# RocksDB Festival

Supported by IITP, StarLab.

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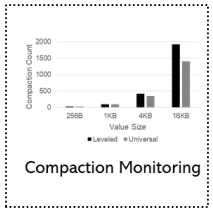
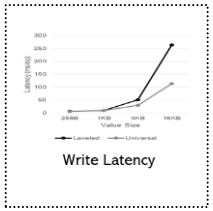
TeamName : 멘탈모델을 만들고 싶어요

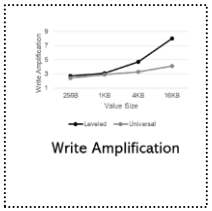
# Contents

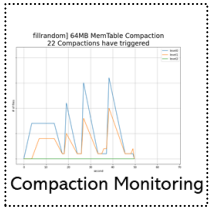
- Last Week
  - ✓ 컴팩션에 영향을 미치는 녀석들 #1 KV Size
  - ✓ 컴팩션에 영향을 미치는 녀석들 #2 SST Size

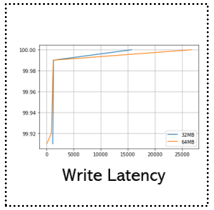
- This Week
  - ✓ Mental Model
    - Alleviating *[PROBLEMS]* of Level Compaction by *[Method]* in Universal Compaction
  - ✓ Leveled vs Universal Compaction Comparison
    - Throughput
    - Write Amplification
    - Latency distribution + # of Compactions
    - ~~Read/Space Amplification~~

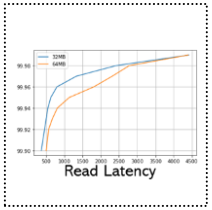


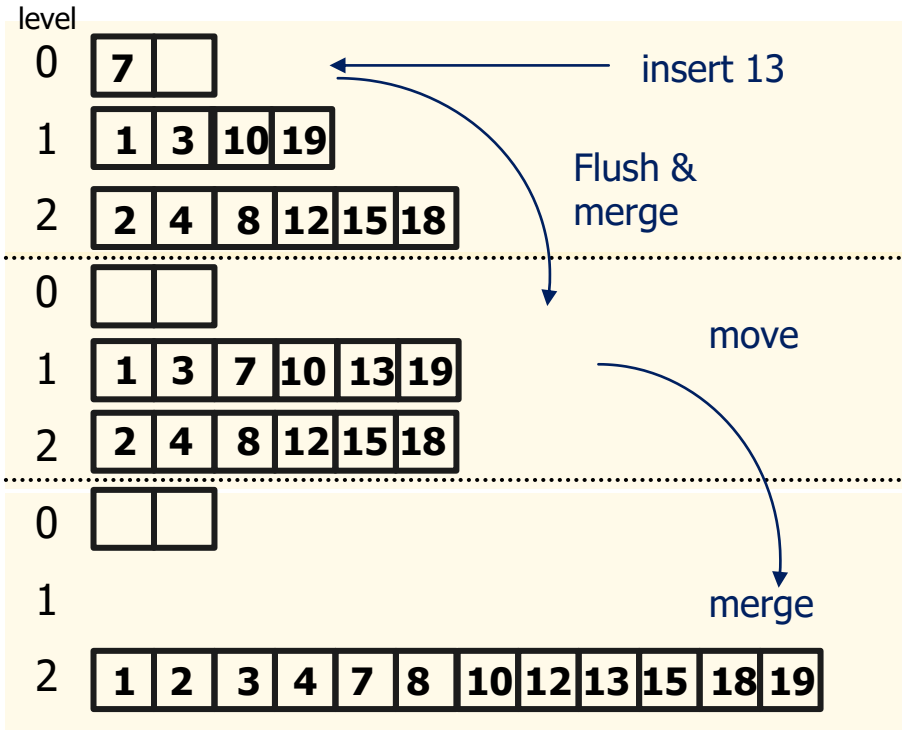



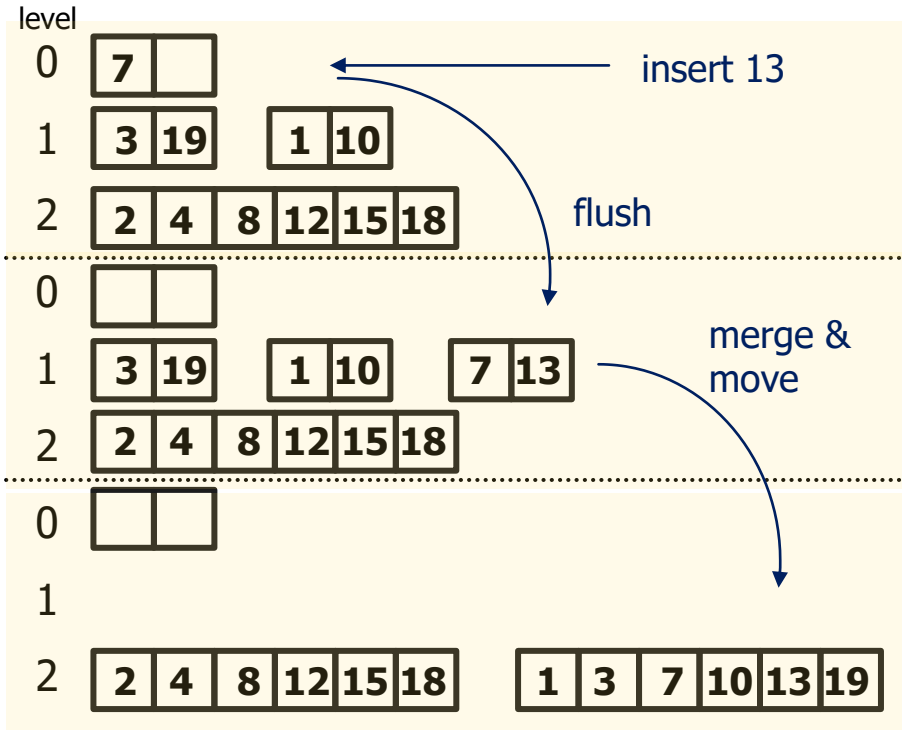
# Compaction Style

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

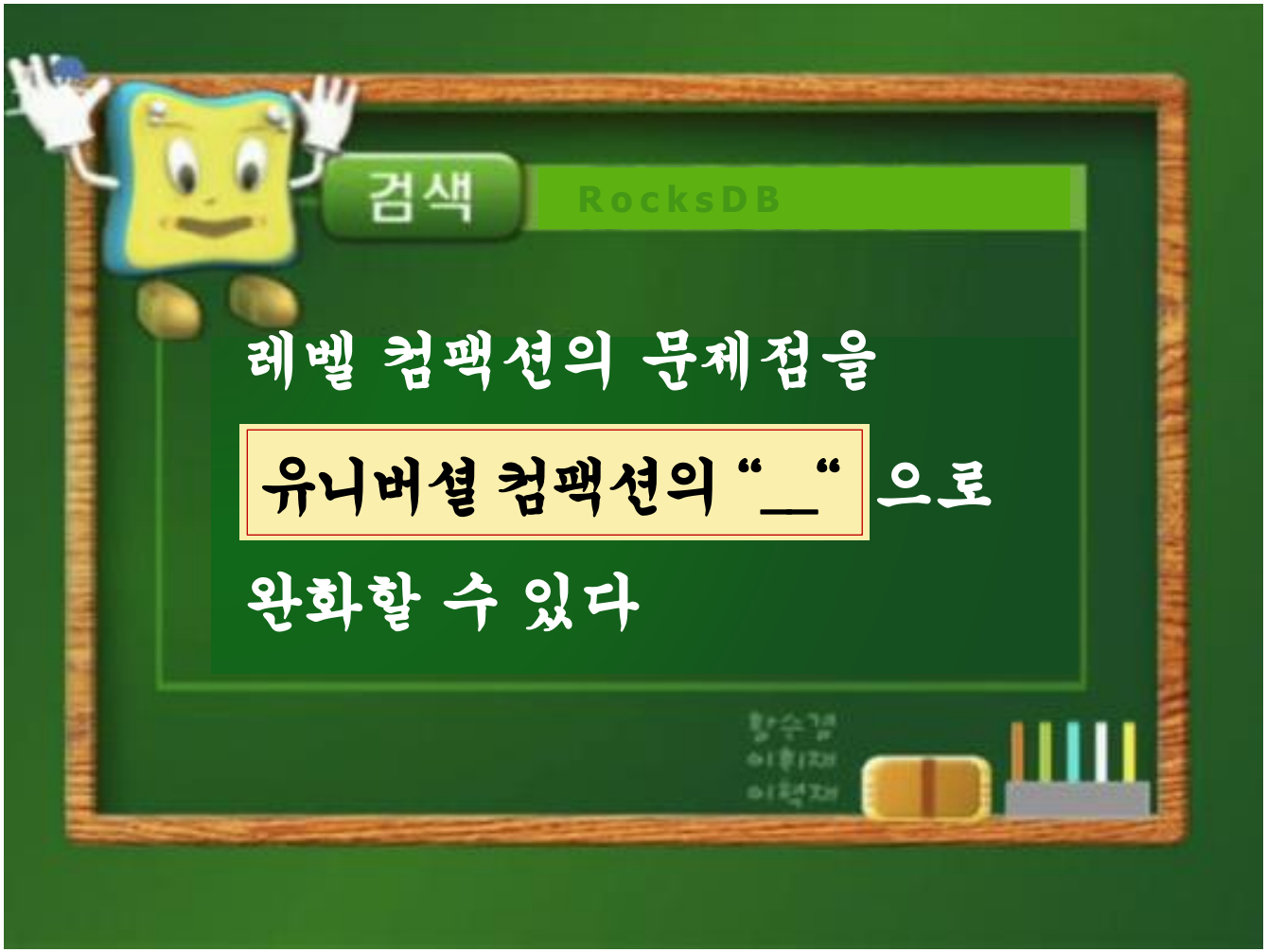
**Example of LeveledCompaction**




**Example of Universal Compaction**



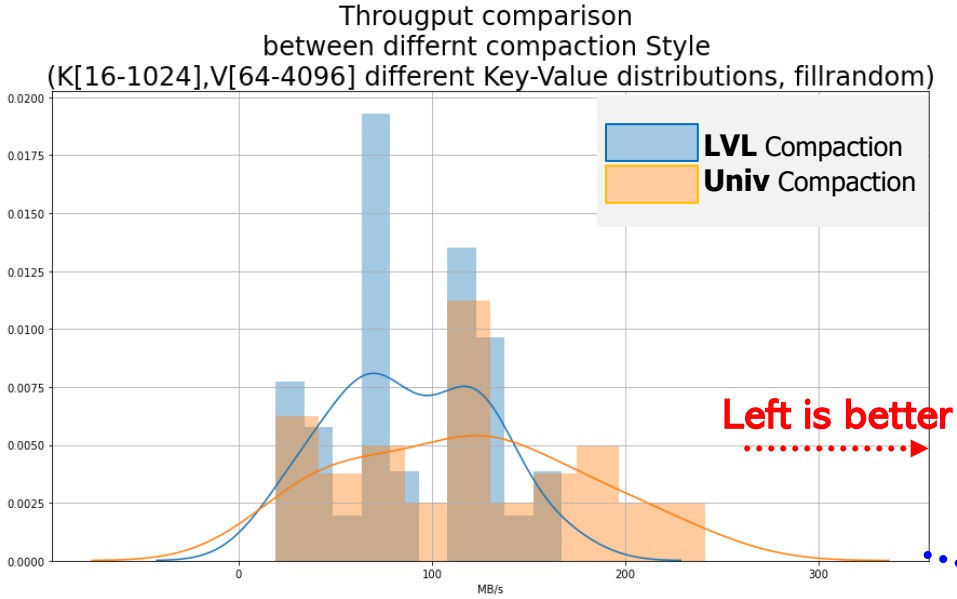
# Mental Model

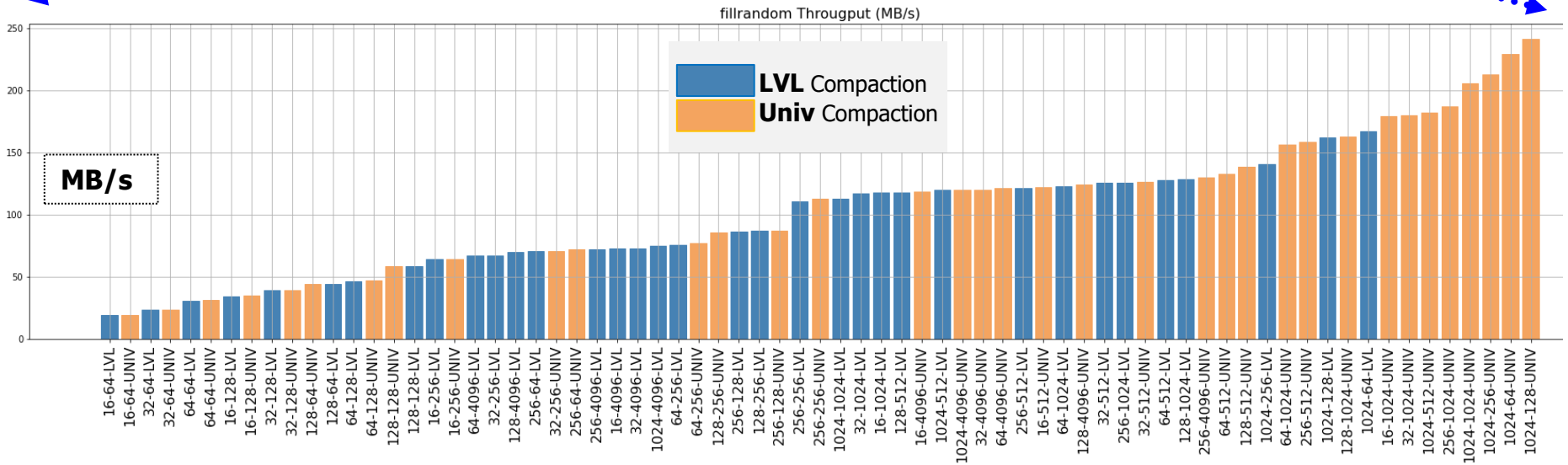


# LVL vs Univ Throughput Comparison

## 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
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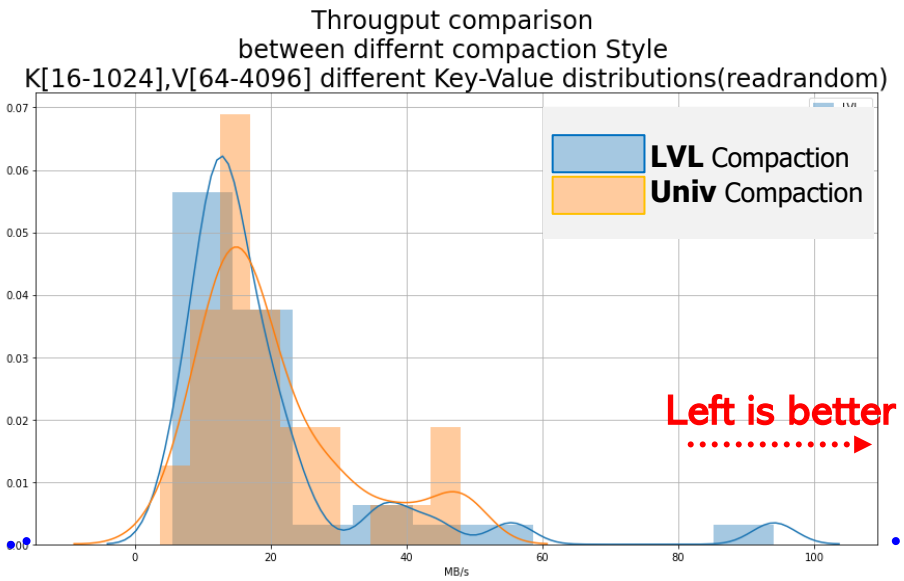


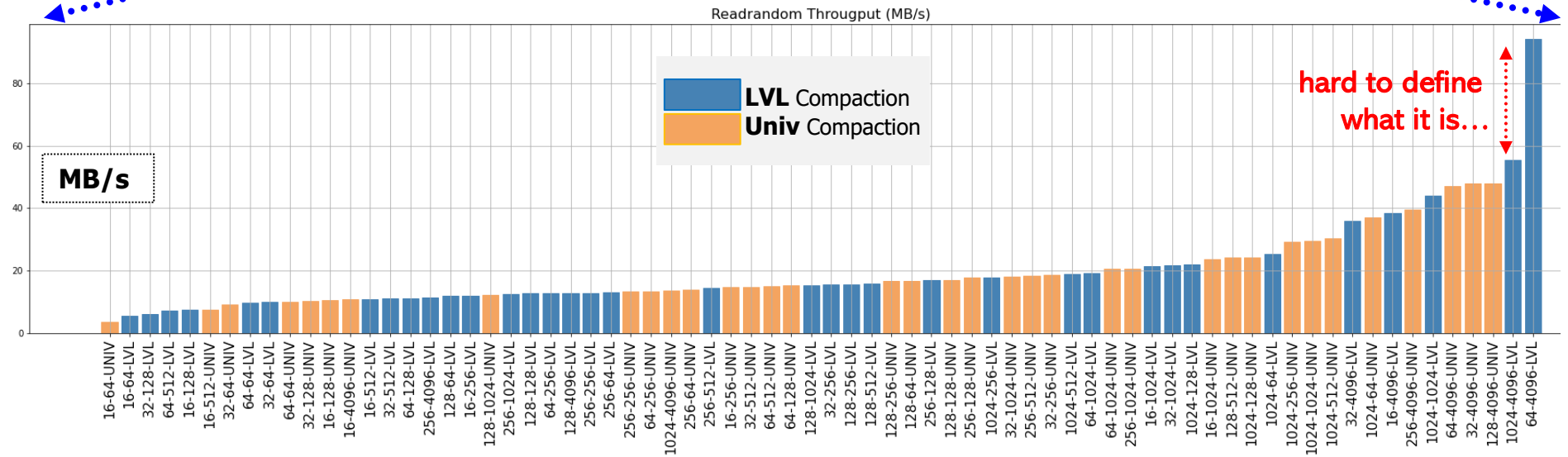

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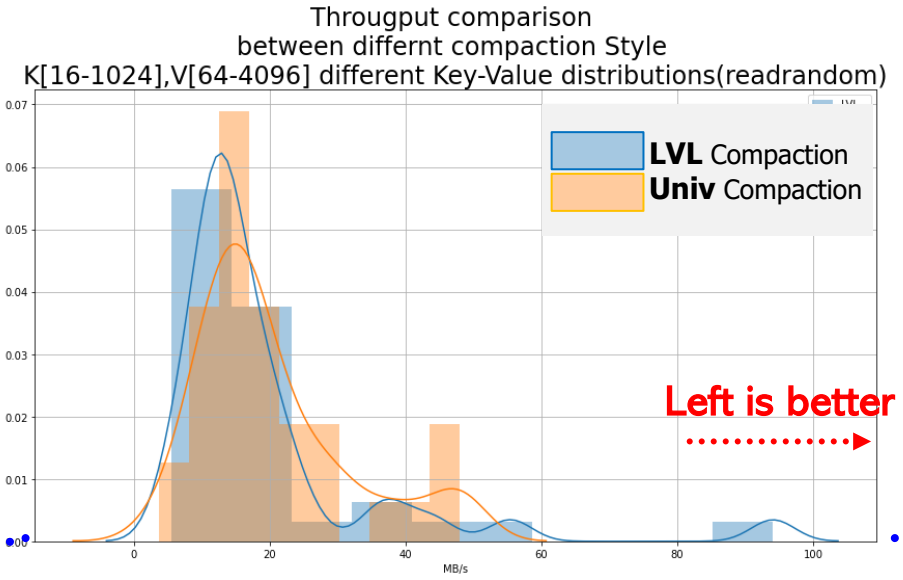
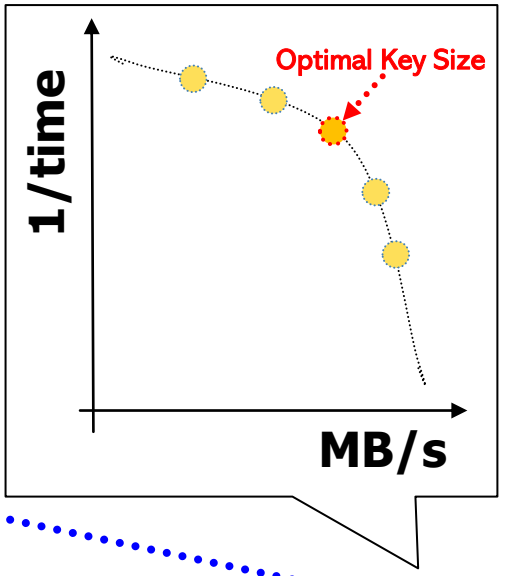
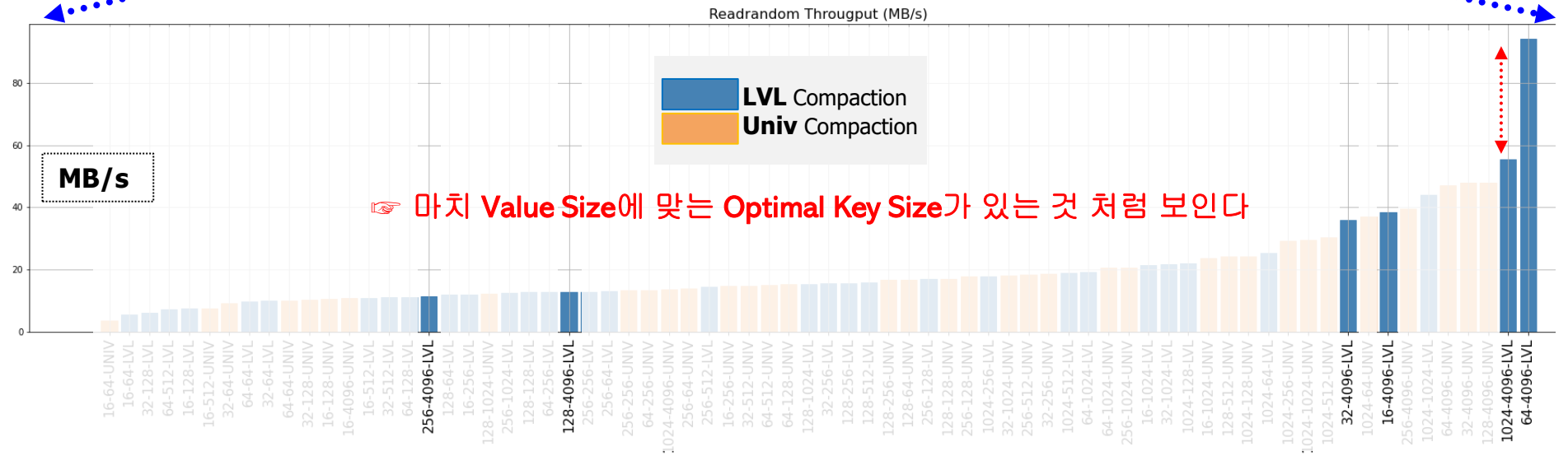
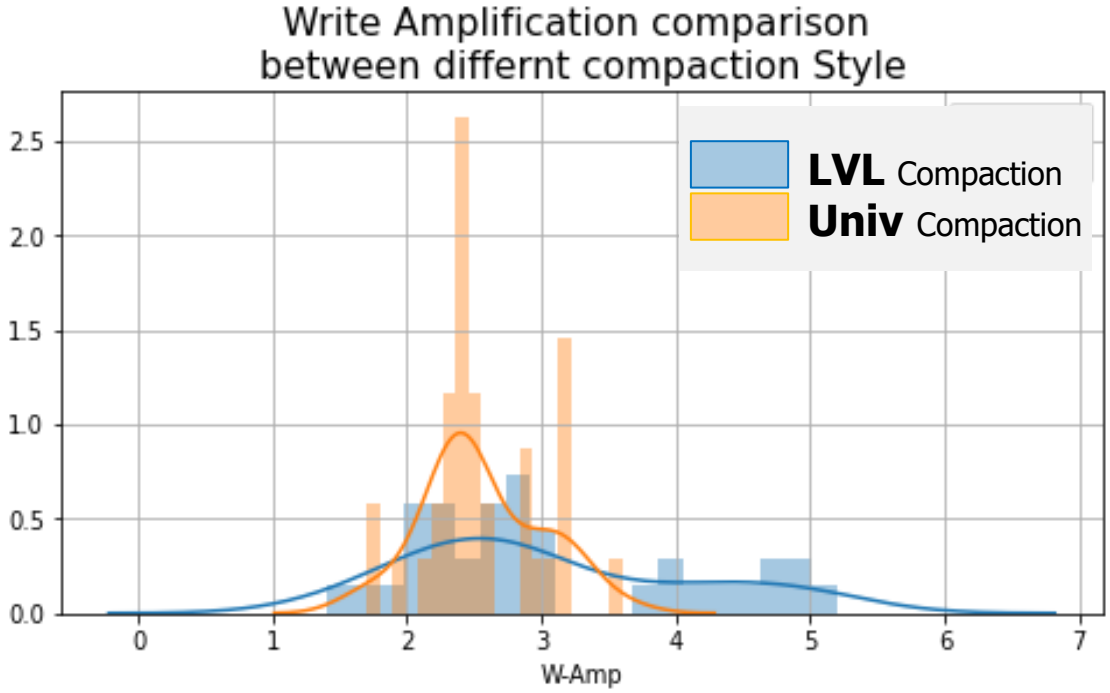
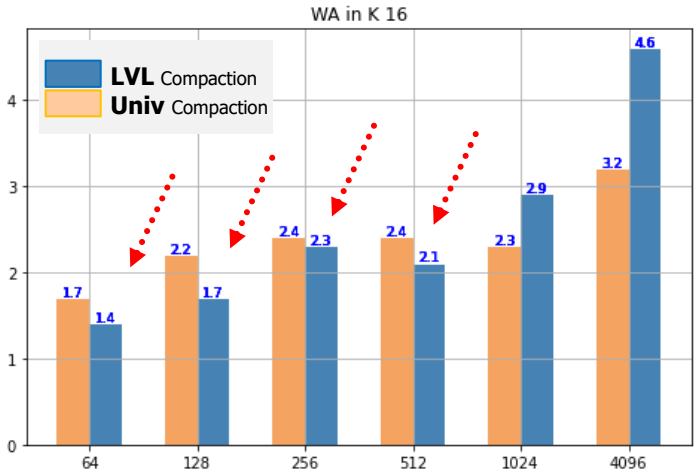


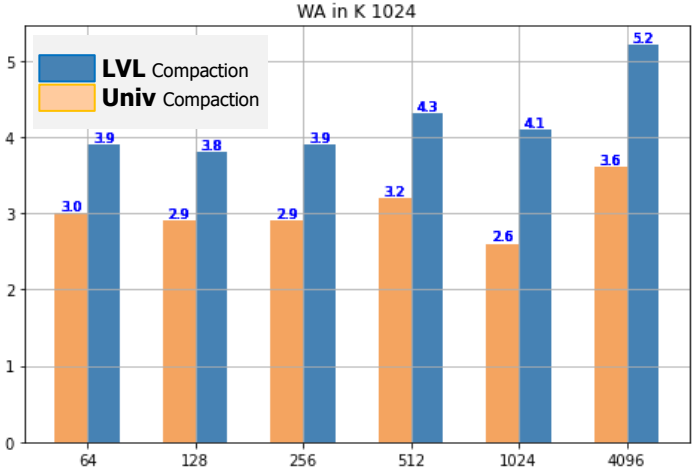



# LVL vs Univ WAF Comparison

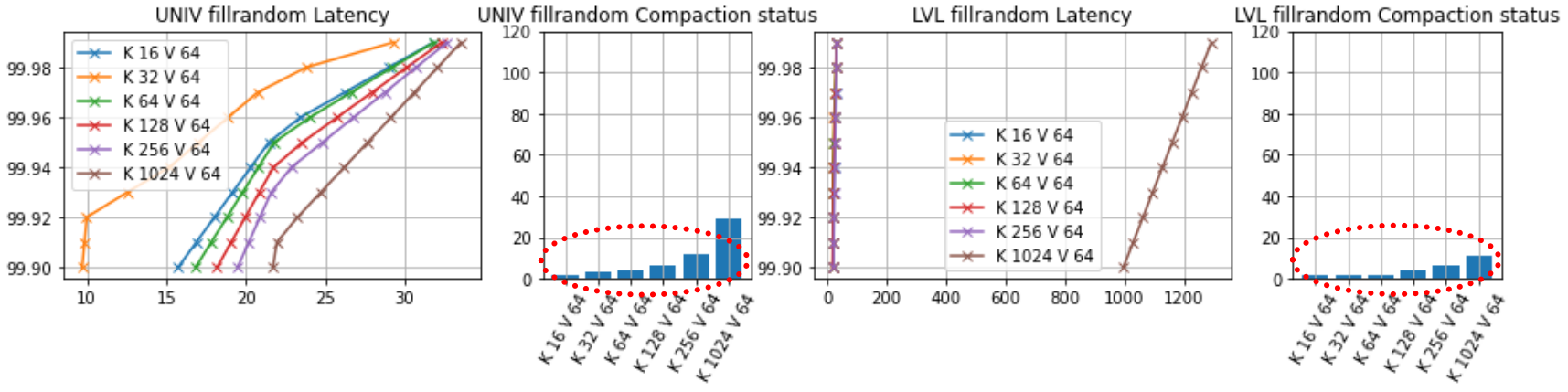


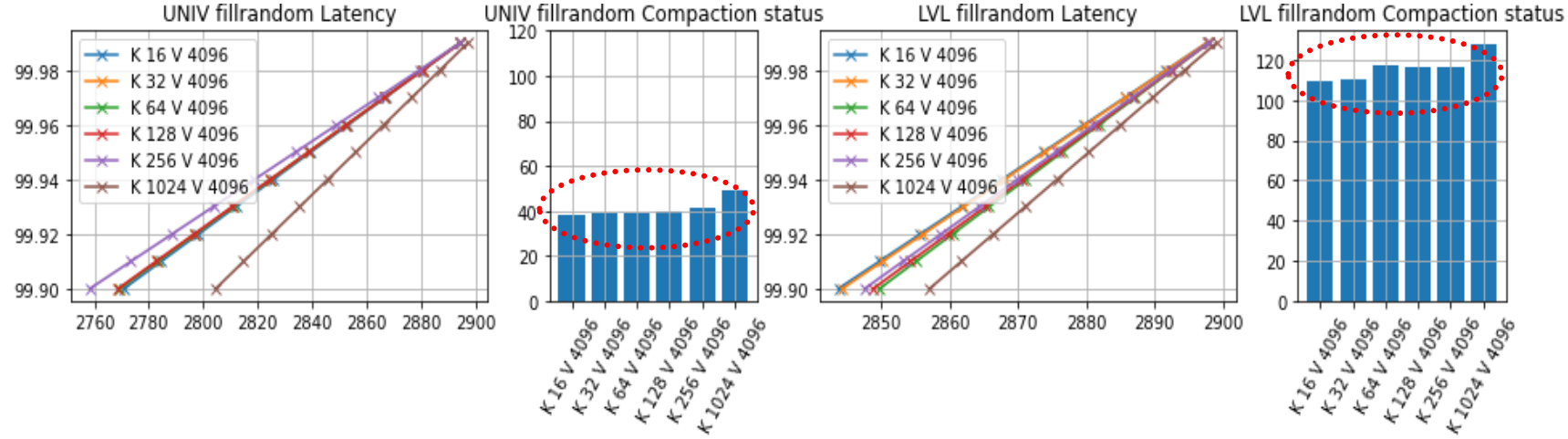



# LVL vs Univ # of Compactions , latency Comparison

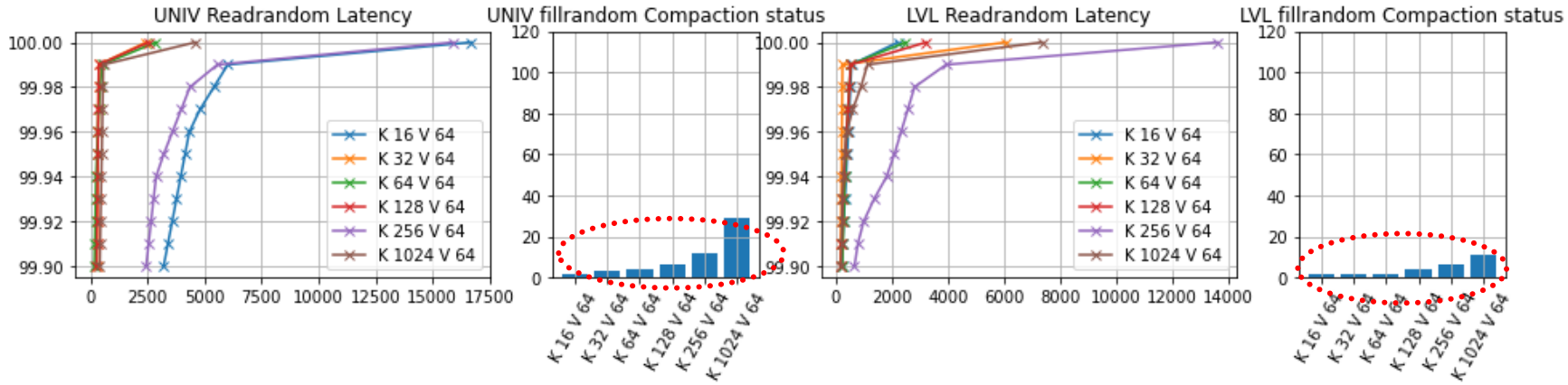
- Fillrandom

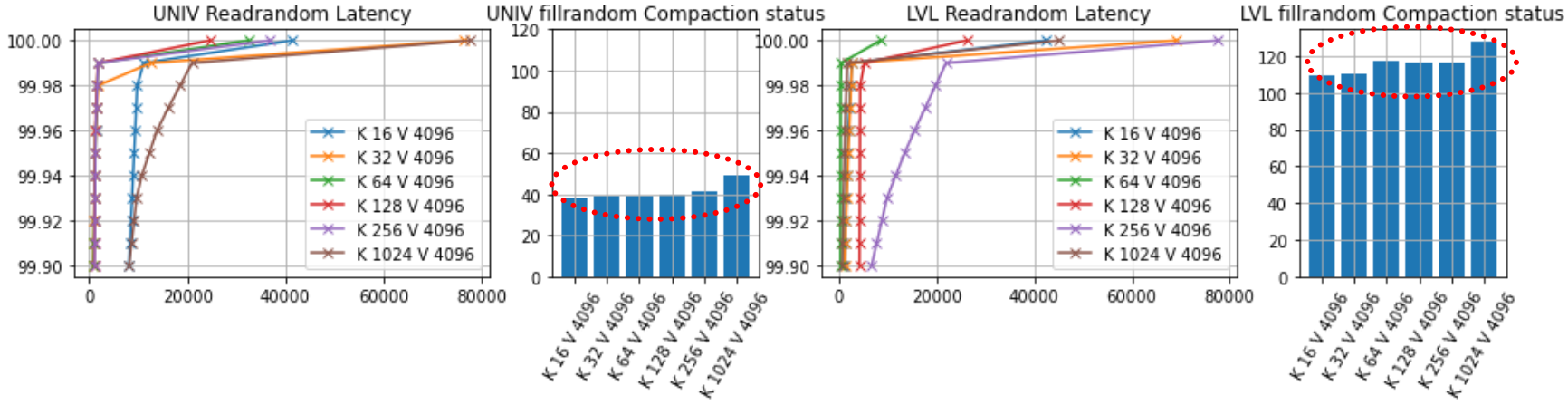


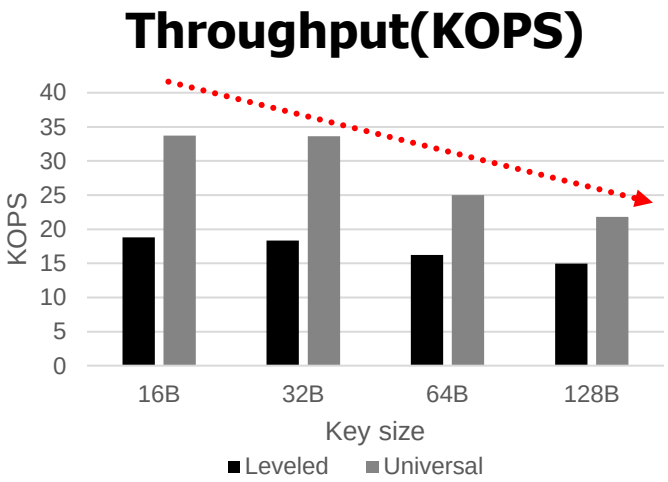
# LVL vs Univ # of Compactions / latency Comparison

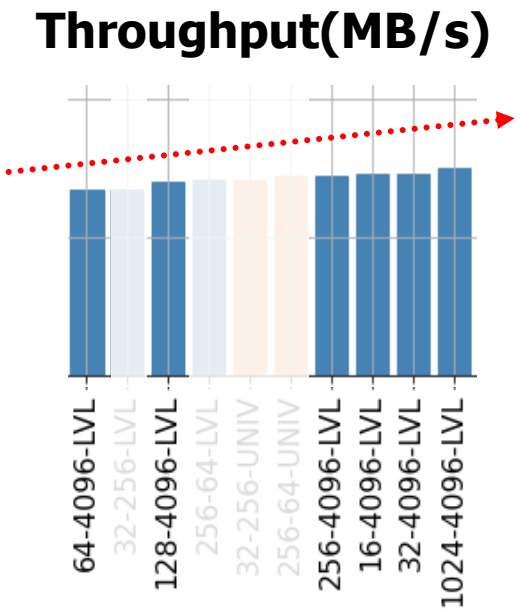
- Readrandom



# 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

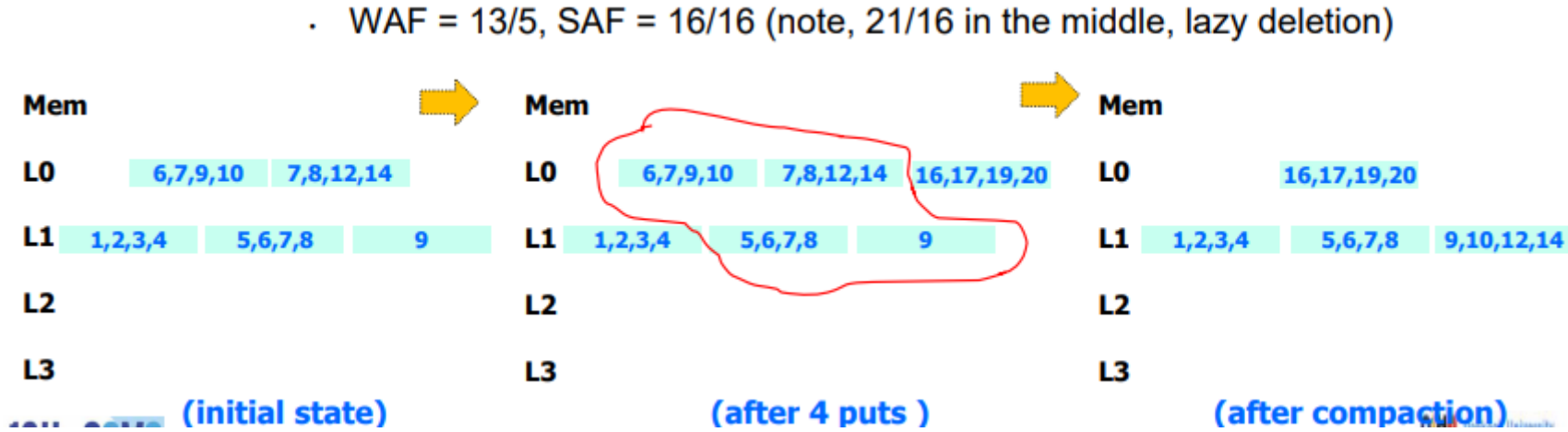
- Next Week
  - ✓ Mental Model
    - Leveled vs Universal Compaction 관련 논문 조사
    - Hybrid Compaction 고민
  - ✓ Leveled vs Universal Compaction Comparison
    - Read 성능에 대한 fine grain 측정 – Read 부분별 시간 측정
    - Space Amplification 측정
    - Read Amplification 측정

# Discussion

# Appendix

- How to estimate Space Amplification Factor?

$$SAF = \frac{Actual\ used\ space}{Required\ space} = \frac{DB\text{에 실제로 저장된 공간}}{\text{최소로 필요한 공간}}$$ ☞ **Not so simple**

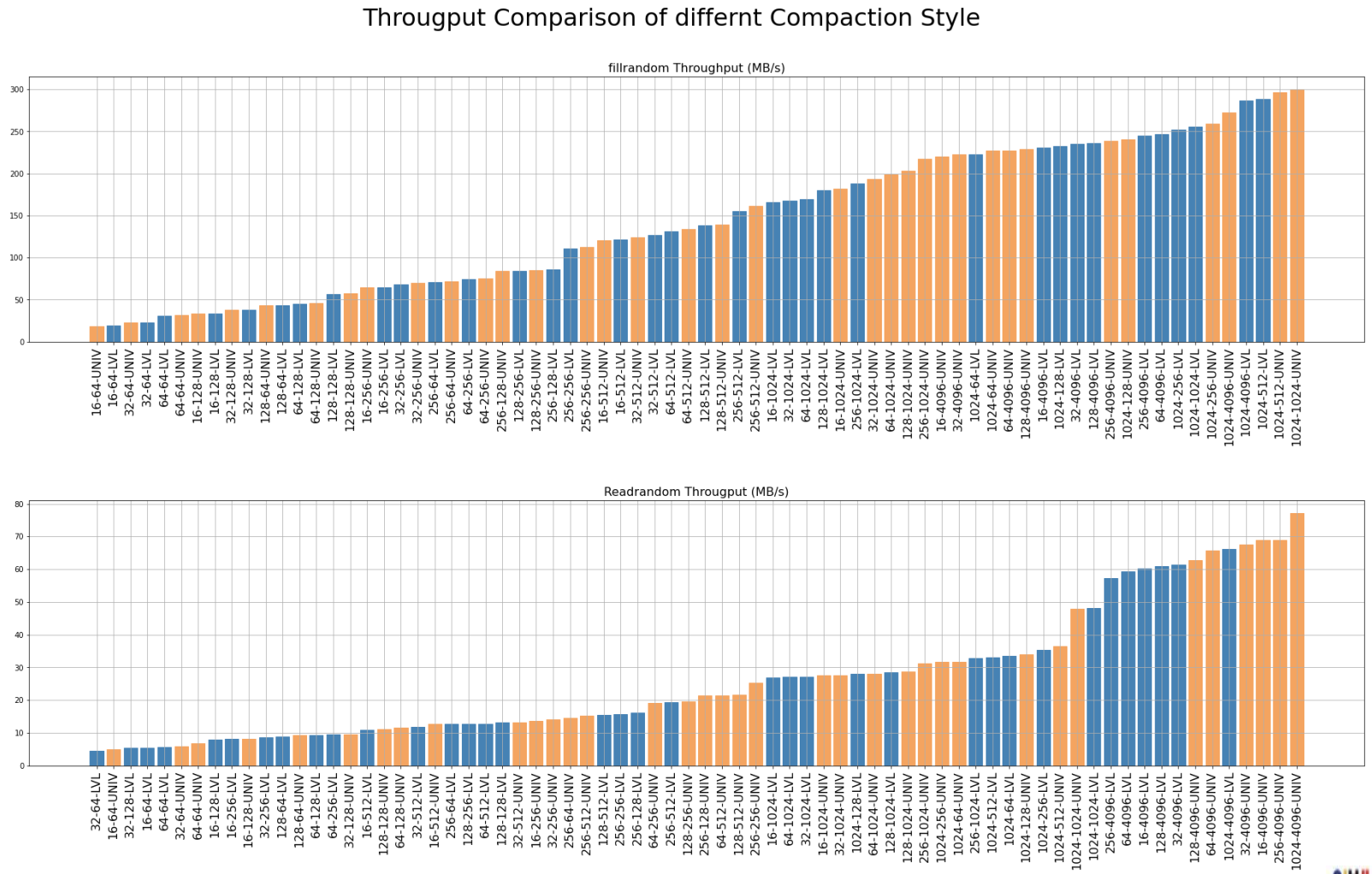



Jongmoo Choi, Key-Value Store: Database for Unstructured Bigdata (Focusing on RocksDB), 12th CSMS 융합·스마트미디어 시스템 워크샵

☞ 중첩된 KV 를 고려하지 않아야함
☞ ☞ 따라서, (바라건대,) Sequential pattern 으로 쓰인 Size를 '최소로 필요한 공간' 으로 두고 구할 예정.
☞ Comment Plz

# When we fix the DB size (Request size ≈ 2.4GB)

- 현재 Request size = 800GB로 수정하고 DB bench 실험중..



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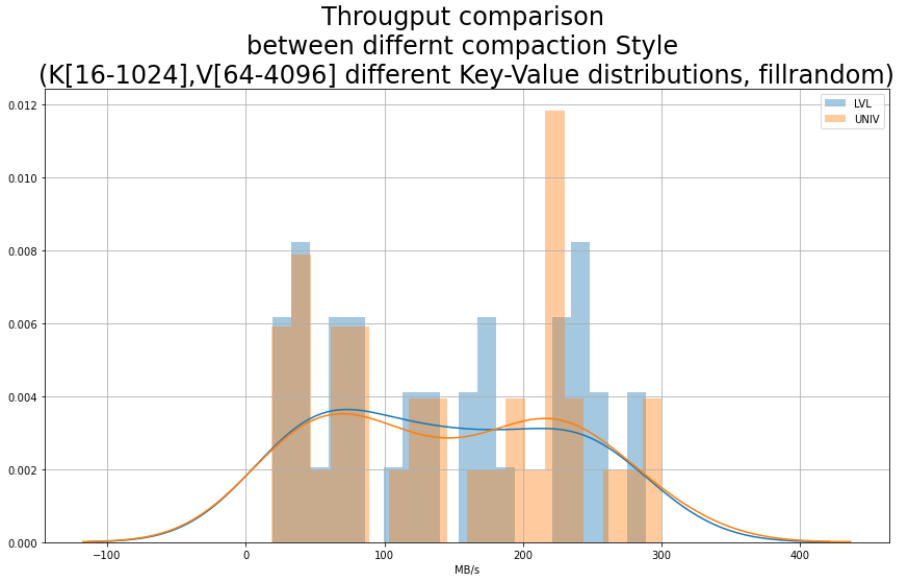
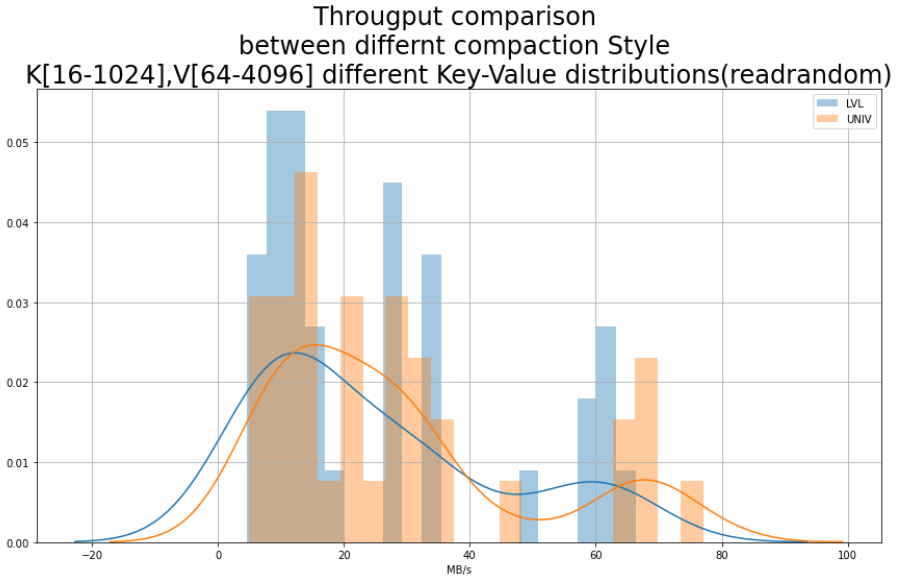
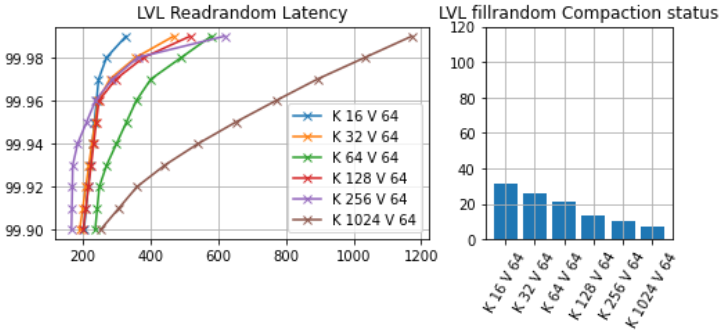
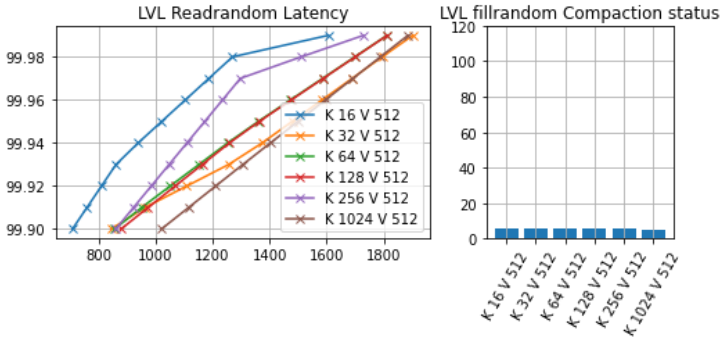


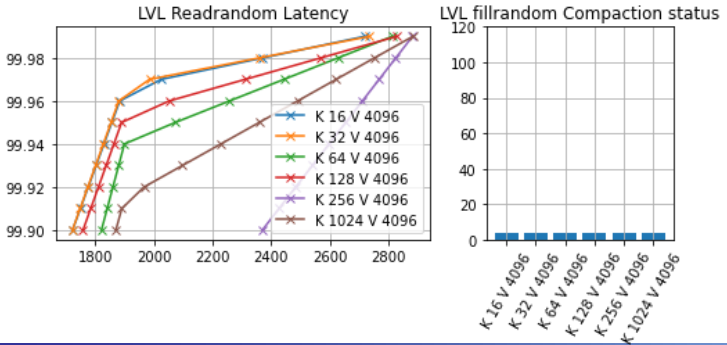



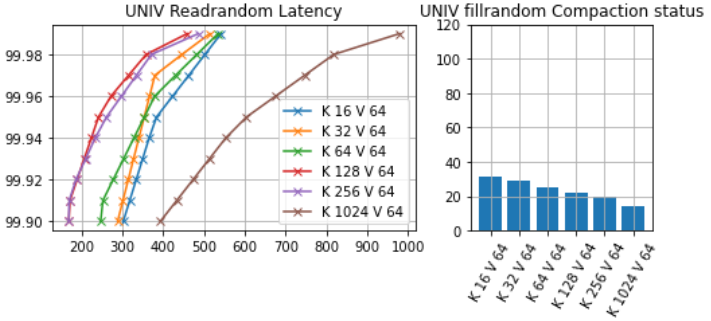
- When we fix the DB size (Request size ≈ 2.4GB)

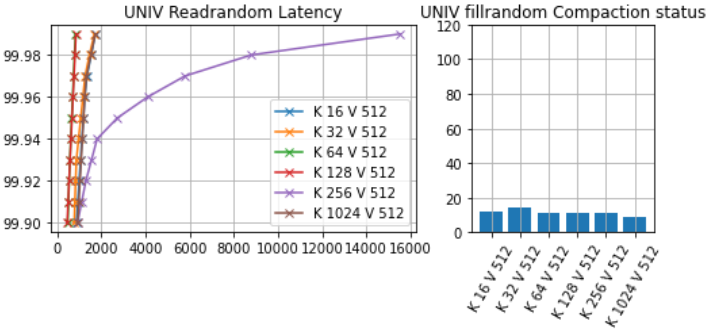
# LVL compaction latency 99.99%  UNIV compaction latency 99.99%

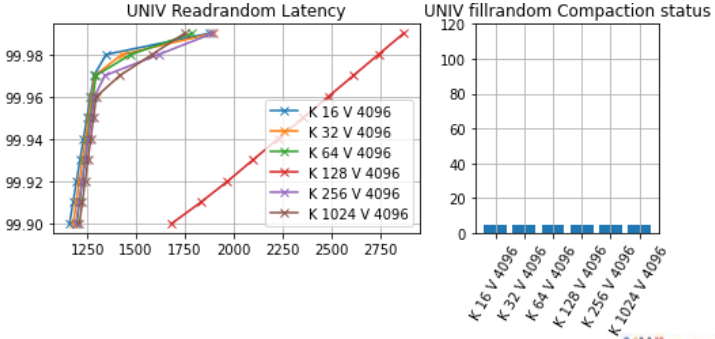


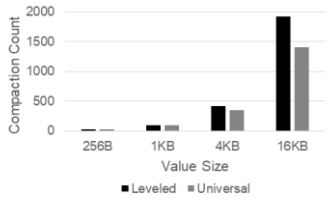



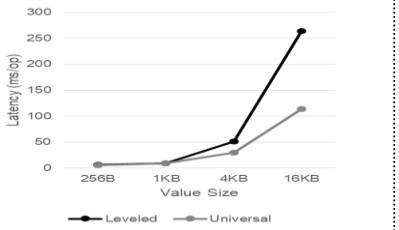
# Last Week

- Compaction에 영향을 미치는 녀석들
  - ✓ #1 KV-Size
    - Various Key Size
      - Key: 16B, 32B, 64B, 128B
      - Value: 8K
      - fillrandom, readrandom, range query, 5000000
      - Leveled Compaction vs. Universal Compaction
      - Write Amplification
    - Various Value Size
      - Key: 16B
      - Value: 256B, 1KB, 4KB, 16KB
      - fillrandom, readrandom, range query, 5000000
      - Leveled Compaction vs. Universal Compaction
      - Write Amplification

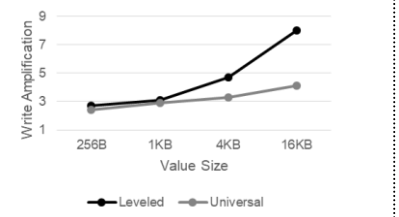
+YCSB Workload, compare Read/Space Amplification




Compaction Monitoring

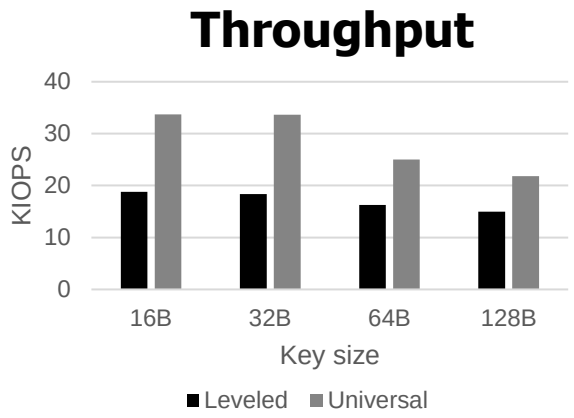


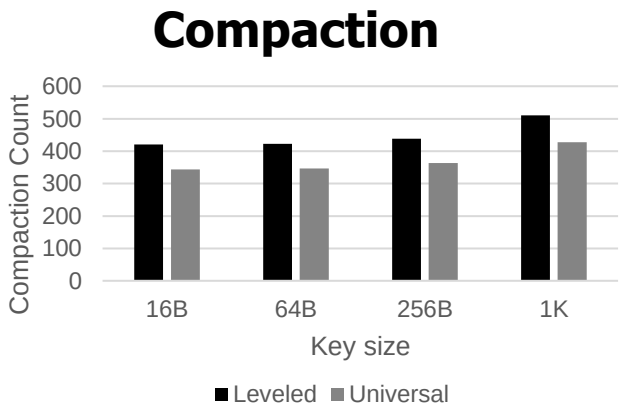

Write Latency

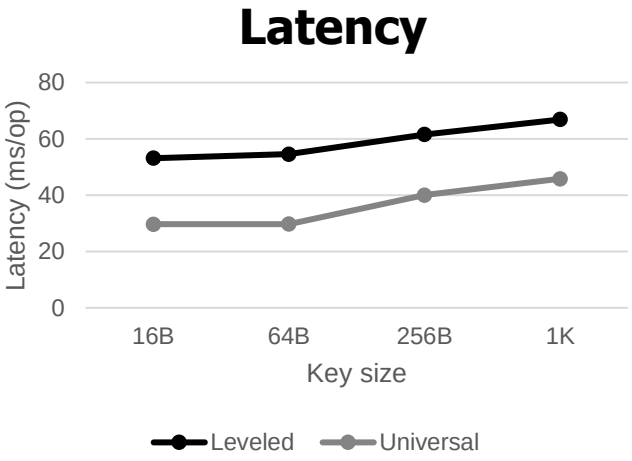


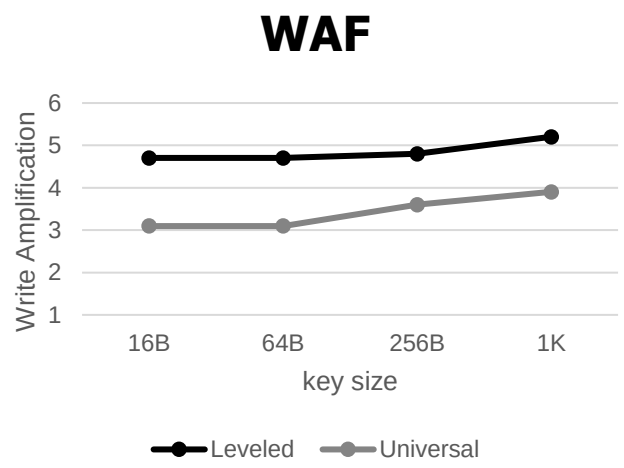

Write Amplification

- RocksDB::Compaction
  - ✓ Trial#3 Compaction on various Key size (random write)

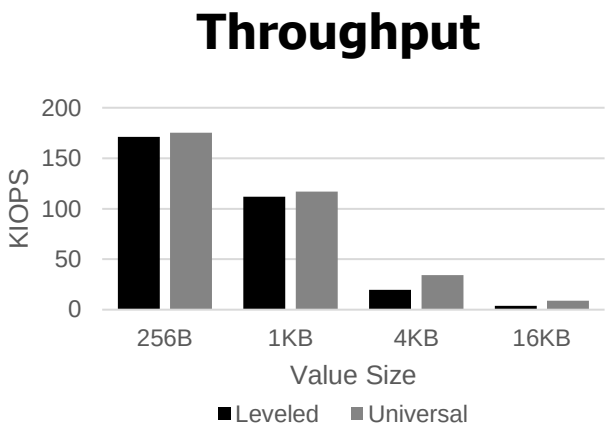


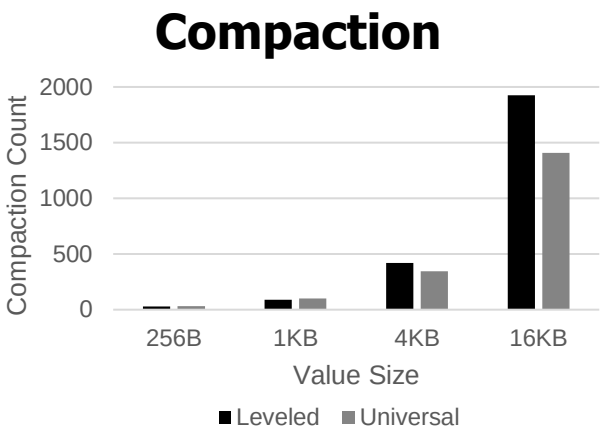



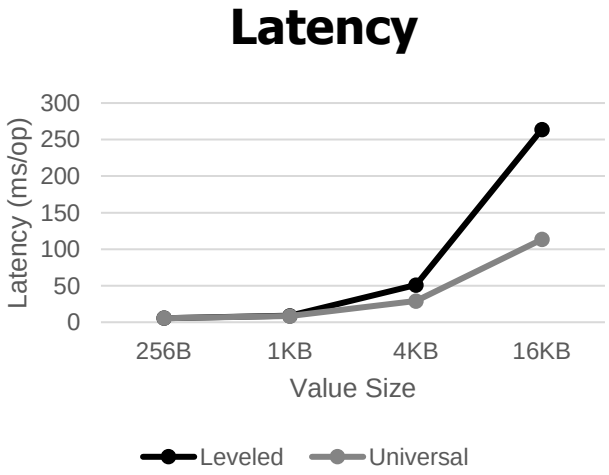



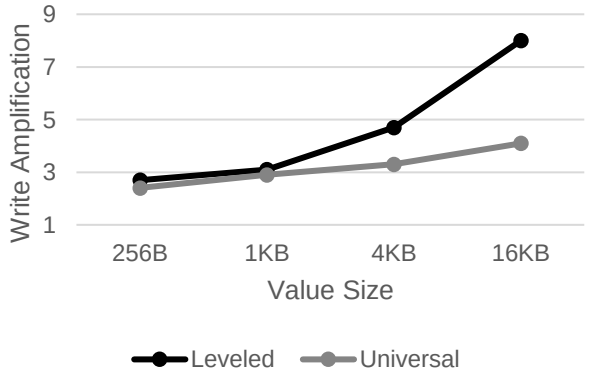



- RocksDB::Compaction
  - ✓ Trial#4 Compaction on various Value size (random write)

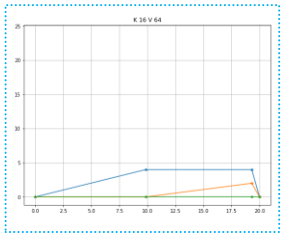
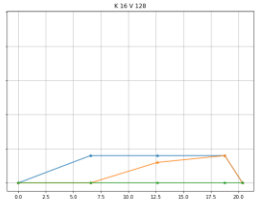
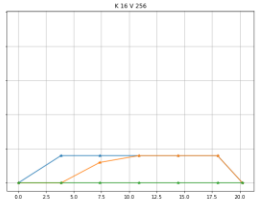
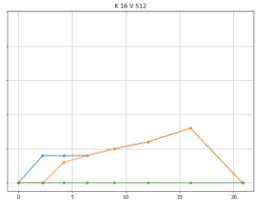
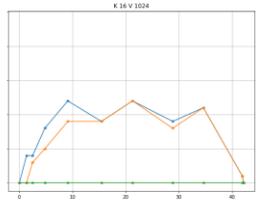
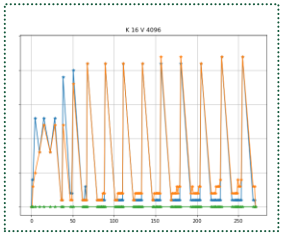


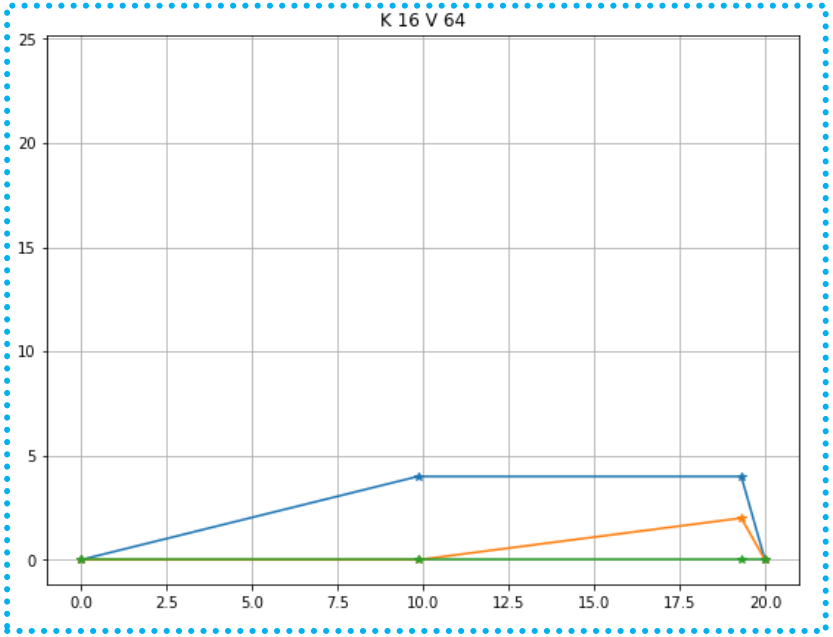



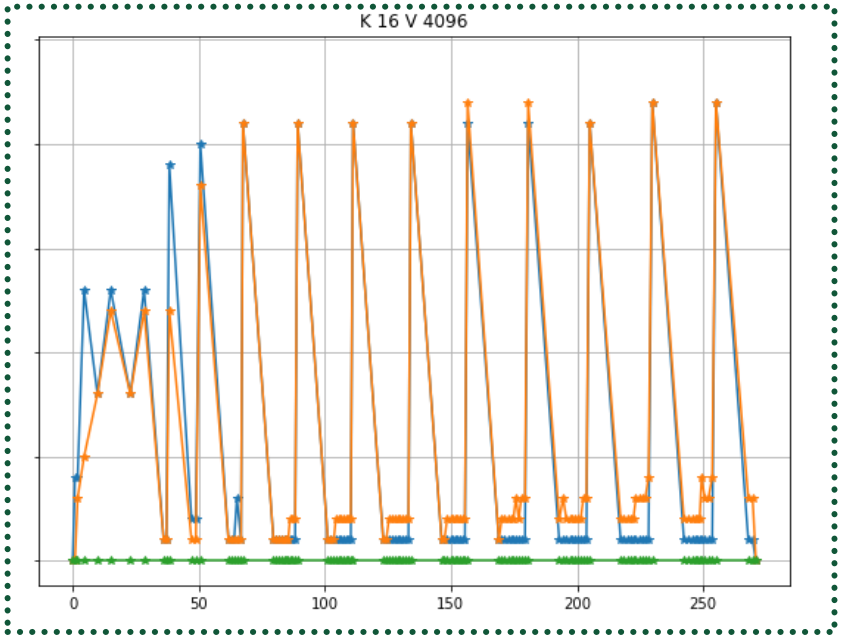



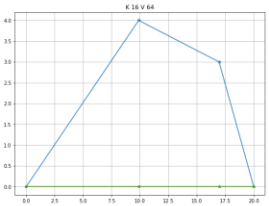
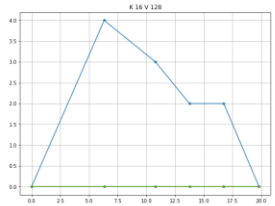
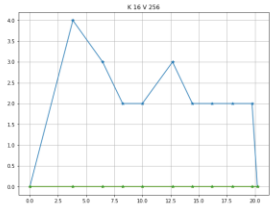
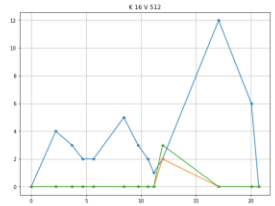
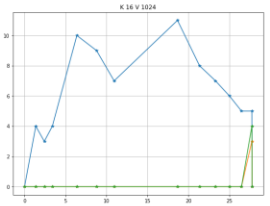
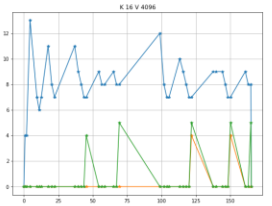
# Level Compactions Trace

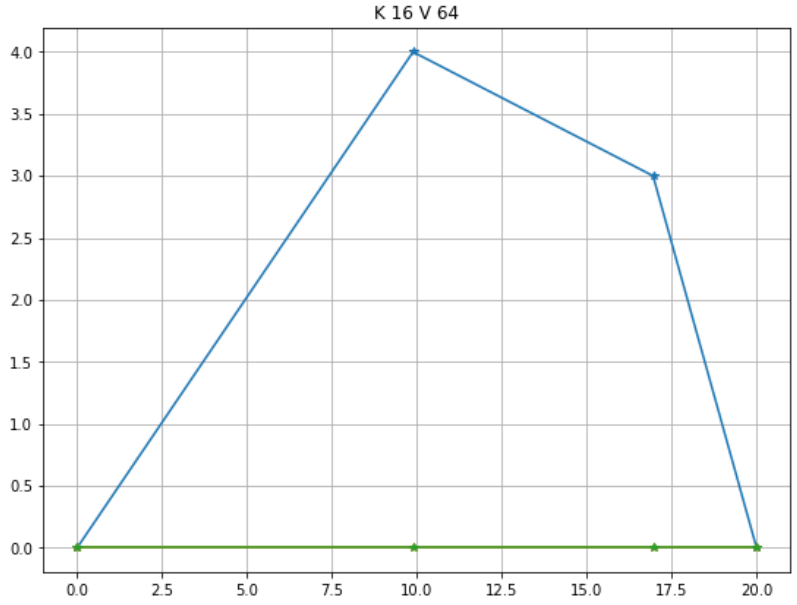







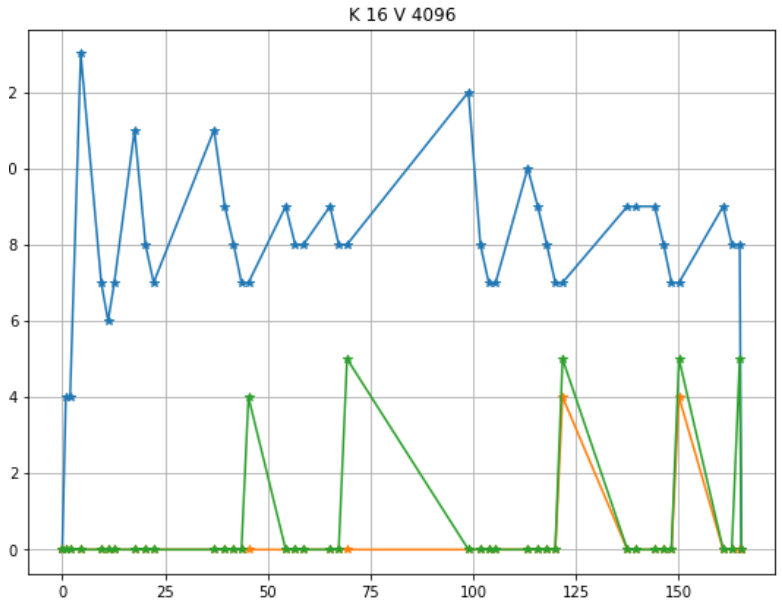


# Universal Compactions Trace

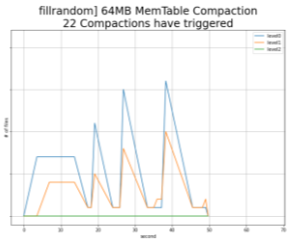









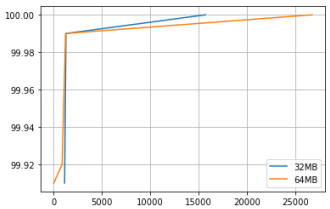




K 32 V 4096

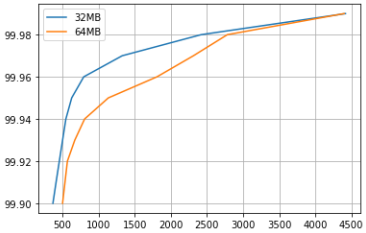
- Compaction에 영향을 미치는 녀석들
  - ✓ #2 MemTable, SSTable
    - Various MemTable + Various SST
      - 64MB, 32MB
      - fillrandom, readrandom, 16-512, 10000000
    - Various MemTable + 64MB SST
      - 64MB, 32MB, ~~16MB, 8MB, 4MB, 2MB~~
      - fillrandom, readrandom, 16-512, 10000000



Compaction Monitoring

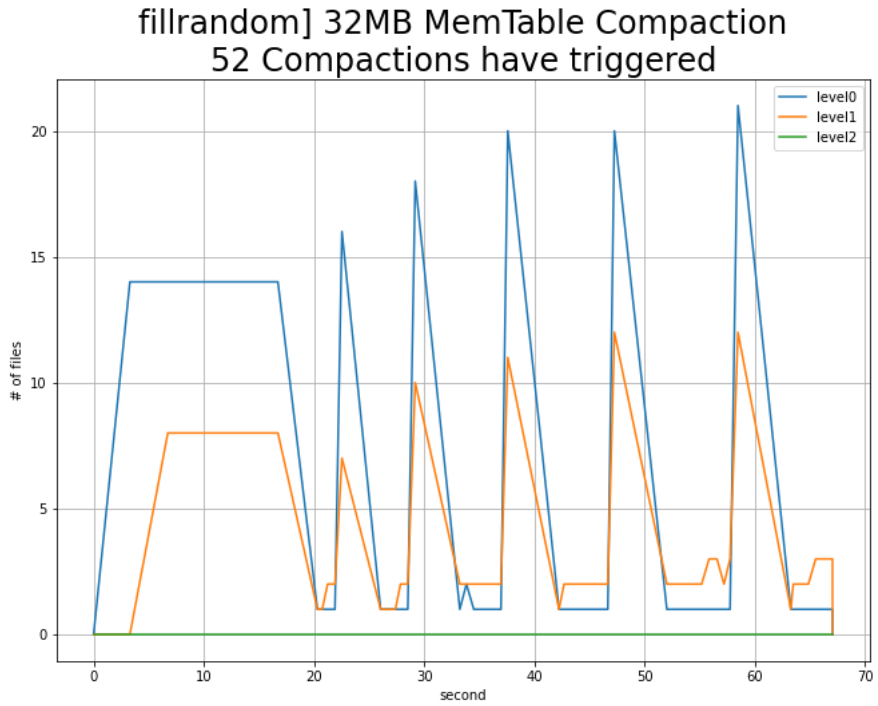


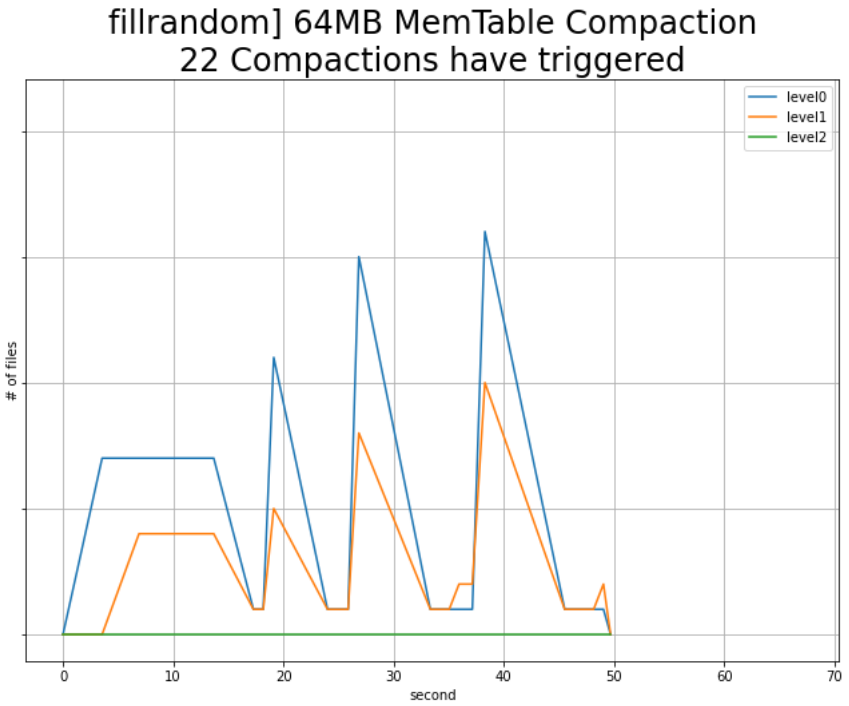
Write Latency



Read Latency

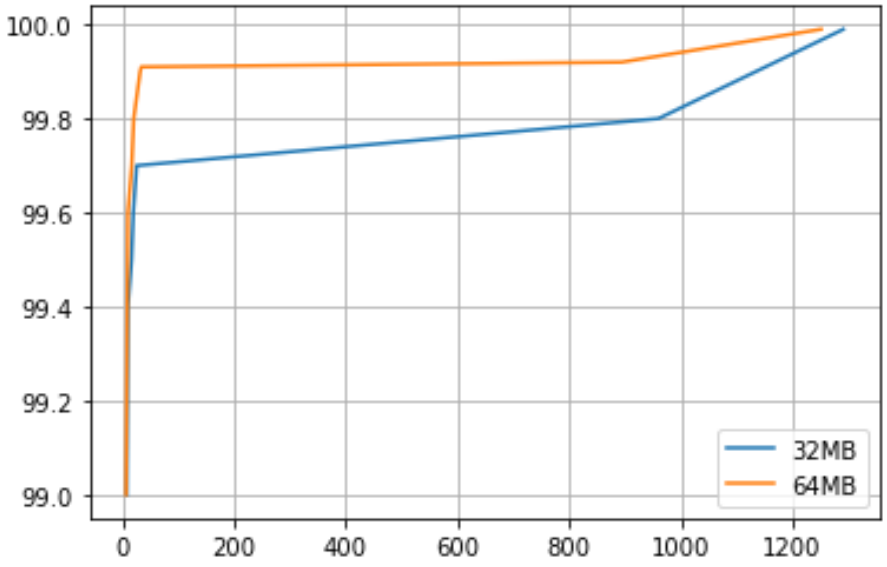
- Compaction::SSTable
  - ✓ Trial#1 Compaction on MemTable size&Target File Size (32MB vs 64MB)



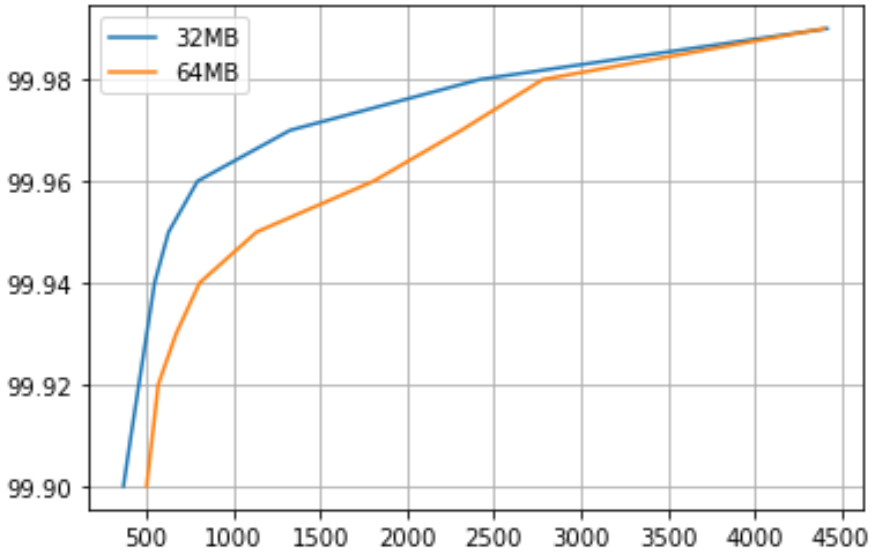




☞

- Compaction::SSTable
  - ✓ Trial#1 Compaction on MemTable size&Target File Size (32MB vs 64MB)



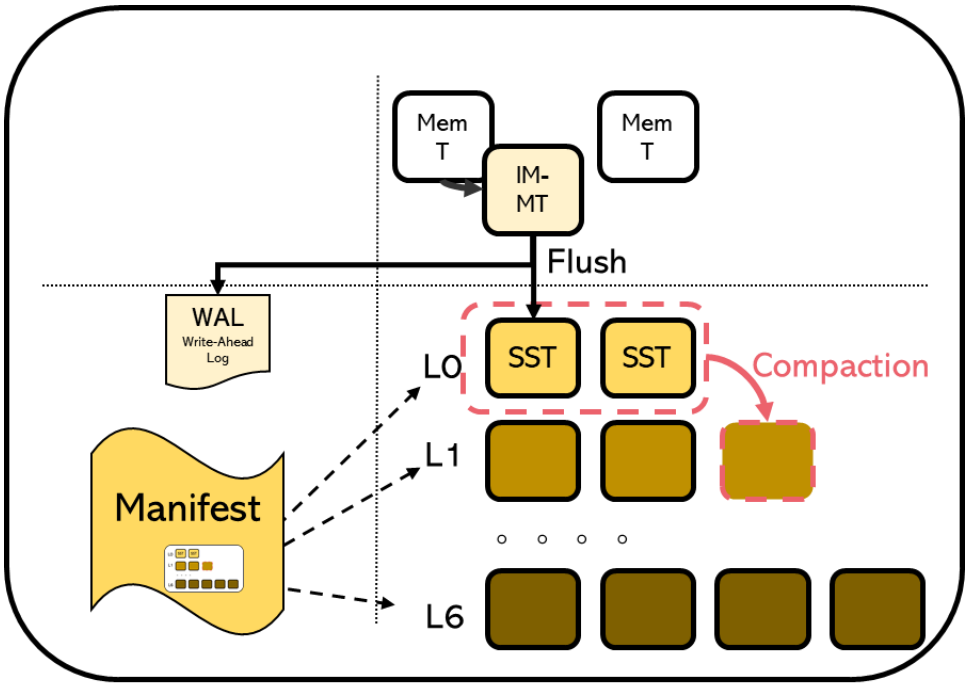

fillrandom] Write Latency (99%)

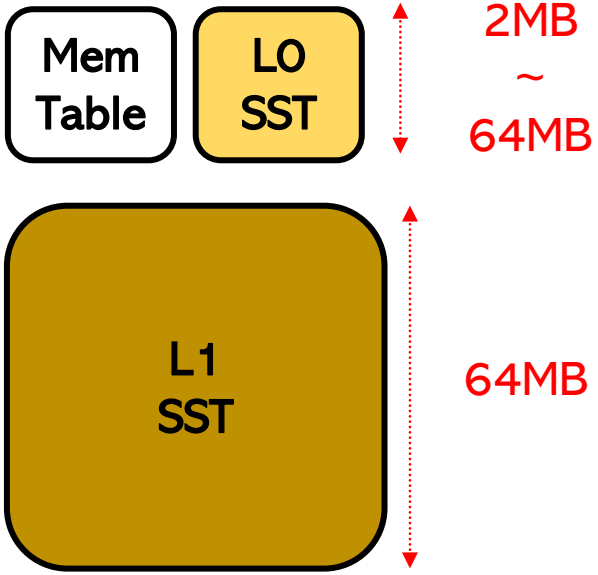



readrandom] Read Latency (99%)

☞ **Read/Write latency Trade-off on MemTable Size**

- Compaction::SSTable
  - ✓ Trial#2 Compaction on MemTable size, but Target File Size 64MB (MemT=[2,4,8,16,32,64]MB, SST_Level1 = 64MB)

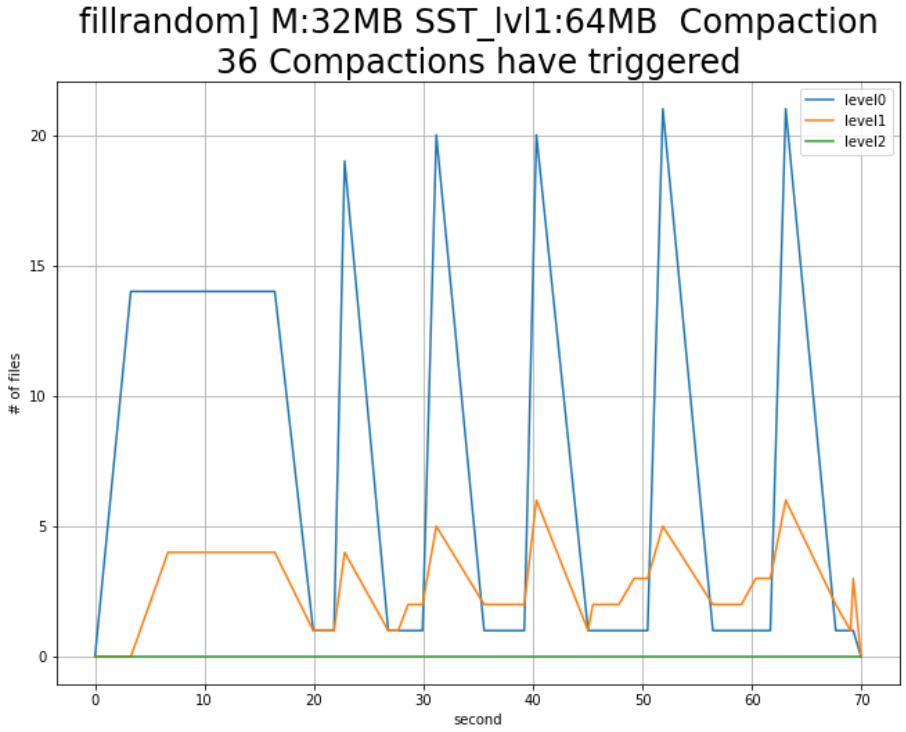


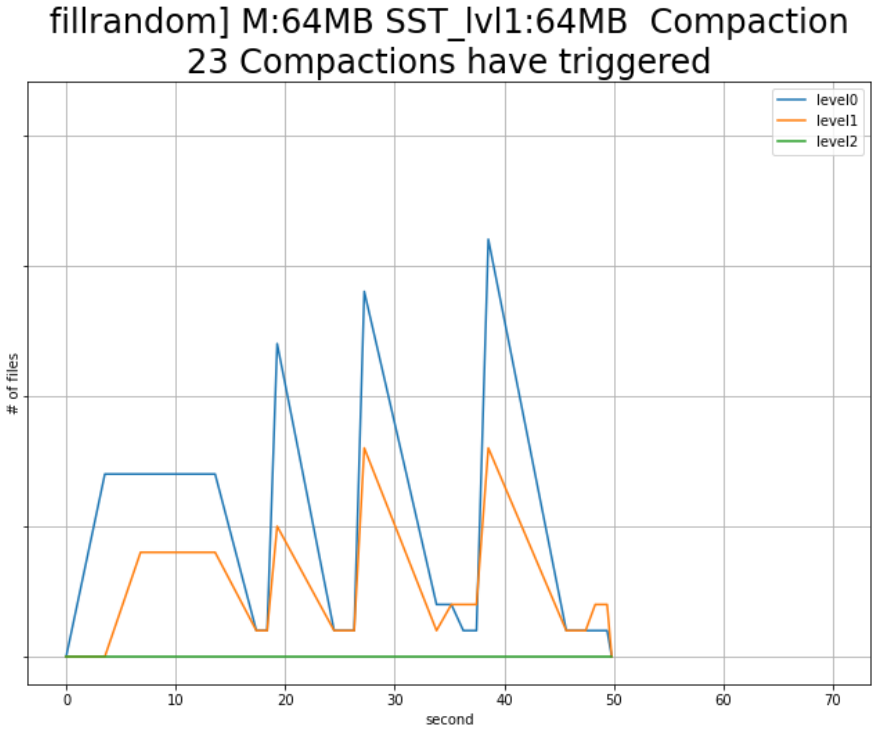




LSM Tree based KV Store

( levelDB , RocksDB )

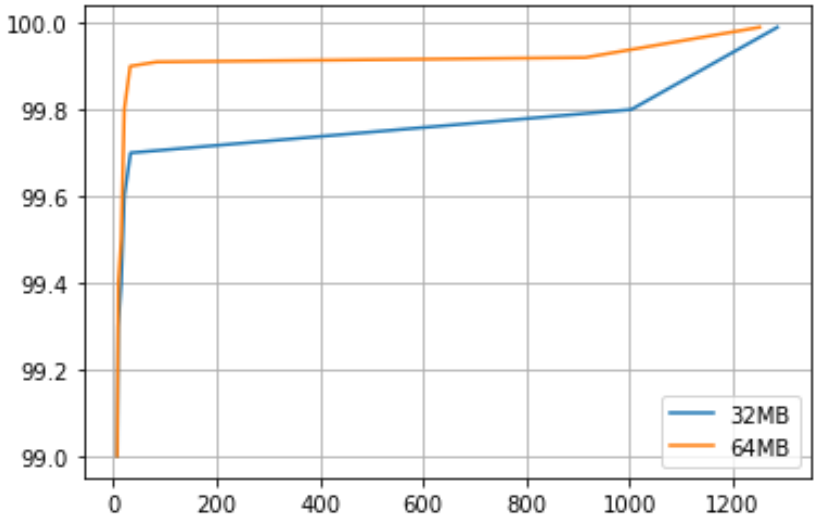
- Compaction::SSTable
  - ✓ Trial#2 Compaction on MemTable size, but Target File Size 64MB (MemT=[2,4,8,16,32,64]MB, SST_Level1 = 64MB)



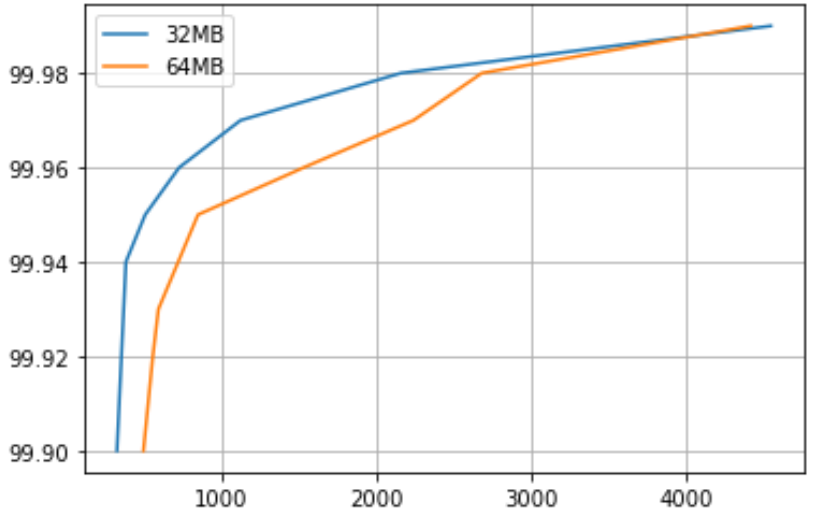




☞ **No difference between previous experiment**

- Compaction::SSTable
  - ✓ Trial#2 Compaction on MemTable size&Target File Size (32MB vs 64MB)




fillrandom] Write Latency (99%)

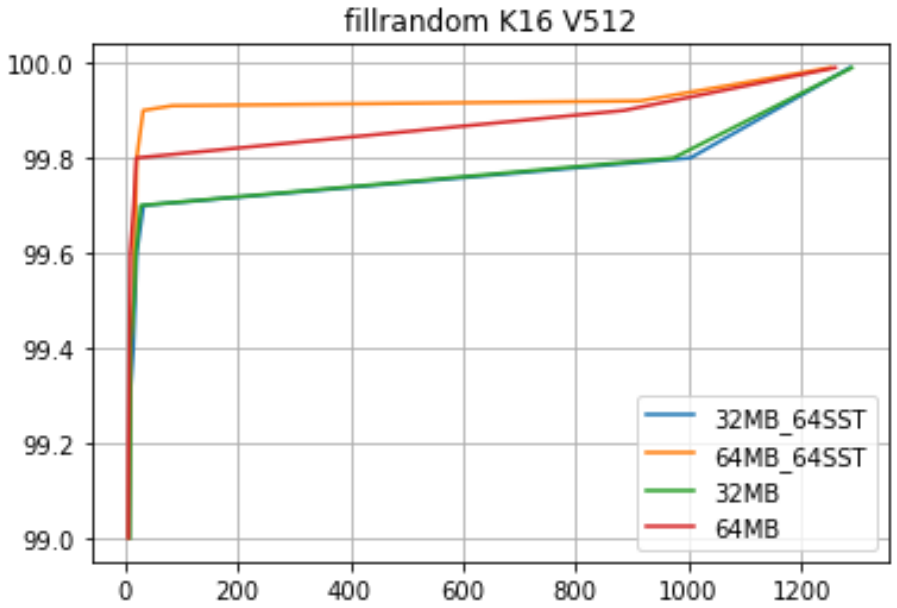



readrandom] Read Latency (99%)

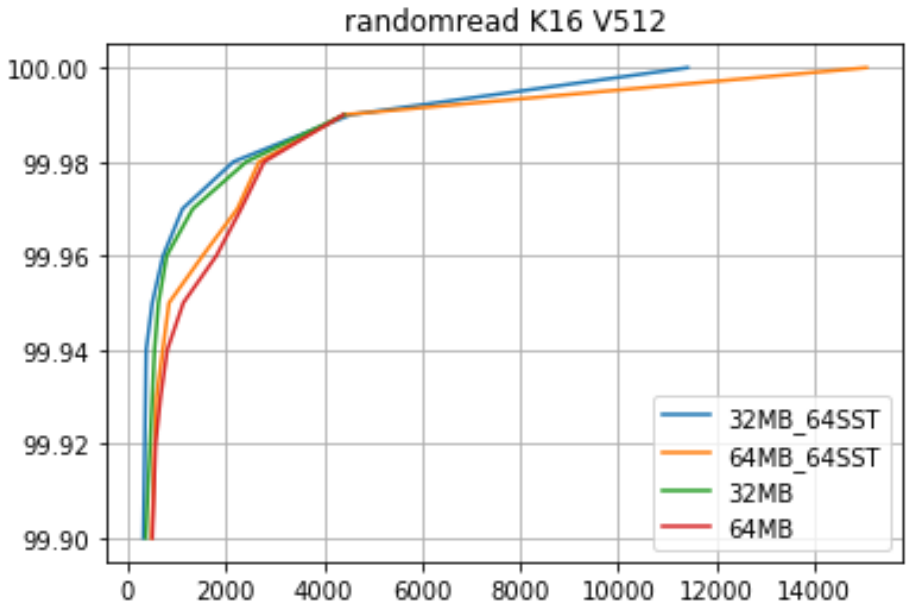
☞ No difference between previous experiment

# RocksDB Festival

- Compaction::SSTable
  - ✓ Trial#1 vs Trial#2




fillrandom] Write Latency (99%)




readrandom] Read Latency (99%)

☞ ..? 😇