GPT Analysis Pre-Merge

Distribution Analysis:

- Pre Ethereum 2.0 Merge,
- 5k Blocks
- 8 Threads for Execution
- Block Size with 0 Transactions Removed,
- For Monad 2PE Only Execution Time is Considered (Clock-tick-starts - Clock-tick-ends)
    - block_state.can_merge(state), block_state._merge(state) time is not considered

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N per bucket: Small (≤50) 700, Medium (51–100) 839, Large (>100) 3370

SupraBTM vs Seq (Seq/SupraBTM)

- **Small (≤50):** mean 1.992×, median 1.973× (p10–p90: 1.087–2.908×)
- **Medium (51–100):** mean 3.081×, median 3.112× (p10–p90: 2.142–3.987×)
- **Large (>100):** mean 4.321×, median 4.474× (p10–p90: 3.022–5.372×)

Monad vs Seq (Seq/Monad) — Phase-1 only

- **Small (≤50):** mean 2.039×, median 2.170× (p10–p90: 0.626–3.201×)
- **Medium (51–100):** mean 2.458×, median 2.648× (p10–p90: 1.093–3.378×)
- **Large (>100):** mean 2.759×, median 2.858× (p10–p90: 1.675–3.584×)

SupraBTM vs Monad (Monad/SupraBTM; >1 ⇒ SupraBTM faster)

- **Small (≤50):** mean 1.747×, median 0.948× (p10–p90: 0.555–2.985×)
  → Monad often wins tiny blocks, but a few SupraBTM wins lift the mean.
- **Medium (51–100):** mean 1.507×, median 1.237× (p10–p90: 0.823–2.211×)
  → SupraBTM generally ahead.
- **Large (>100):** mean 1.717×, median 1.603× (p10–p90: 1.119–2.373×)
  → SupraBTM clearly dominates.

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Note: bucket has changed here

Small (≤50 txs) — 700 blocks

- **SupraBTM vs Seq:** mean **1.99×**, median **1.97×**
- **Monad vs Seq:** mean **2.04×**, median **2.17×**
- **SupraBTM vs Monad:** mean **1.75×**, median **0.95×**
- **Head-to-head:** SupraBTM wins **323**, Monad wins **377**

Medium (51–200 txs) — 2,090 blocks

- **SupraBTM vs Seq:** mean **3.52×**, median **3.57×**
- **Monad vs Seq:** mean **2.56×**, median **2.71×**
- **SupraBTM vs Monad:** mean **1.59×**, median **1.37×**
- **Head-to-head:** SupraBTM wins **1,673**, Monad wins **417**

Large (>200 txs) — 2,119 blocks

- **SupraBTM vs Seq:** mean **4.62×**, median **4.79×**
- **Monad vs Seq:** mean **2.84×**, median **2.91×**
- **SupraBTM vs Monad:** mean **1.77×**, median **1.67×**
- **Head-to-head:** SupraBTM wins **1,954**, Monad wins **165**

📌 **Verdict by buckets:**

- **Small blocks:** Monad slightly ahead (377 vs 323 wins).
- **Medium blocks:** SupraBTM strongly dominates (1673 vs 417).
- **Large blocks:** SupraBTM overwhelmingly dominates (1954 vs 165).

Overall averages (all buckets):

- Avg **SupraBTM over Seq: 3.777×**
- Avg **SupraBTM over Monad: 1.687×**
- Mean **% less time** for SupraBTM vs Monad: **22.34%**

Best / Worst cases (by speedup)

- **Best SupraBTM > Seq:** Block **14004745** (size **342**) → **6.070×**
- **Worst SupraBTM < Seq:** Block **14004589** (size **3**) → **0.344×**
- **Best Monad > Seq:** Block **14002522** (size **431**) → **7.069×**
- **Worst Monad < Seq:** Block **14000032** (size **19**) → **0.00515×**
- **Best SupraBTM > Monad:** Block **14000032** (size **19**) → **222.33×**
- **Worst SupraBTM < Monad:** Block **14004589** (size **3**) → **0.108×**

General Verdict (8 threads, Monad Phase-1 only)

- **SupraBTM** scales smoothly and is the **clear winner** as block size grows: ~**3.78×** over Seq on average, and ~**1.69×** over Monad (≈**22% less time** than Monad on average).
- **Monad** is competitive in **very small blocks** (median edge there), but exhibits higher variance and rare collapses (e.g., **14000032**) that hurt tail behavior.
- **Medium/Large blocks**: SupraBTM's advantage is consistent (median **~1.24×** in medium, **~1.60×** in large vs Monad) while also delivering stronger acceleration over Seq.

- Pre Ethereum 2.0 Merge,
- 5k Blocks

- 4 Threads for Execution
- Block Size with 0 Transactions Removed,
- For Monad 2PE Only Execution Time is Considered
    - block_state.can_merge(state), block_state._merge(state) time is not considered

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Small (≤50 txs) — 700 blocks

- **SupraBTM vs Seq:** mean **1.99×**, median **1.97×** (10–90%: 1.09–2.91×)
- **Monad vs Seq:** mean **2.04×**, median **2.17×** (10–90%: 0.63–3.20×)
- **SupraBTM vs Monad:** mean **1.75×**, median **0.95×** (10–90%: 0.50–3.27×)
- **Head-to-head:** SupraBTM wins **323**, Monad wins **377**

Medium (51–200 txs) — 2,090 blocks

- **SupraBTM vs Seq:** mean **3.52×**, median **3.57×** (10–90%: 2.35–4.66×)
- **Monad vs Seq:** mean **2.56×**, median **2.71×** (10–90%: 1.34–3.44×)
- **SupraBTM vs Monad:** mean **1.59×**, median **1.37×** (10–90%: 0.83–2.76×)
- **Head-to-head:** SupraBTM wins **1,673**, Monad wins **417**

Large (>200 txs) — 2,119 blocks

- **SupraBTM vs Seq:** mean **4.62×**, median **4.79×** (10–90%: 3.50–5.48×)
- **Monad vs Seq:** mean **2.84×**, median **2.91×** (10–90%: 1.84–3.63×)
- **SupraBTM vs Monad:** mean **1.77×**, median **1.67×** (10–90%: 1.08–2.58×)
- **Head-to-head:** SupraBTM wins **1,954**, Monad wins **165**

Best / Worst Cases

- **Best SupraBTM > Seq:** Block **14004745** (342 txs) → **6.07×**
- **Worst SupraBTM < Seq:** Block **14004589** (3 txs) → **0.34×**
- **Best Monad > Seq:** Block **14002522** (431 txs) → **7.07×**
- **Worst Monad < Seq:** Block **14000032** (19 txs) → **0.005×**
- **Best SupraBTM > Monad:** Block **14000032** (19 txs) → **222× faster**
- **Worst SupraBTM < Monad:** Block **14004589** (3 txs) → **0.11×**

✅ **General Verdict (4 threads)**

- **Overall averages:**
    - SupraBTM over Seq: **3.78×**
    - SupraBTM over Monad: **1.69×**
    - SupraBTM ~**22% less time** than Monad on average
- **Small blocks:** Monad has an edge (377 vs 323 wins).
- **Medium blocks:** SupraBTM takes clear lead (1673 vs 417 wins).
- **Large blocks:** SupraBTM overwhelmingly dominates (1954 vs 165 wins).
- **Pathological cases:**
    - Block **14000032** → Monad collapse, SupraBTM ~222× faster.
    - Block **14004589** → SupraBTM collapse, only 0.11× vs Monad.

📌 **Conclusion:** At 4 threads, SupraBTM shows consistent scaling and stronger performance beyond very small blocks, while Monad remains competitive only in tiny workloads.