grid connection, permits, GST/import duties, civil works, and full fire/BMS integration.

2. Conventional 1 MW IT-Load Build: Without Jam

The baseline uses conventional storage, vendor-standard compression where available, KMS-backed encryption, and accelerator-first inference. It consumes the full 1,000 kW IT design load and therefore carries the full power, cooling, UPS, battery, and generator envelope.

Component	Specification
Compute	68 × 2U dual-socket AMD EPYC-class servers; ~13k cores; ~50 TB DDR5 aggregate.
Storage	40 × 4U dense hybrid chassis: 60 × 20 TB HDD + 12 × 15.36 TB NVMe each. 2,400 HDDs + 480 NVMe devices.
GPU tier	12 × NVIDIA L40S + 8 × NVIDIA H100-class. Corrected board-power basis ~9.8 kW pre-host overhead.
Network	28–32 × 100 GbE ToR + 4 × 400 GbE spine; diverse 100 GbE carrier uplinks.
UPS	3 × 500 kW modular UPS, N+1. One failed module still leaves 1,000 kW protected.
Battery	~250 kWh usable LFP bank (larger nominal after design margins).
Generators	2 × 2.0 MVA diesel gensets, N+1. One 2.0 MVA set covers ~1.4 MW facility draw.
Cooling	Mechanical plant for ~1,000 kW IT heat rejection; ~400 kW electrical overhead at PUE 1.40.
Rack count	~28 racks at ~36 kW/rack average.

3. Jam-Enabled 1 MW-Equivalent Build (Conservative)

The Jam case serves the same workload output with fewer physical bytes stored, moved, encrypted, and repeatedly read. Jam combines lossless compression and dedupe, semantic indexing, keyless/indirect encryption, and CPU/SSD-sufficient execution paths for sub-frontier inference.

Component	Specification
Compute	54 × 2U dual-socket EPYC-class servers. Lower I/O, crypto, and inference pressure reduces required pool.
Storage	20 × 4U dense hybrid chassis using the same media profile. ~2× effective footprint reduction (conservative).
GPU tier	0 GPUs required for sub-frontier inference. Optional reduced pool: up to 6 × L40S + 4 × H100 for frontier/training/compatibility.
Network	16–20 × 100 GbE ToR + 2 × 400 GbE spine. Less east–west replication and backup traffic.

UPS	3 × 400 kW modular UPS, N+1. 800 kW protected + spare module covers ~720 kW IT draw with headroom.
Battery	~180 kWh usable VRLA lead-acid bank (larger nominal after margins).
Generators	2 × 1.5 MVA diesel gensets, N+1. One set covers ~958 kW facility draw at typical PF.
Cooling	Mechanical plant for ~720 kW IT heat rejection; ~238 kW electrical overhead at PUE 1.33.
Rack count	~14 racks at ~30–36 kW/rack average.

4. Where the Delta Comes From

Storage compression + dedupe: Jam stores fewer physical bytes and avoids duplicating blocks across backup and replication paths, reducing storage chassis from 40 to 20 in the conservative case.

Semantic indexing: indexed reads avoid full decompression and repeated scan paths, reducing compute and I/O pressure.

Keyless / indirect encryption: the encryption envelope sits in the data path without a hot KMS round trip for every access. Security improves without adding latency tax.

CPU/SSD inference path: sub-frontier inference runs on commodity CPU/SSD paths rather than defaulting to accelerator tiers. GPUs become optional for many enterprise workloads.

Lower facility load: IT draw falls from 1,000 kW to ~720 kW (conservative) or ~70 kW (backup-tier best case). Facility draw falls accordingly, avoiding ~3.87 GWh/year (conservative) up to ~11.4 GWh/year (backup-tier).

5. Battery Chemistry: Why VRLA Becomes Viable With Jam

The defensible claim is not "lead-acid is always safer than LFP." The narrower claim is that Jam reduces the UPS energy requirement from ~250 kWh usable to ~180 kWh (conservative) or ~18 kWh (backup-tier), making a larger/heavier VRLA bank practical. In stationary UPS float-duty, VRLA has a familiar ventilation-managed failure model, while LFP remains a lithium-ion ESS that must be engineered around thermal-runaway propagation.

Why Jam can use lead-acid

The lower Jam IT load reduces the 15-minute bridge battery to a manageable footprint and weight at VRLA densities.

Why not claim VRLA is simply safer

Both chemistries have hazards. VRLA emits hydrogen and acid and needs ventilation, detection, containment, and maintenance. LFP is safer than NMC/NCA lithium-ion, but thermal runaway and propagation still need BMS, spacing, detection, suppression, and testing.

Where LFP is still better

Floor/weight constrained sites, high-cycle demand-response/peak-shaving, or jurisdictions/insurers that prefer lithium-ion ESS packages.

6. Captive Solar Economics (India)

For a Jam-enabled site sized at ~720 kW IT (conservative case) or ~70 kW (backup-tier), captive solar shifts the operating economics meaningfully:

Lever	Number	Source / note
Captive solar tariff (assumed)	~₹2.35 / kWh	PPA-style rooftop / open-access; verify per state.
Grid tariff (industrial, India avg)	~₹8.00 / kWh	Refresh per state utility tariff schedule.

Off-grid 1 MW build cost (assumed)	~₹2.25 Cr	Solar + ESS + BMS + civils; refresh against vendor BoM.
Conservative-case Jam saving (5 yr, ₹8/kWh)	~₹15.5 Cr	vs conventional 1 MW; avoided ~3.87 GWh/yr × 5 yr.
Backup-tier Jam saving (5 yr, ₹8/kWh)	~₹45.6 Cr	vs conventional 1 MW; avoided ~11.4 GWh/yr × 5 yr.

These are planning numbers, not procurement quotes. Substitute the state tariff, captive PPA terms, and finance cost before issuing tender or BOM.

7. India-Specific Implementation Notes

- Final site sizing should use the state-level utility tariff, diesel runtime requirement, fuel logistics, ambient temperature, monsoon humidity, and local fire authority requirements.
- VRLA battery rooms need ventilation, hydrogen detection, acid-resistant containment, charger controls, maintenance clearance, and alarm integration.
- LFP systems need a tested ESS design package: BMS, spacing, detection/suppression, emergency response plan, and propagation/fire-test evidence acceptable to the authority and insurer.
- Battery procurement and end-of-life handling should comply with India Battery Waste Management Rules 2022 and use registered producers/recyclers under EPR obligations.
- CapEx bands exclude GST/import duties, grid interconnect, network carrier NRCs, shell/civil works, and full site commissioning.

8. Caveats and Next Artefact

- Named-vendor BOM: required before quoting. This memo is a reference architecture, not a procurement schedule.
- Jam savings: assumes inline Jam deployment at OS/storage path level. Partial deployments should use lower savings bands. Backup-tier 100× requires a backup-tier corpus.
- GPU strategy: use "0 GPUs required for sub-frontier inference" rather than "no GPUs ever." Training/frontier workloads may still warrant a reduced pool.
- Battery engineering: chemistry guidance must be validated by licensed electrical and fire engineers, insurer, and local authority.
- Tier certification: Tier III-like architecture is not certified Tier III; certification requires full MEP design review.

Appendix A: Core Calculations

- Facility draw without Jam: 1,000 kW IT × PUE 1.40 = ~1,400 kW.
- Facility draw with Jam (conservative): ~720 kW IT × PUE 1.33 = ~958 kW.
- Facility draw with Jam (backup-tier): ~70 kW IT × PUE 1.40 ≈ ~100 kW (engineered down from baseline; PUE assumption pessimistic at this scale).
- Annual energy without Jam: 1,400 kW × 8,760 h ≈ ~12.26 GWh/yr.
- Annual energy with Jam (conservative): 958 kW × 8,760 h ≈ ~8.39 GWh/yr.
- Annual energy with Jam (backup-tier): 100 kW × 8,760 h ≈ ~0.88 GWh/yr.
- Annual energy avoided (conservative): ~3.87 GWh/yr; (backup-tier): ~11.4 GWh/yr.
- 5-year energy at USD $0.11/kWh: ~$6.74M without Jam vs ~$4.61M conservative vs ~$0.48M backup-tier.
- 5-year energy at INR 8/kWh: ~₹49.1 Cr without Jam vs ~₹33.6 Cr conservative vs ~₹3.5 Cr backup-tier.
- Battery usable kWh: baseline 1,000 kW × 0.25 h = 250 kWh; conservative 720 × 0.25 = 180 kWh; backup-tier 70 × 0.25 = 17.5 kWh.
- GPU board-power correction: 12 × 350 W L40S + 8 × 700 W H100 = ~9.8 kW before host/node overhead. Remove the earlier ~180 kW claim.

Appendix B: Source Notes

- [1] NVIDIA L40S official product page, 350 W maximum power: https://www.nvidia.com/en-us/data-center/l40s/
- [2] NVIDIA H100 official product page, SXM TDP up to 700 W: https://www.nvidia.com/en-eu/data-center/h100/
- [3] OSHA battery charging ventilation requirement: https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.441
- [4] UL overview of UL 9540A and NFPA 855 thermal-runaway propagation testing: https://www.ul.com/thecodeauthority/knowledge/understanding-UL-9540A-NFPA-855
- [5] US EPA lead-acid battery collection/recycling note: https://www.epa.gov/electronics-batteries-management/battery-collection-action-case-study-lead-acid-battery-collection
- [6] India Battery Waste Management Rules 2022 notification: https://mnre.gov.in/en/document/notification-on-battery-waste-management-rules-2022-by-ministry-of-environment-forest-and-climate-change/
- [7] Cithorum + Jam April 2026 backup-tier 100× rsync comparator (recording: videopress.com/v/w4Z0jvUC).