RocksDB Festival

Supported by IITP, StarLab.

August 2, 2021

송인호, 한예진
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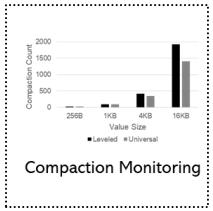
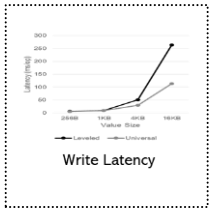
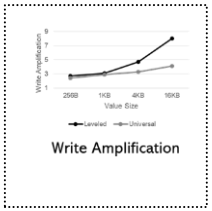
TeamName : 멘탈모델을 만들고 싶어요

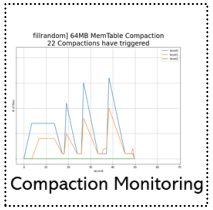
Contents

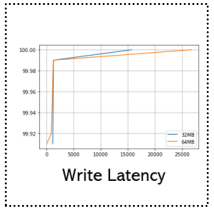
- Last Week
  - ✓ Leveled vs Universal Compaction Comparison
    - Block cache size – Hit ratio
    - Write-Ahead-Log – Throughput, Latency
- This Week
  - 관련 논문 조사

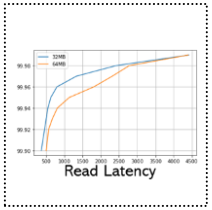




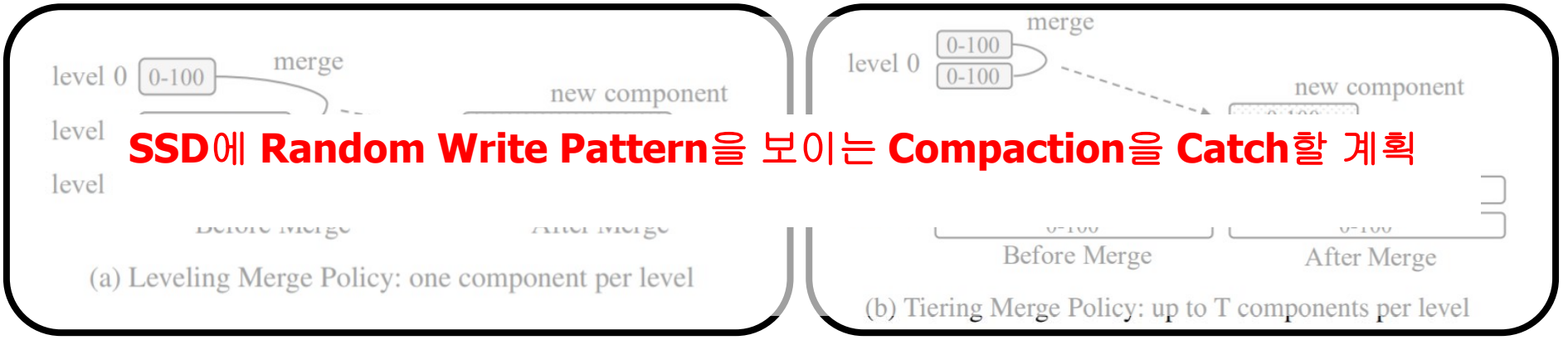








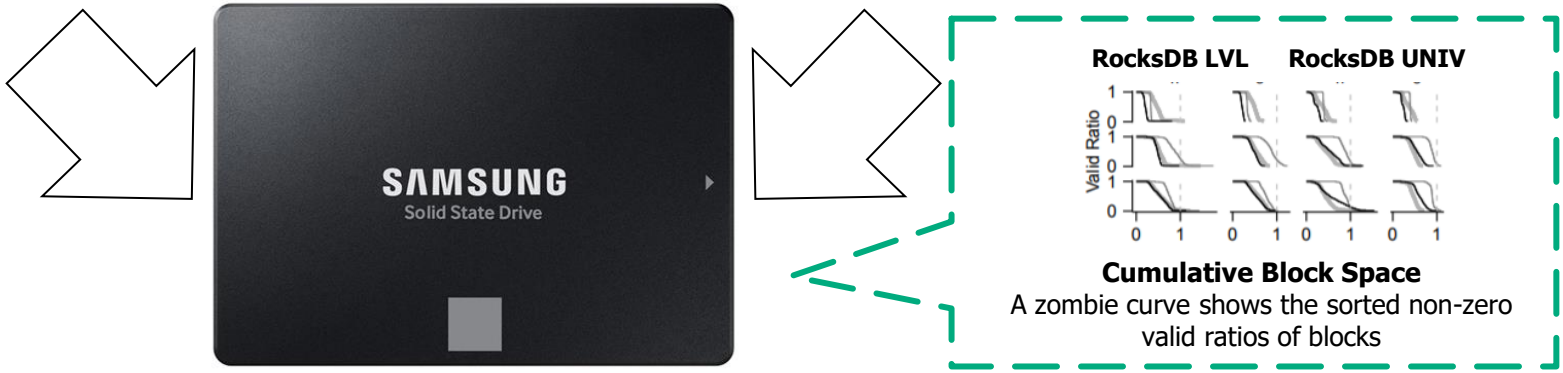
Plan



SSD에 Random Write Pattern을 보이는 Compaction을 Catch할 계획

`Level Compaction` `Universal Compaction`

Fig: Luo, Chen, and Michael J. Carey. "`LSM-based storage techniques: a survey`." The VLDB Journal 29.1 (2020): 393-418.



Jun He, Sudarsun Kannan, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau, `The Unwritten Contract of Solid State Drives`, EuroSys '17

https://github.com/junhe/wiscsee

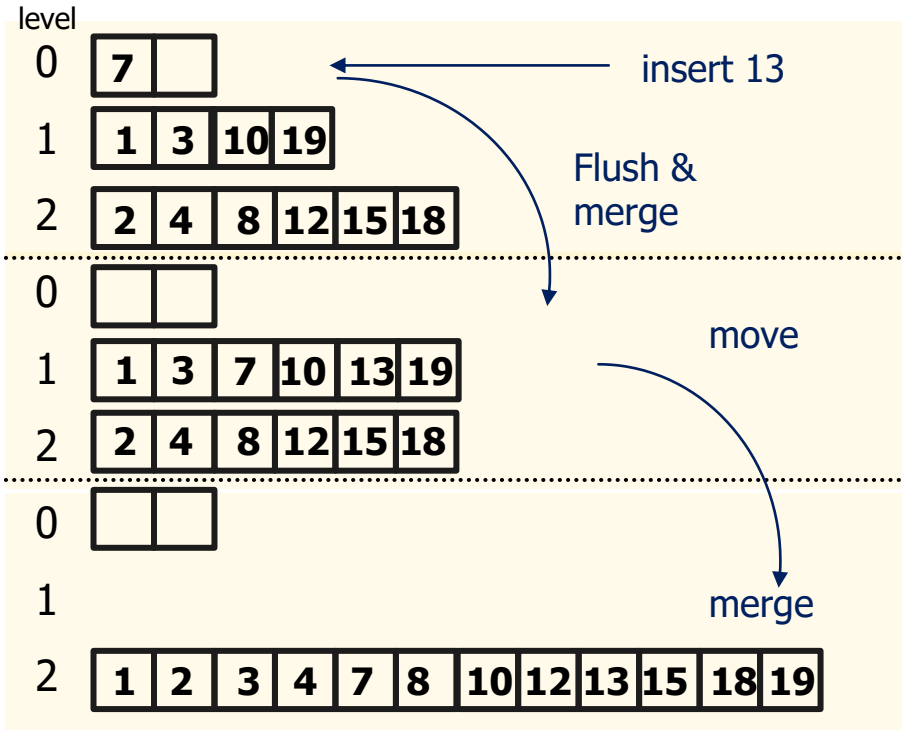
Discussion

Last Week

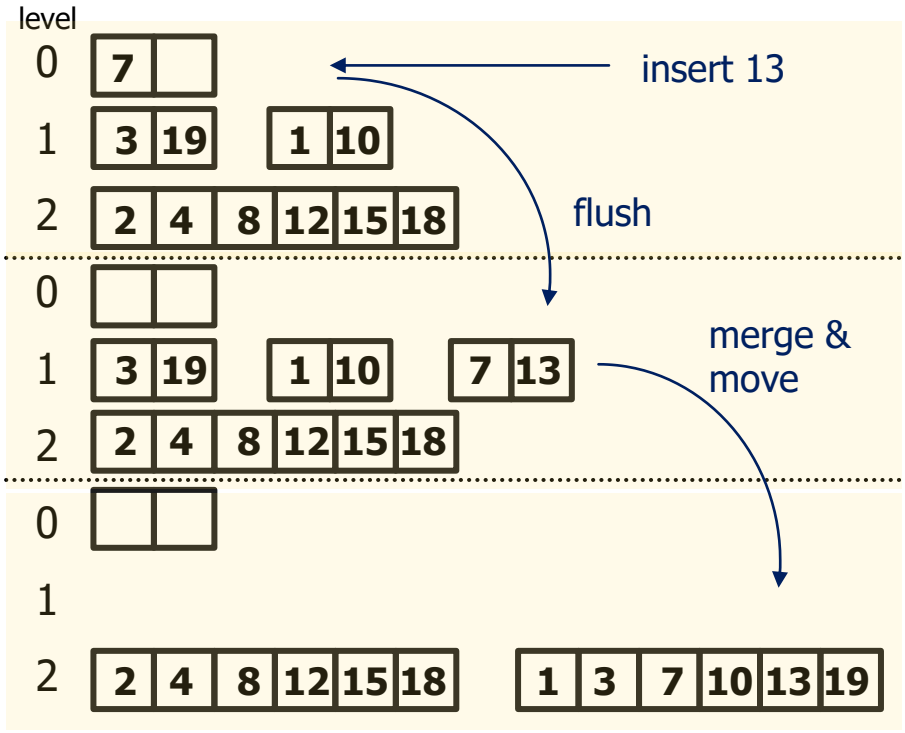
Compaction Style

- Leveled Compaction, Universal Compaction
  - ✓ Sorted Level vs Sorted Run

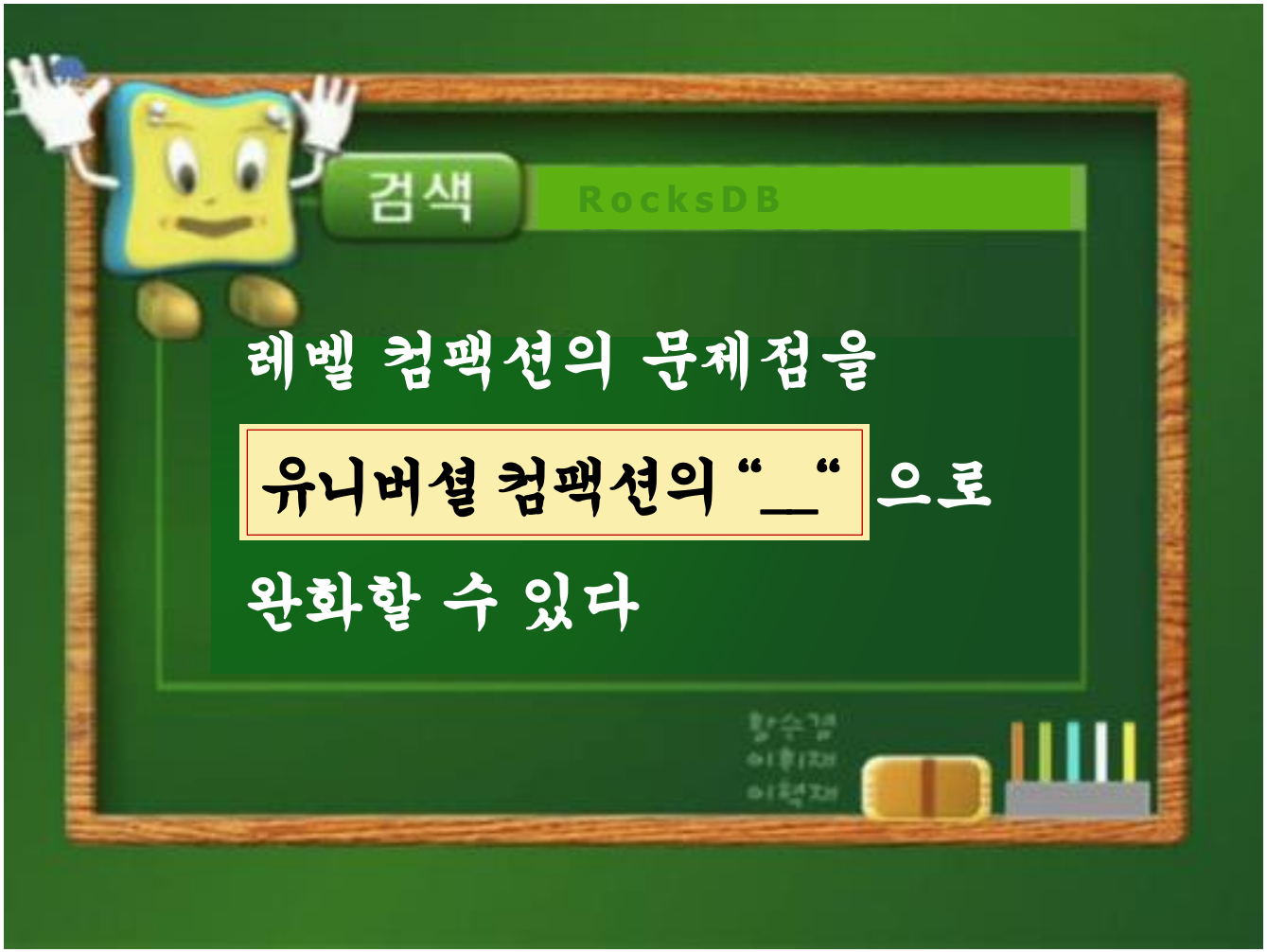
Example of LeveledCompaction



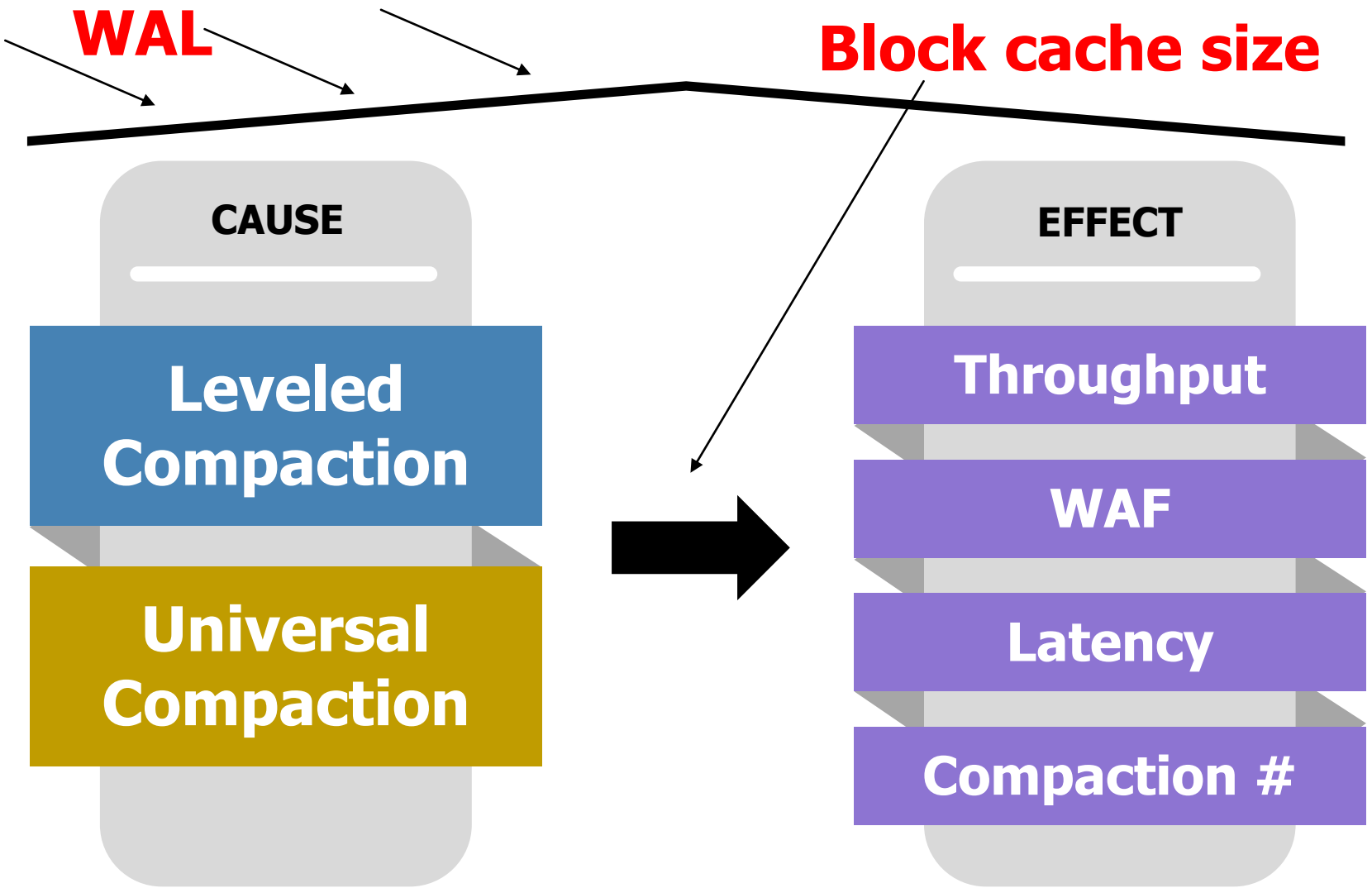
Example of Universal Compaction



Mental Model



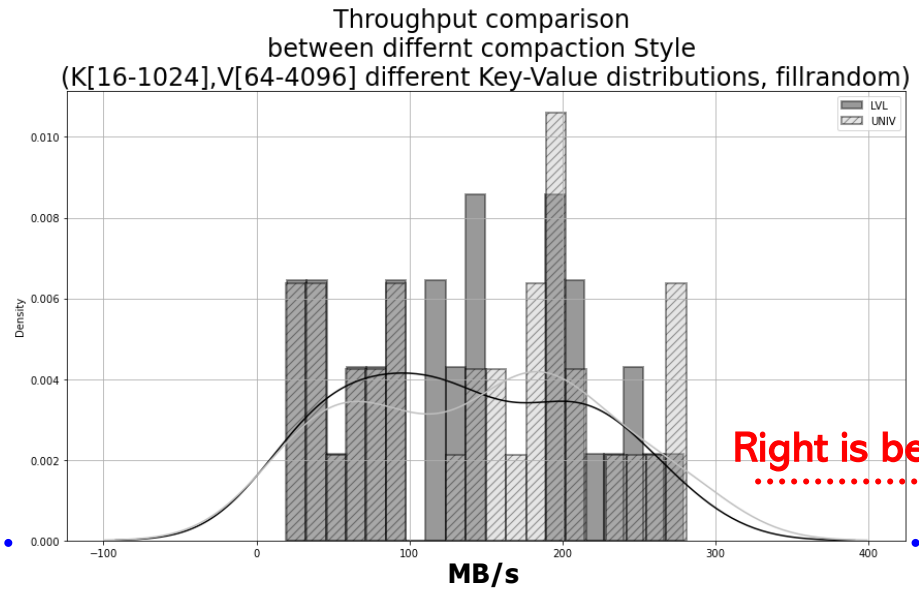
LVL vs Univ Compaction Comparison



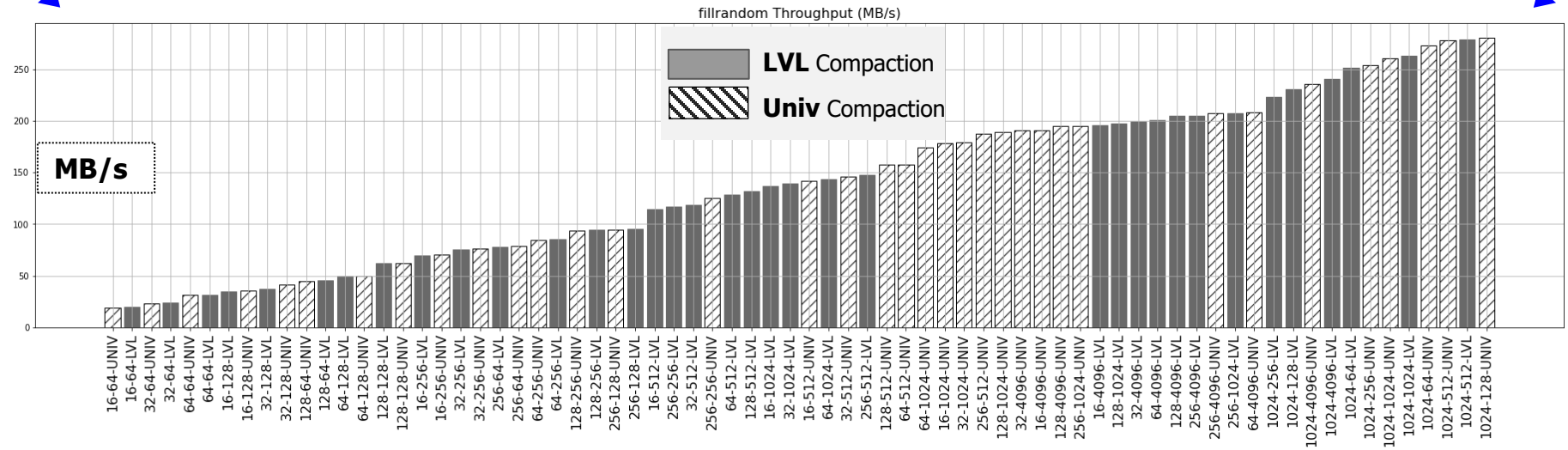
LVL vs Univ Write Throughput: WAL_OFF

Fillrandom

Key [16, 32, 64, 128, 256, 1024]
Value [64, 128, 256, 512, 1024, 4096]
DB_Size 2.4GB
Storage Samsung 512GB 860 Pro
File System Ext4
CPU Intel(R) Core(TM) i5-4440 CPU @ 3.10GHz

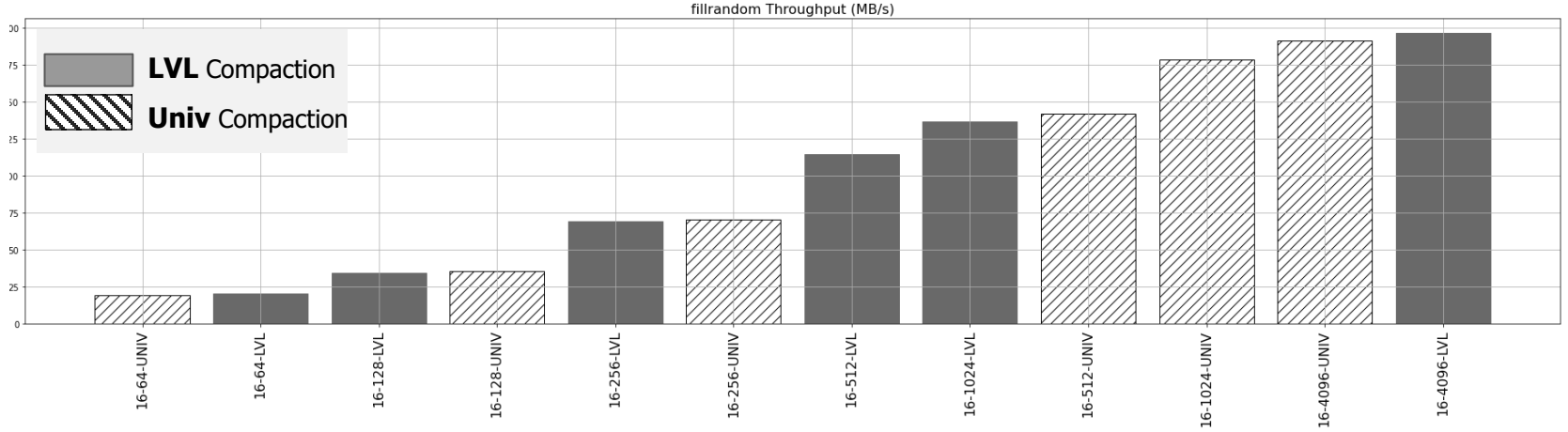


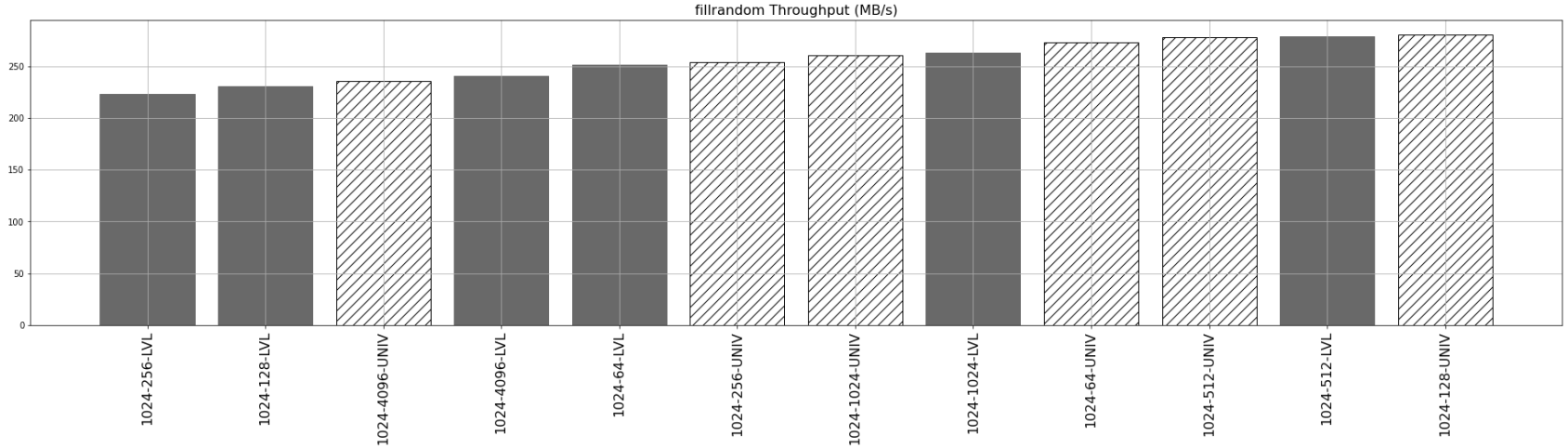
Right is better



LVL vs Univ Write Throughput: WAL_OFF

- Write Throughput: WAL_OFF - K16, 1024 / V[64-4096]



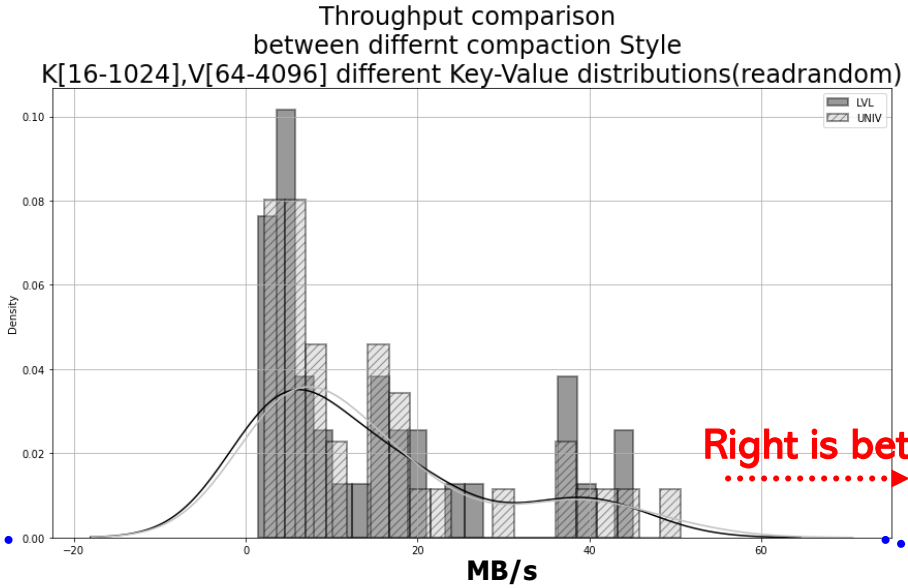


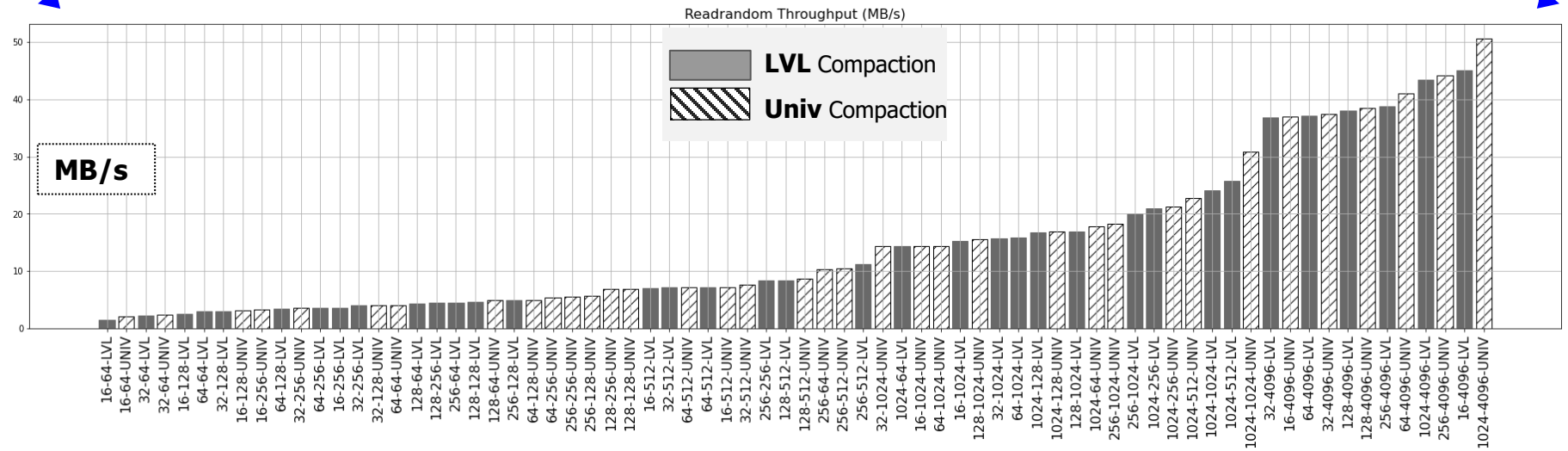
LVL vs Univ Read Throughput: WAL_OFF

Readrandom

--use_existing_db

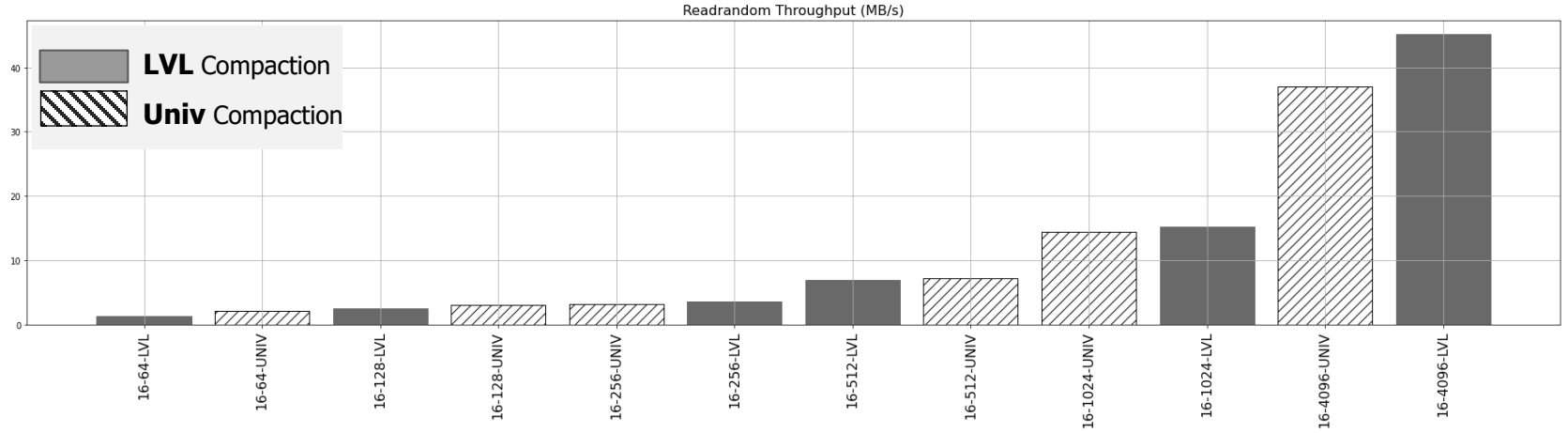
Key [16, 32, 64, 128, 256, 1024]
Value [64, 128, 256, 512, 1024, 4096]
DB_Size 2.4GB
Storage Samsung 512GB 860 Pro
File System Ext4
CPU Intel(R) Core(TM) i5-4440 CPU @ 3.10GHz

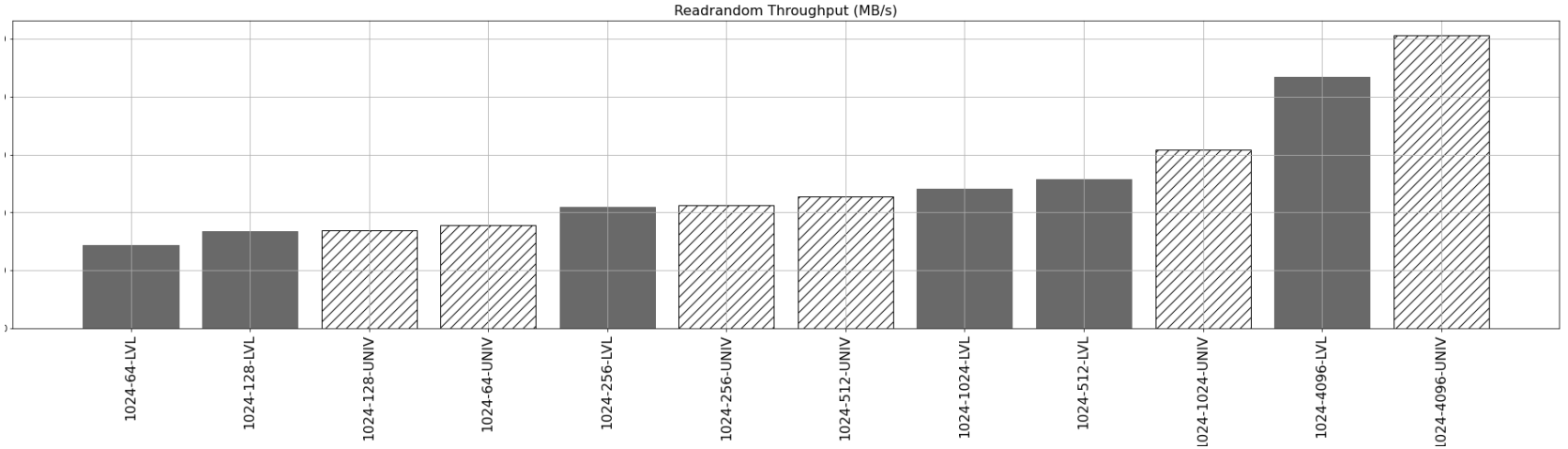




LVL vs Univ Read Throughput: WAL_OFF

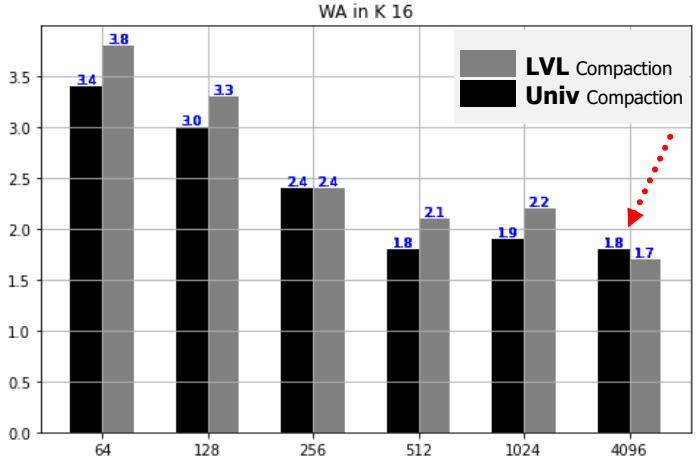
- Read Throughput: WAL_OFF - K16, 1024 / V[64-4096]



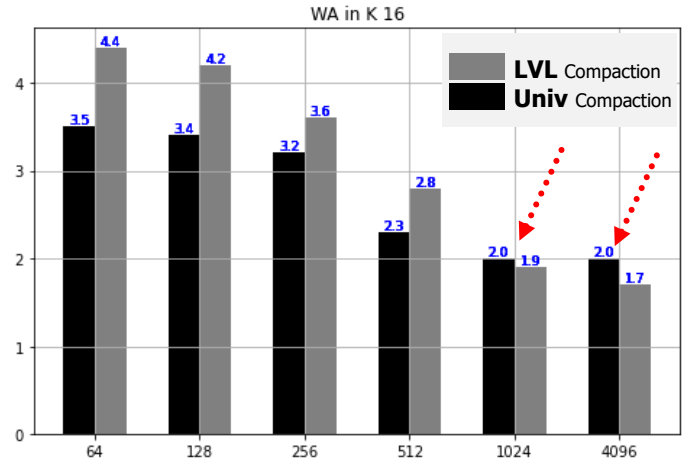


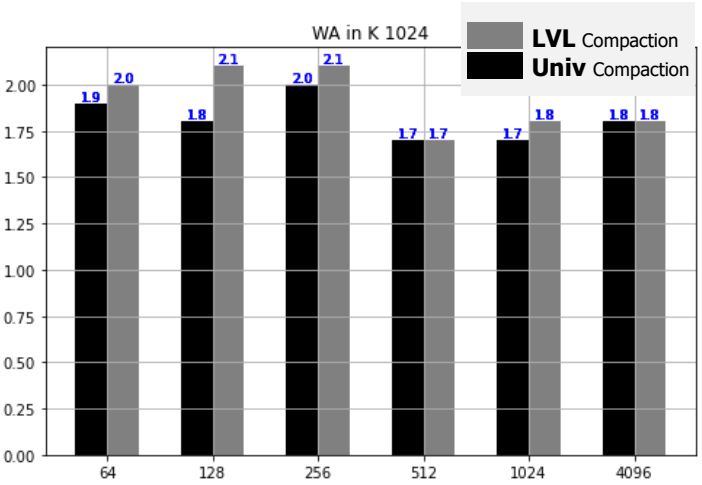
LVL vs Univ WAF Comparison:WAL_OFF

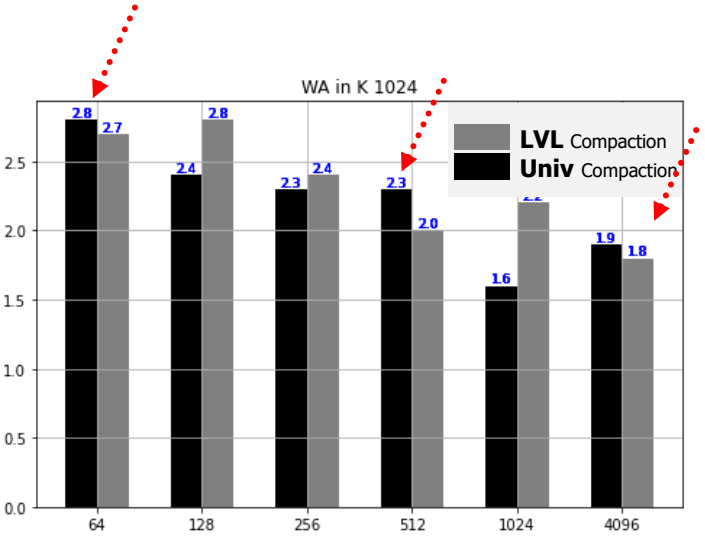
- WAF: WAL_OFF



- WAF: WAL_ON

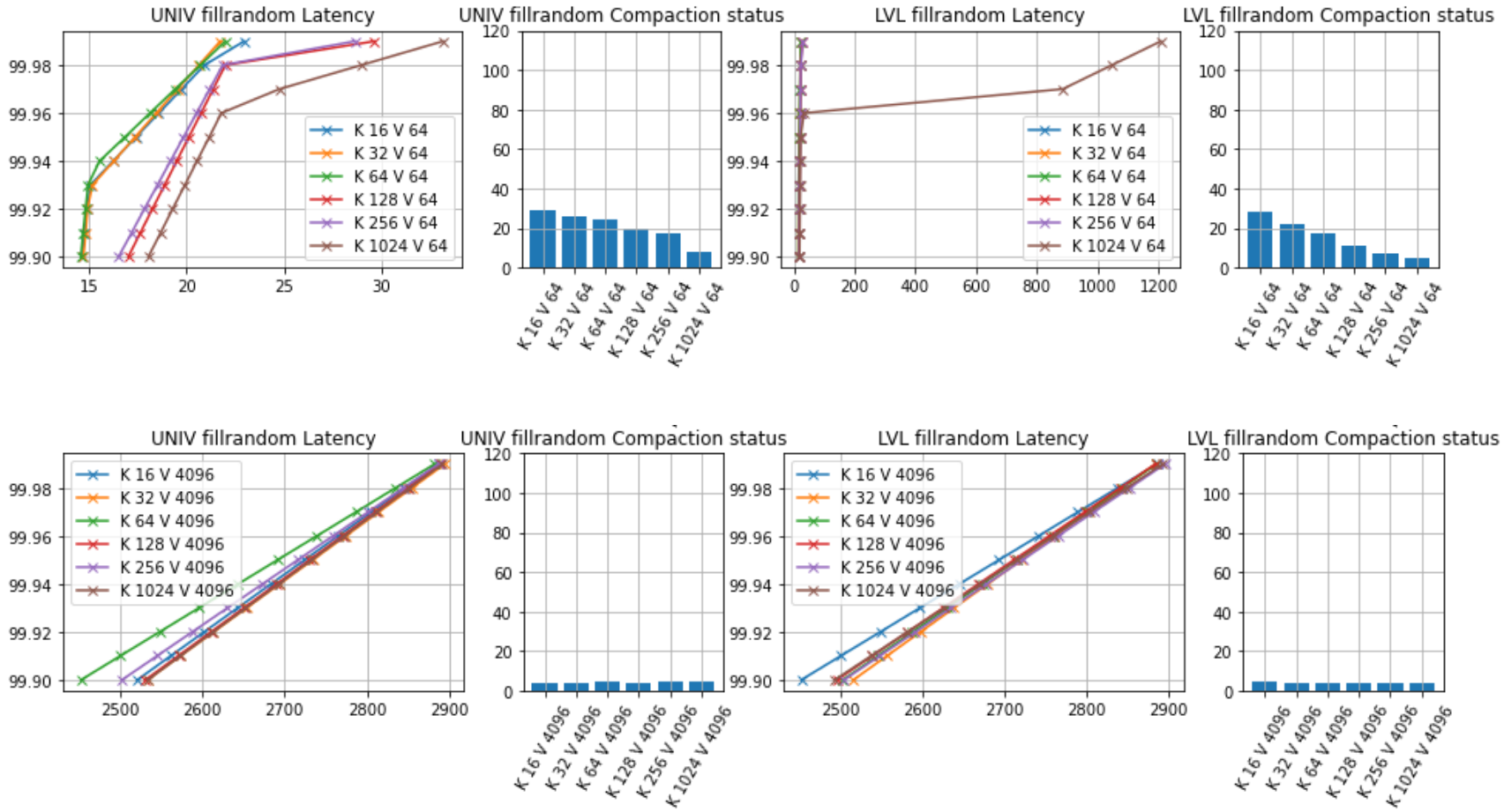






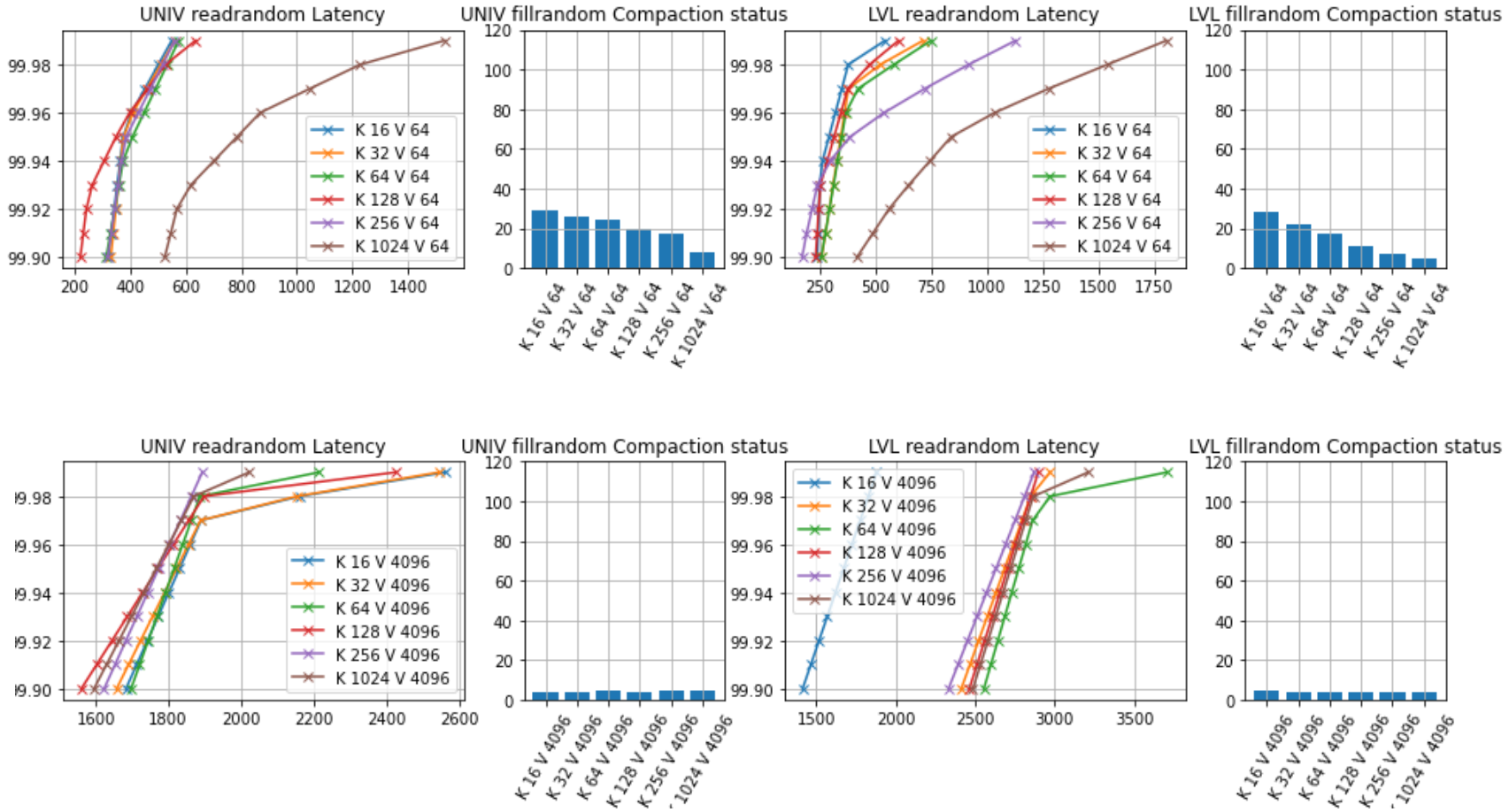
LVL vs Univ # of Compactions , latency Comparison

- Fillrandom latency 99.99%: WAL_OFF



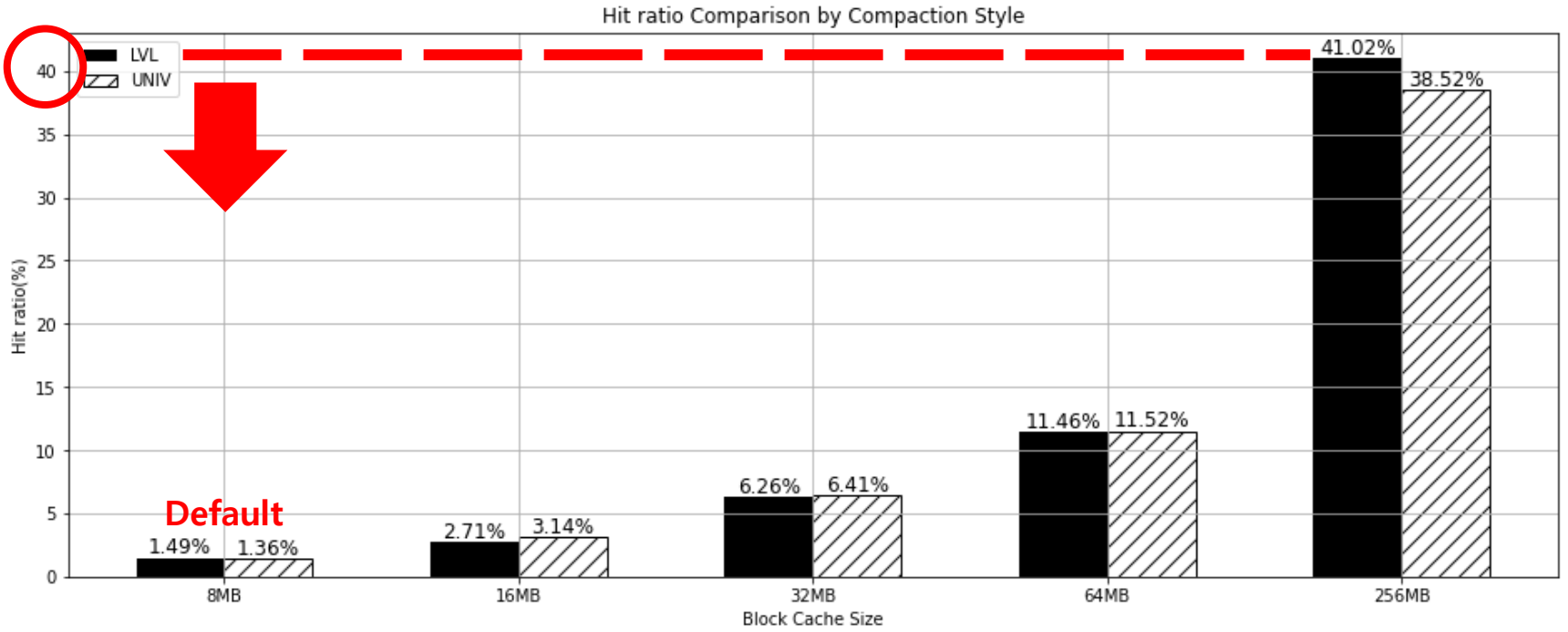
LVL vs Univ # of Compactions , latency Comparison

- Readrandom latency 99.99%: WAL_OFF



LVL vs Univ Cache Hit ratio Comparison

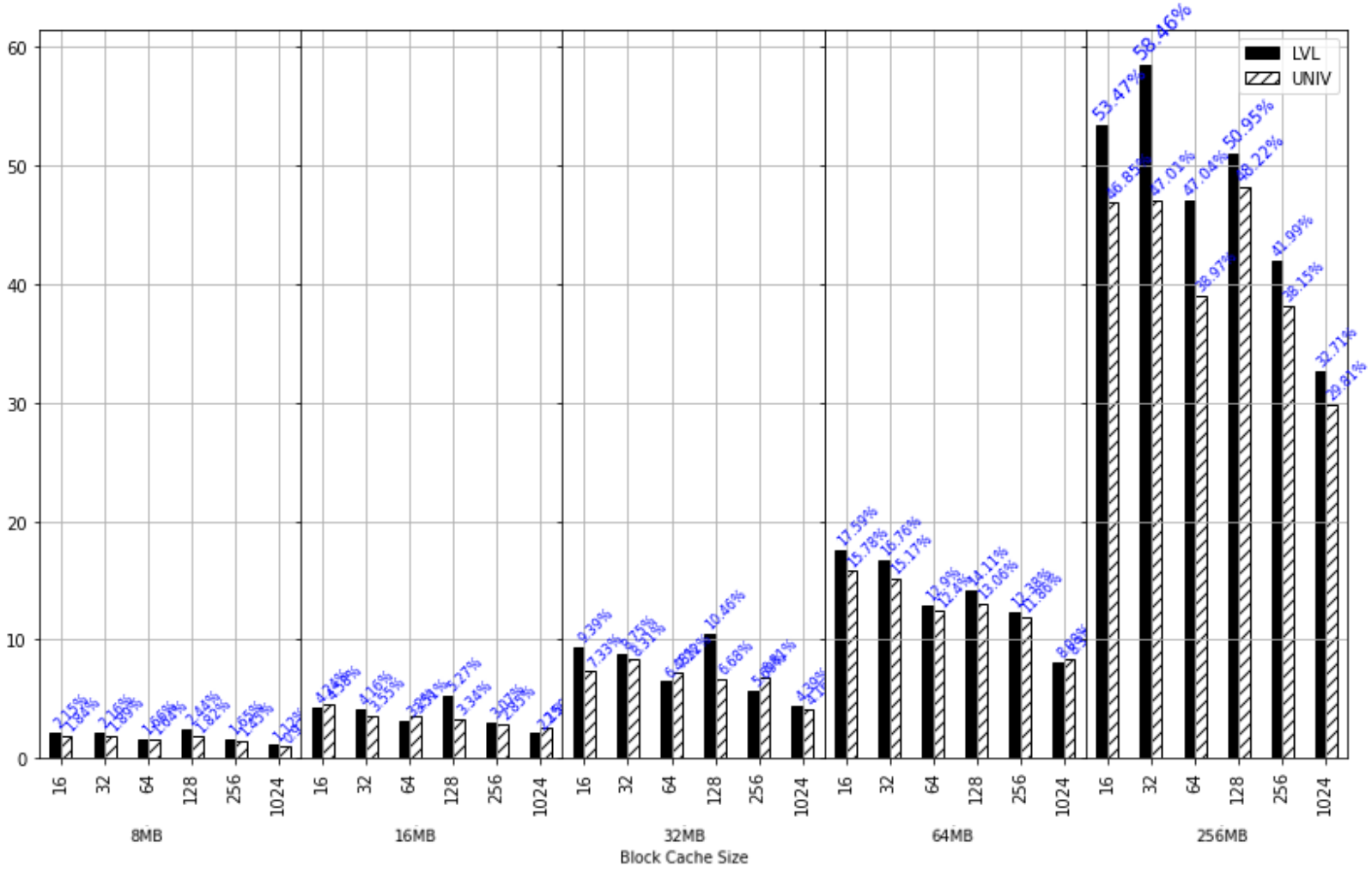
- Block Cache Hit ratio Comparison
  - ✓ 8MB, 16MB, 32MB, 64MB, 256MB → 512MB, 1GB, 2GB, 4GB 실험 중..



☞ **Hit ratio is less than 50% under block cache size == 256MB**

LVL vs Univ Cache Hit ratio Comparison

- Block Cache Hit ratio Comparison

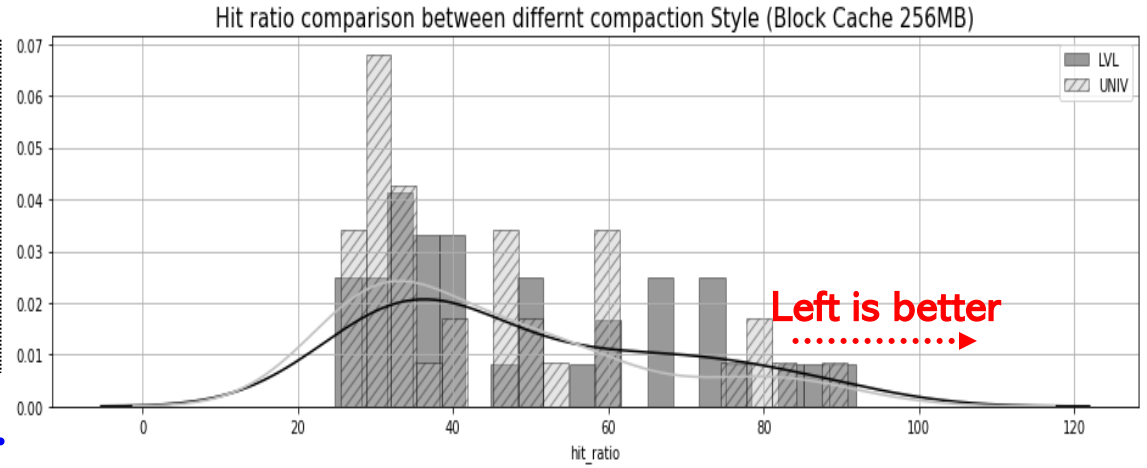


LVL vs Univ Cache Hit ratio Comparison

Readrandom

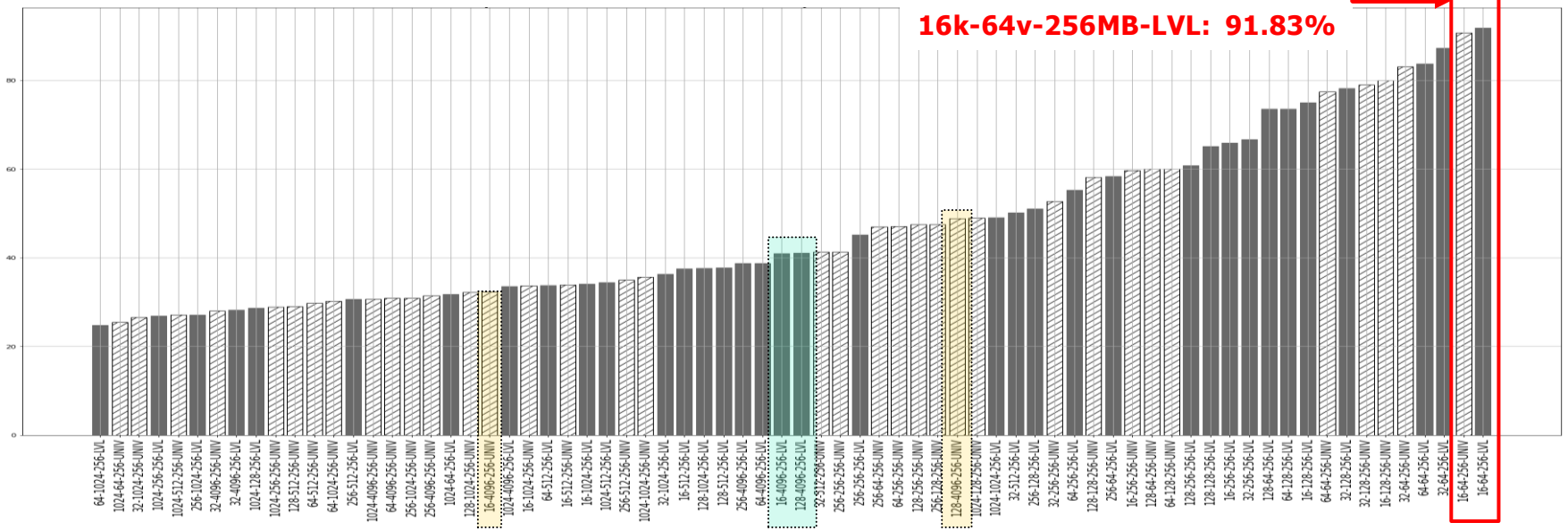
--use_existing_db

Key [16, 32, 64, 128, 256, 1024]
Value [64, 128, 256, 512, 1024, 4096]
Entries 500 0000
Storage Samsung 512GB 860 Pro
File System Ext4
CPU Intel(R) Core(TM) i5-4440 CPU @ 3.10GHz



16k-64v-256MB-UNIV: 90.79%

16k-64v-256MB-LVL: 91.83%



Mental Model

- Quantative Experiment
  - ✓ LvL vs Univ
    - KV distribution
      - Throughput, latency, Hit ratio, QPS(queries per second)
    - SST Table Size
      - Throughput, latency
    - WAL off
    - Adjusting block cache size

- Qualitative Experiment
  - ✓ Level Compaction's weak point
    - Write Amplification
    - Write Stall
    - → Methods to overcome

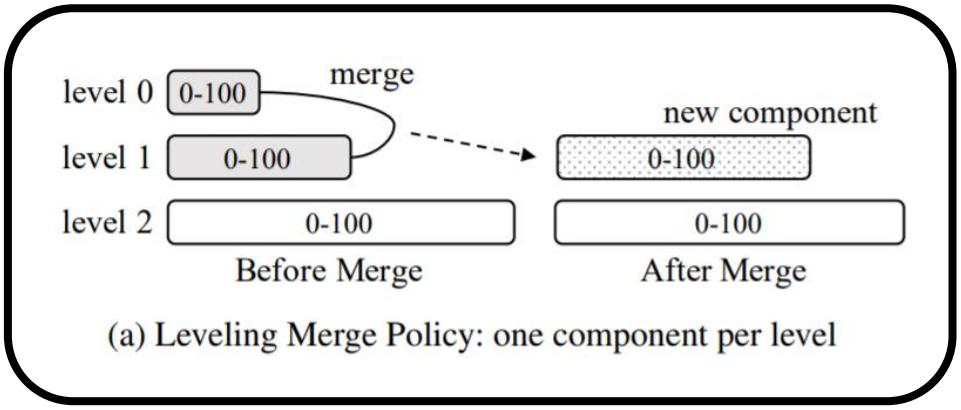
  1~2 Week

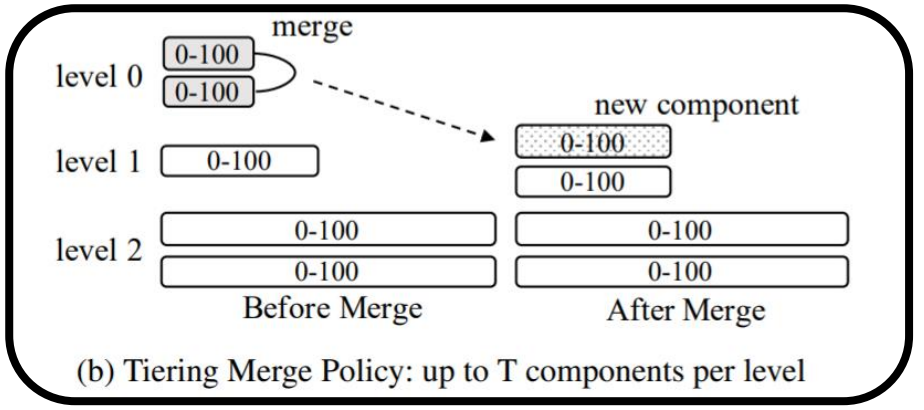
  - ✓ Universal Compaction's weak point
    - Read Amplification
    - Space Amplification
    - → Methods to overcome

  1~2 Week

  → New Idea!

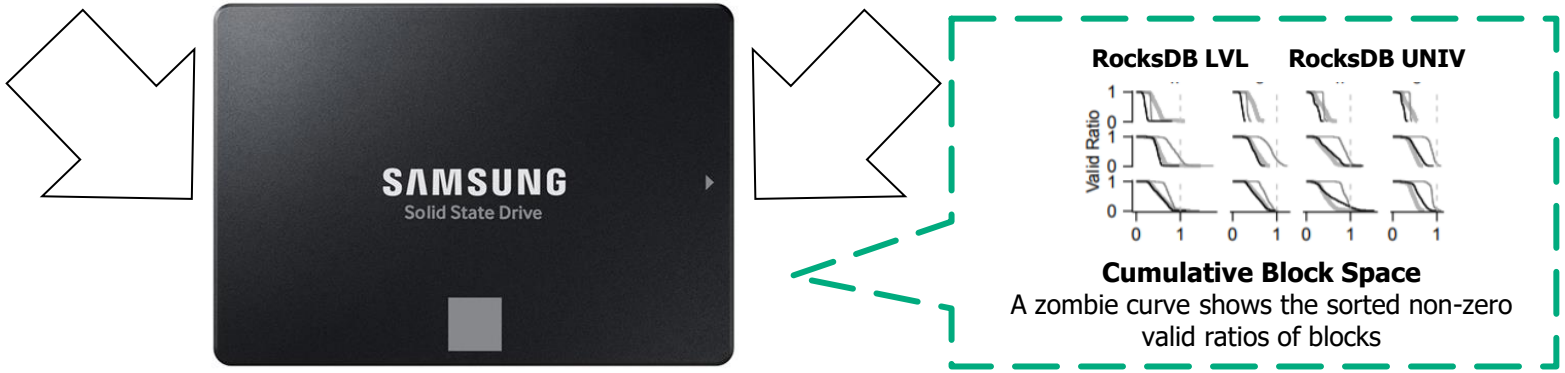
Mental Model





Level Compaction **Universal Compaction**

Fig: Luo, Chen, and Michael J. Carey. "LSM-based storage techniques: a survey." The VLDB Journal 29.1 (2020): 393-418.



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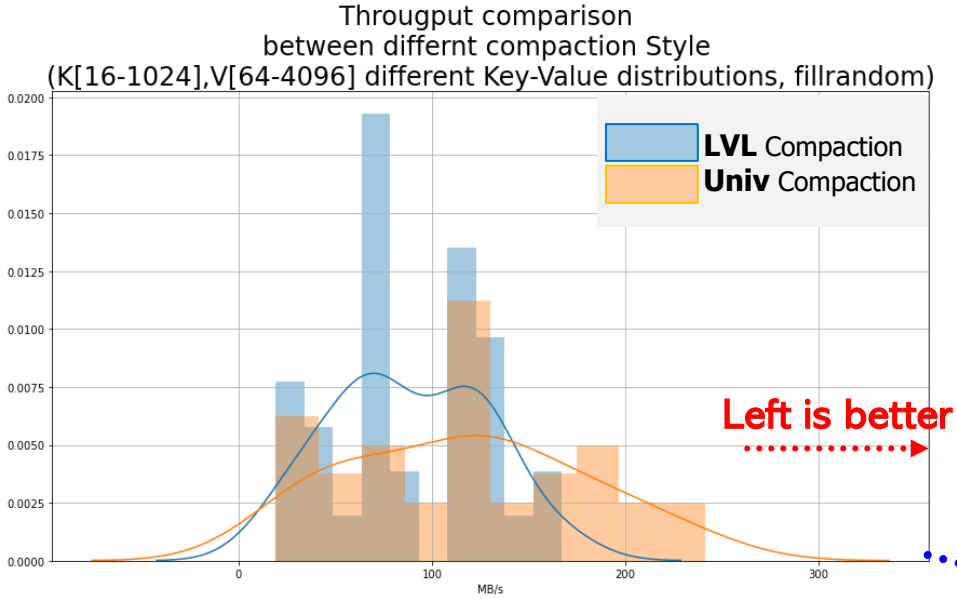
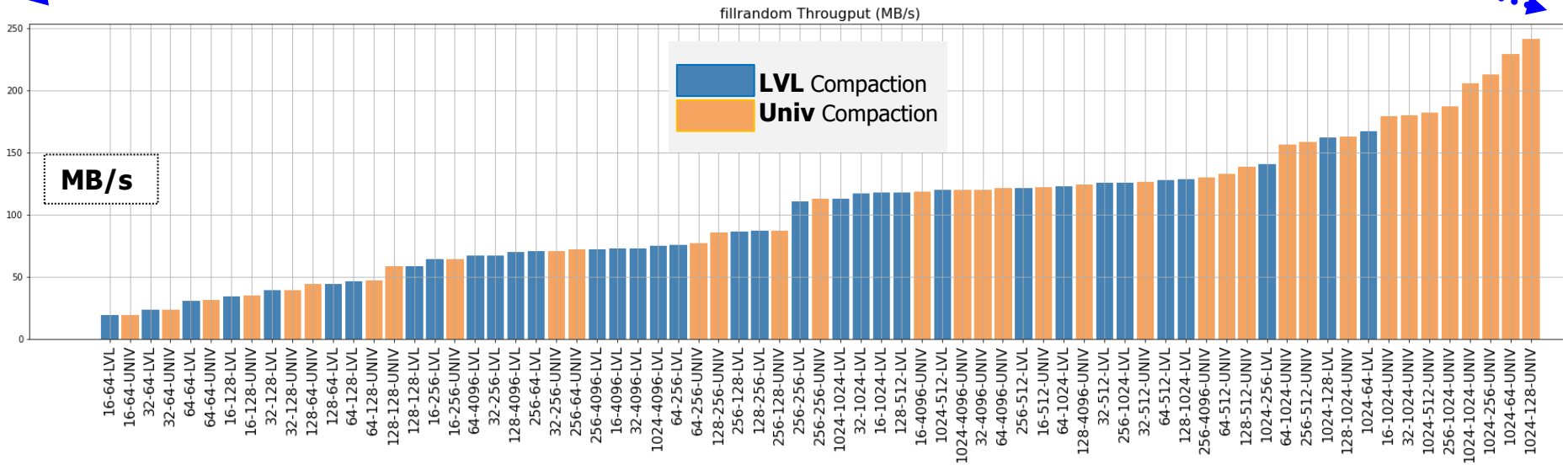
https://github.com/junhe/wiscsee

LVL vs Univ Throughput Comparison

Fillrandom

Key [16, 32, 64, 128, 256, 1024]
Value [64, 128, 256, 512, 1024, 4096]
Entries 500 0000
Storage Samsung 1TB 860 Pro
File System Ext4
CPU Intel(R) Core(TM) i7-10700K CPU @ 3.80GHz



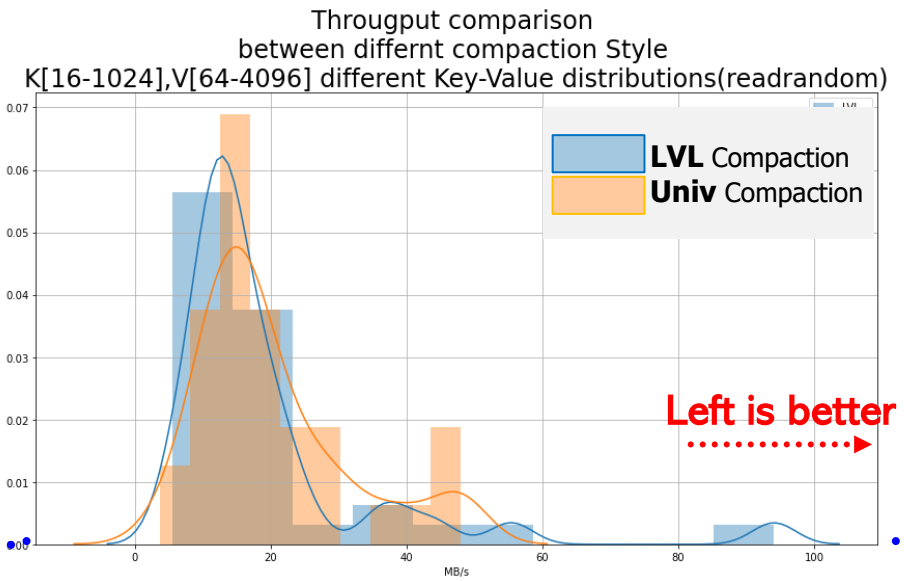


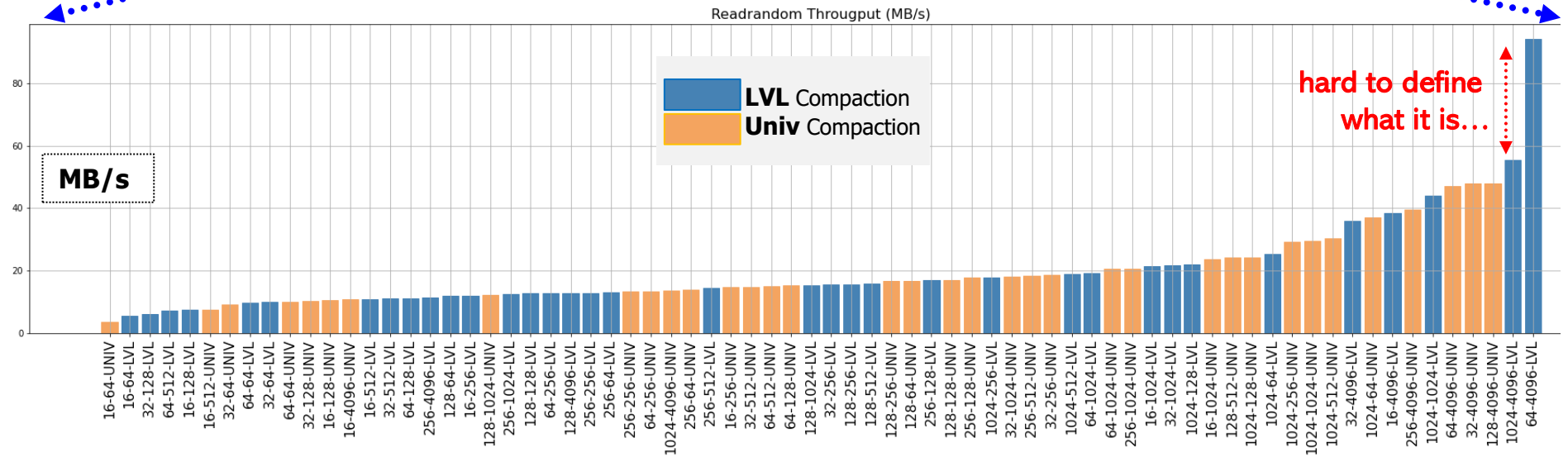
LVL vs Univ Throughput Comparison

Readrandom

--use_existing_db

Key [16, 32, 64, 128, 256, 1024]
Value [64, 128, 256, 512, 1024, 4096]
Entries 500 0000
Storage Samsung 1TB 860 Pro
File System Ext4
CPU Intel(R) Core(TM) i7-10700K CPU @ 3.80GHz





LVL vs Univ Throughput Comparison

Readrandom

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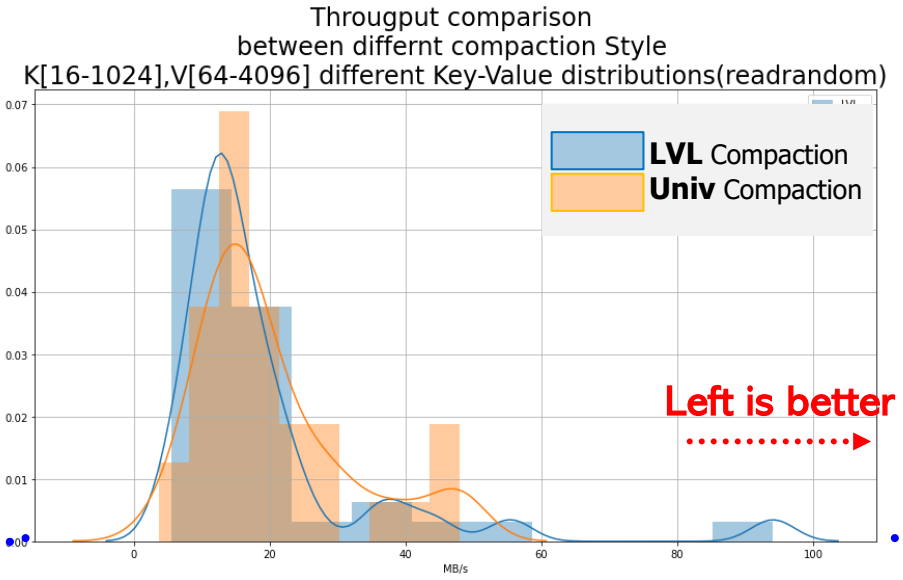
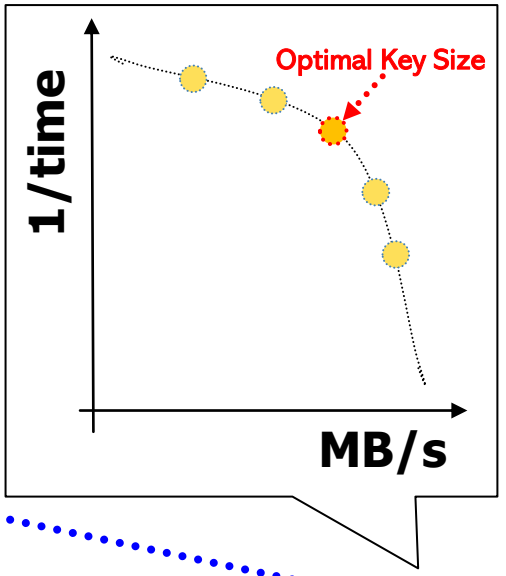
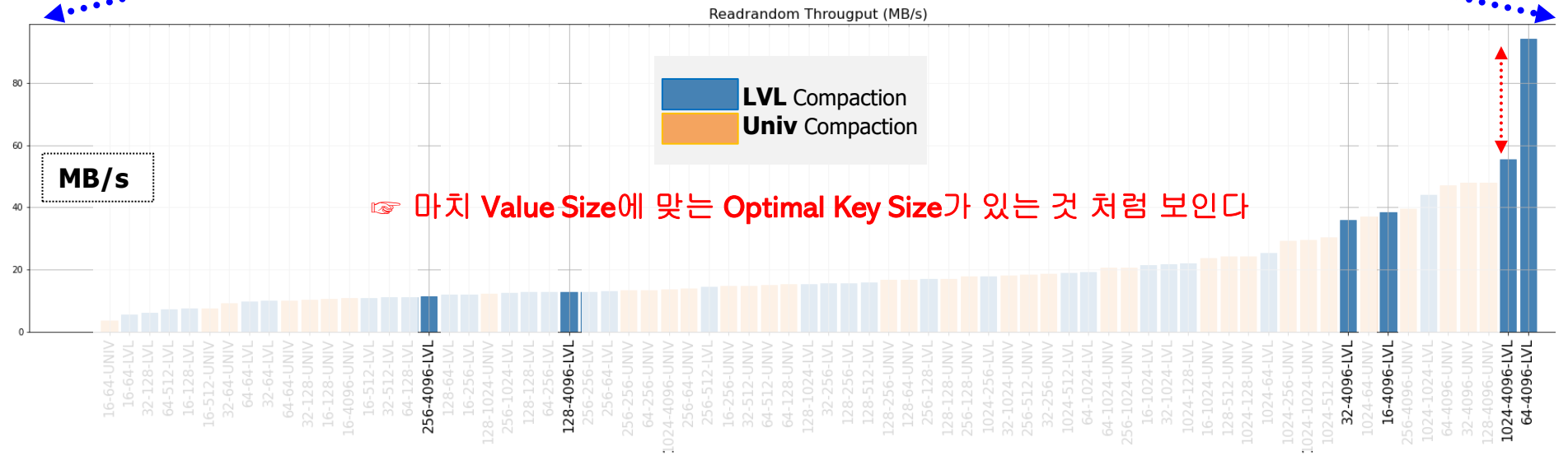
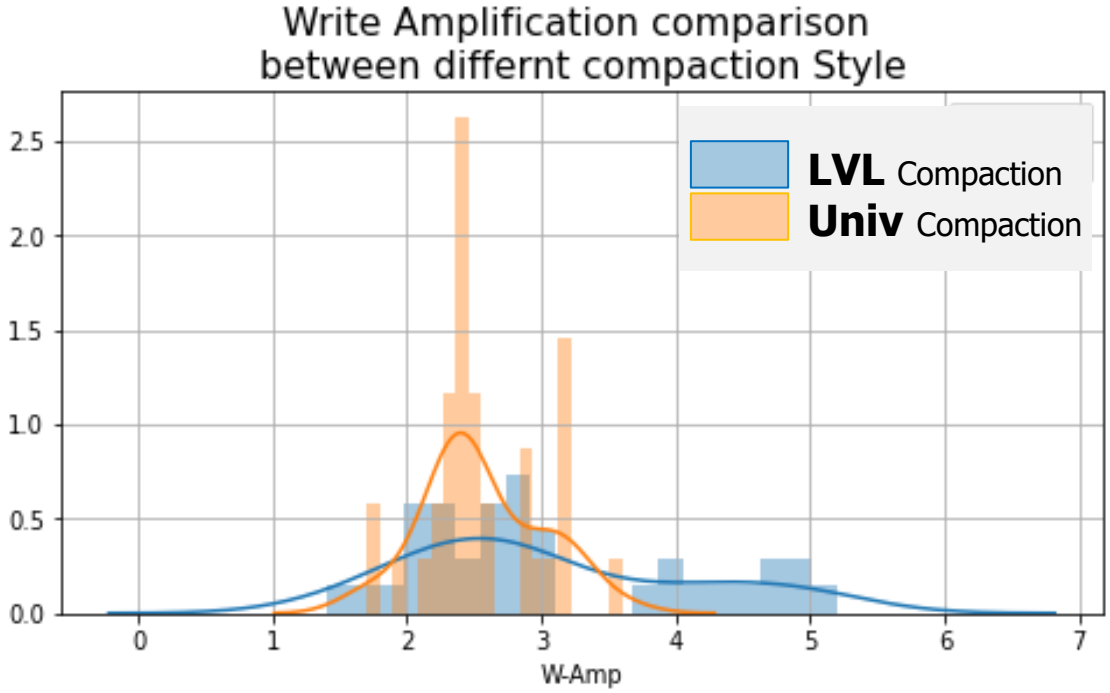
Key [16, 32, 64, 128, 256, 1024]
Value [64, 128, 256, 512, 1024, 4096]
Entries 500 0000
Storage Samsung 1TB 860 Pro
File System Ext4
CPU Intel(R) Core(TM) i7-10700K CPU @ 3.80GHz

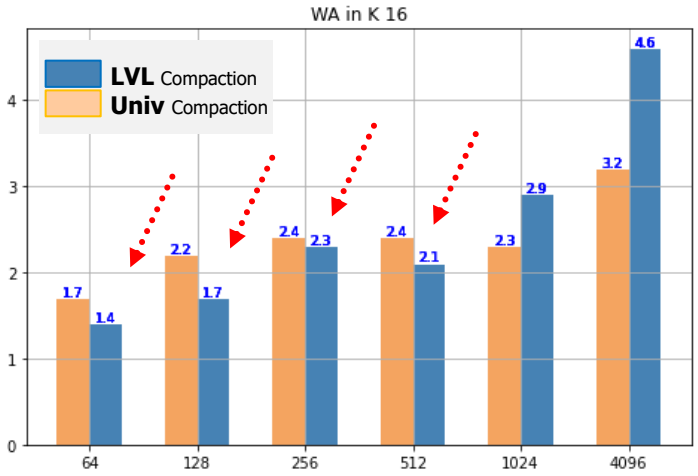


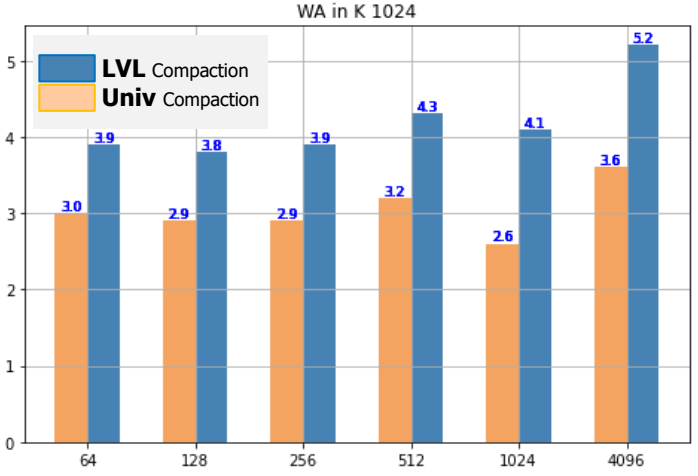




LVL vs Univ WAF Comparison

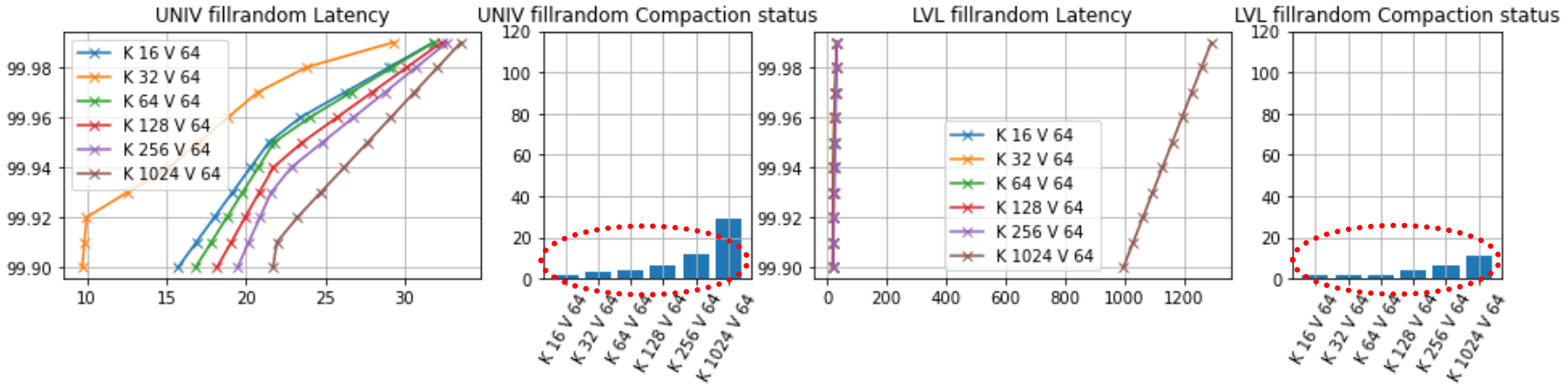


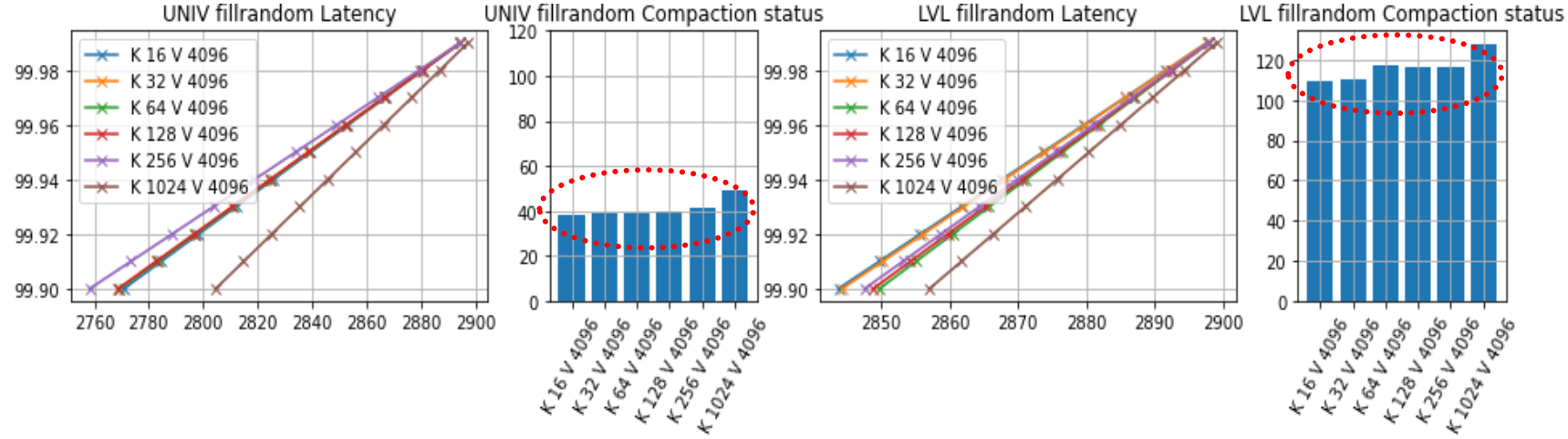




LVL vs Univ # of Compactions , latency Comparison

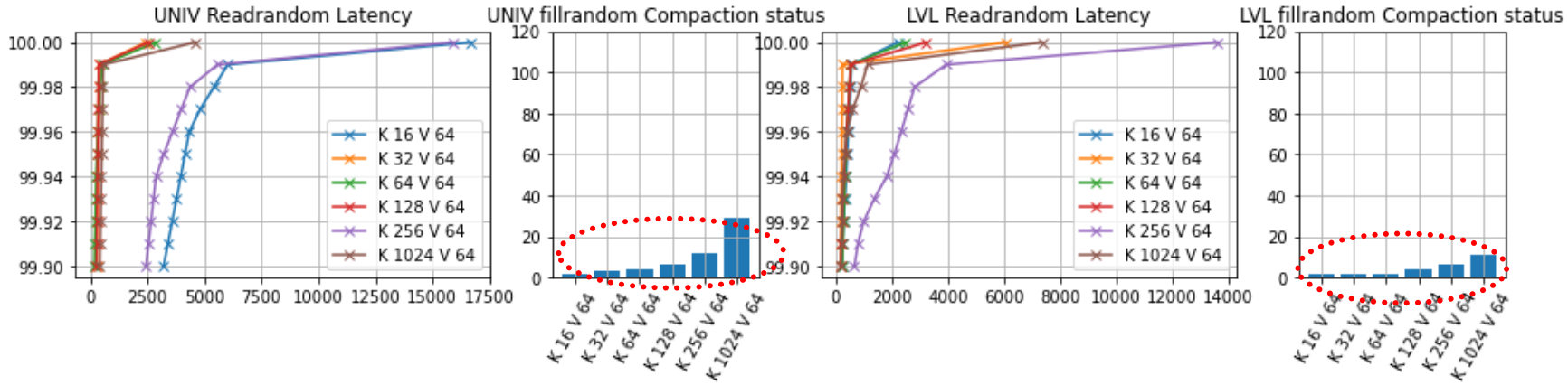
- Fillrandom

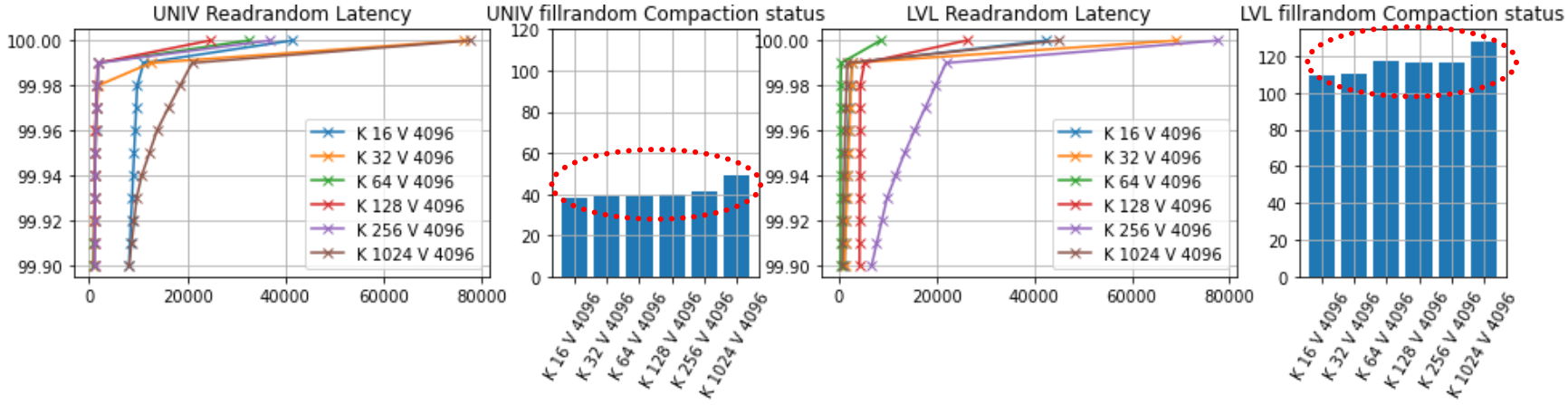




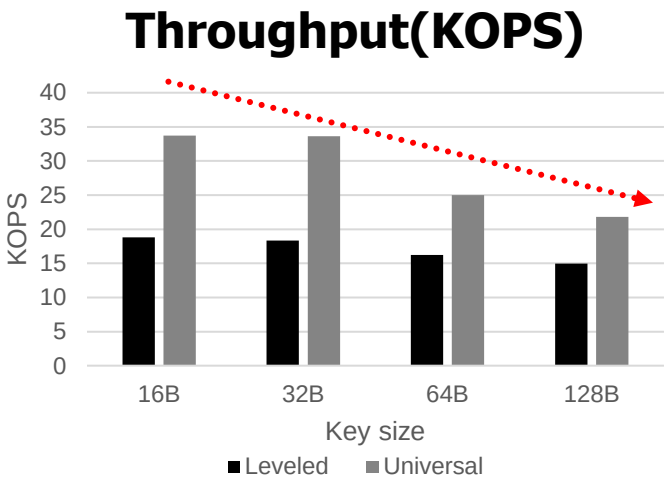
LVL vs Univ # of Compactions / latency Comparison

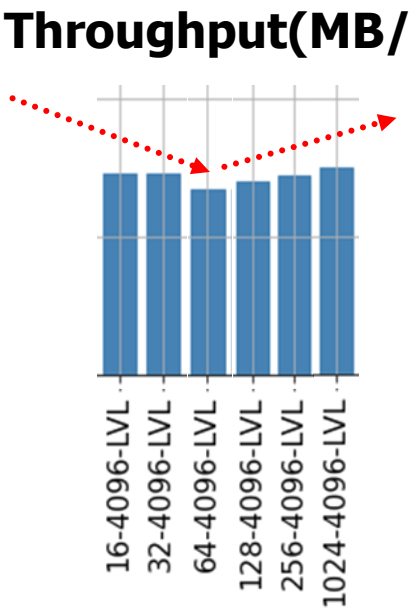
- Readrandom





Issue on Last week





☞ 한 쪽은 **OPS,** 한 쪽은 **MB/s** 임.

즉, **KV Size**가 늘어날 수록 **MB/s**는 늘어나고, **OPS**는 줄어들게 됨