RocksDB Festival

RF5_Team_Key_Value

revised opinion about key distribution (p2)

Supported by IITP, StarLab.

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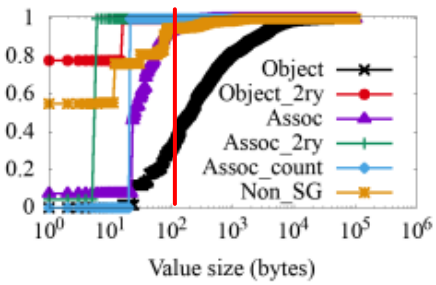
Docks

Experiments Q & A

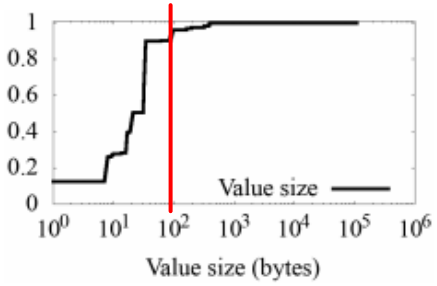
✓ Real-World key/value distribution
value over 100B/1KB is ~~not general~~ -> it depends on workload

- Facebook: [value >100B] is not general

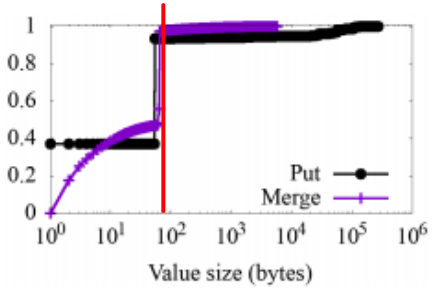
  Cao, Zhichao, et al. "Characterizing, modeling, and benchmarking rocksdb key-value workloads at facebook." *18th {USENIX} Conference on File and Storage Technologies ({FAST} 20)*. 2020.



(b) UDB value size CDF



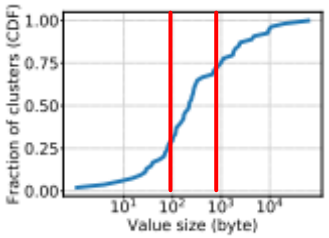
(d) ZippyDB value size CDF



(f) UP2X value size CDF

- Twitter: [value >100B] is general, Also [value > 1KB] is general

  Source: Yang, Juncheng, Yao Yue, and K. V. Rashmi. "A large scale analysis of hundreds of in-memory cache clusters at Twitter." *14th {USENIX} Symposium on Operating Systems Design and Implementation ({OSDI} 20)*. 2020.



(b) Value size

RocksDB Festival

- 1. Team
- 2. db_bench Experiment
  - ✓ 1. key_size
  - ✓ 2. value_size
  - ✓ 3. data_size
- 3. Topic: Key-value
- 4. Goals
  - ✓ 1. Latest research trends
    - Characterizing, Modeling, and Benchmarking RocksDB Key-Value Workloads at Facebook
  - ✓ 2. Research topic
  - ✓ 3. Final goal

1. Team

- Team: Docks

- Member
  - ✓ Minguk Choi 최민국 [Leader]
    - **koreachoi96@gmail.com**
    - **www.github.com/korea-choi**
  - ✓ Jungwon Lee 이정원
    - **gardenlee960828@gmail.com**
    - **www.github.com/gardenlee96**
  - ✓ Guangxun shin 좌오꾸와쉰
    - **guangxun0621@naver.com**
    - **www.github.com/GUANG32194441**

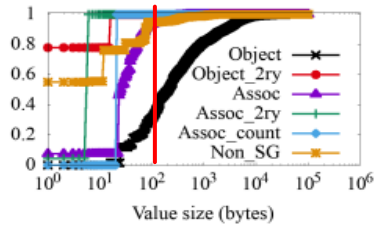
2. db_bench Experiment

- 0. Experiment subject
  - ✓ Check out read/write throughput when [key/value/data] size changes
    - Just simple experiment
    - Just to be familiar with rocksdb & db_bench

```
Initializing RocksDB Options from the specified file
Initializing RocksDB Options from command-line flags
RocksDB:    version 6.22
Date:       Sun Jul 18 16:50:59 2021
CPU:        4 * Intel(R) Core(TM) i3-2100 CPU @ 3.10GHz
CPUCache:   3072 KB
Keys:       16 bytes each (+ 0 bytes user-defined timestamp)
Values:     100 bytes each (50 bytes after compression)
Entries:    10000000
Prefix:    0 bytes
Keys per prefix:    0
RawSize:    1106.3 MB (estimated)
FileSize:   629.4 MB (estimated)
Write rate: 0 bytes/second
Read rate: 0 ops/second
Compression: Snappy
Compression sampling rate: 0
Memtablerep: skip_list
Perf Level: 1
WARNING: Assertions are enabled; benchmarks unnecessarily slow
```

2. db_bench Experiment

- 1. Value_size
  - ✓ Workload
    - Key_size = 16 Byte / Data_number = 10,000,000
    - Value_size = 100/200/400Byte



(b) UDB value size CDF

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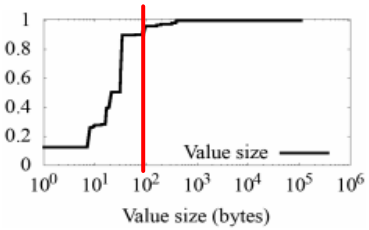
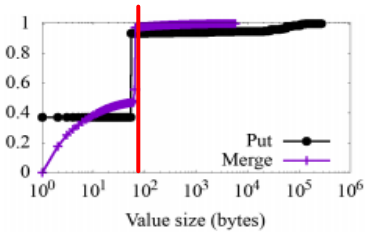
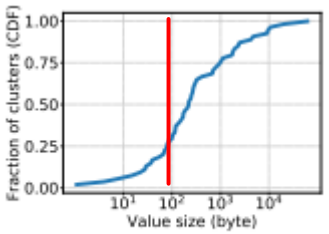


(d) ZippyDB value size CDF

·al



(f) UP2X value size CDF



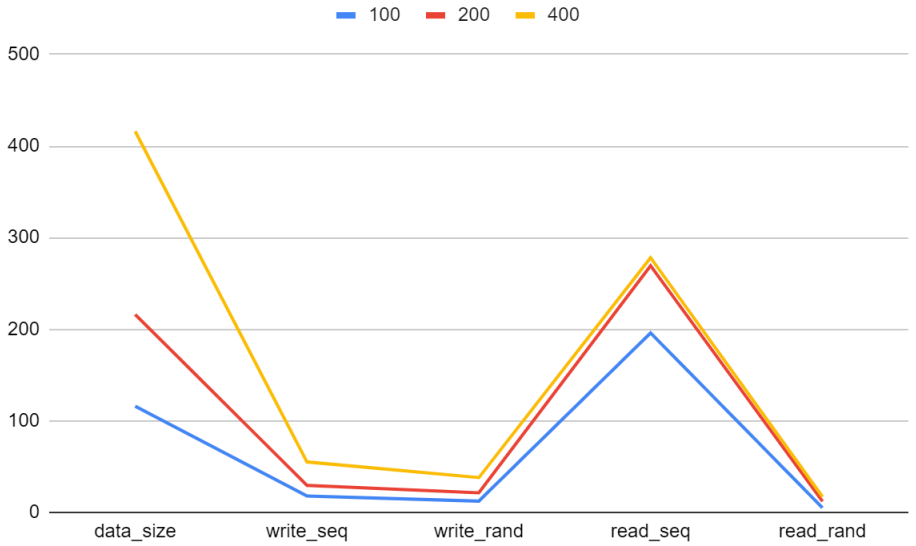
(b) Value size

2. db_bench Experiment

- 1. Value_size
  - ✓ Workload
    - Key_size = 16 Byte / Data_number = 10,000,000
    - Value_size = 100/200/400Byte
    - write_seq / write_rand / read_seq / read_rand

value_size (B)	data_size	write_seq	write_rand	read_seq	read_rand
100	116	17.8	12.3	195.9	5
200	216	29.4	21.3	269.2	12.1
400	416	55	38	278	17

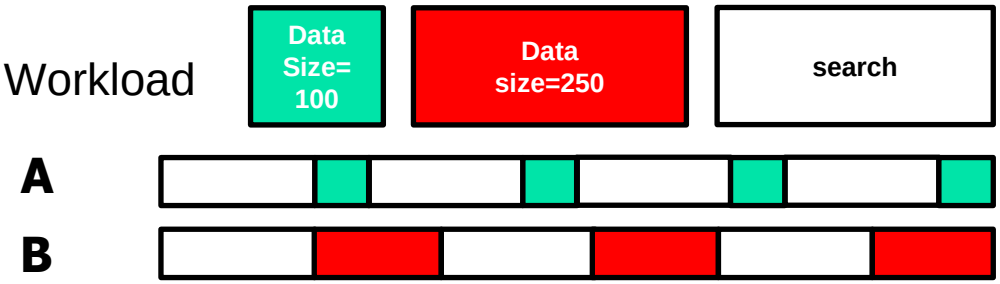
Ratio (/K16-V100)	data_size	write_seq	write_rand	read_seq	read_rand
K16-V100	1.00	1.00	1.00	1.00	1.00
K16-V200	1.86	1.65	1.73	1.37	2.42
K16-V400	3.59	3.09	3.09	1.42	3.40



  - ✓ value size ∝ throughput
    - the bigger value size, the better performance? Maybe Not.
    - More flush/compactions, longer total execution time

2. db_bench Experiment

- 1. Value_size
  - ✓ the bigger value size, the better performance? Maybe Not.
  - ✓ Why?
    - Throughput is rate of transferring data
  - ✓ EX.
    - Workload



    - Throughput = $\frac{read\_data}{time}$ -> Ta < Tb

      -> B's performance is better than A?

  - ✓ Data size ∝ throughput
  - ✓ If data size is different, how about comparing performance with…
    - Compaction number
    - Total execution time

2. db_bench Experiment

- 1. Value_size
  - ✓ Ratio
    - Ratio = [K16, V100/200/400] value / [K16, V100] value

value_size (B)	data_size	write_seq	write_rand	read_seq	read_rand
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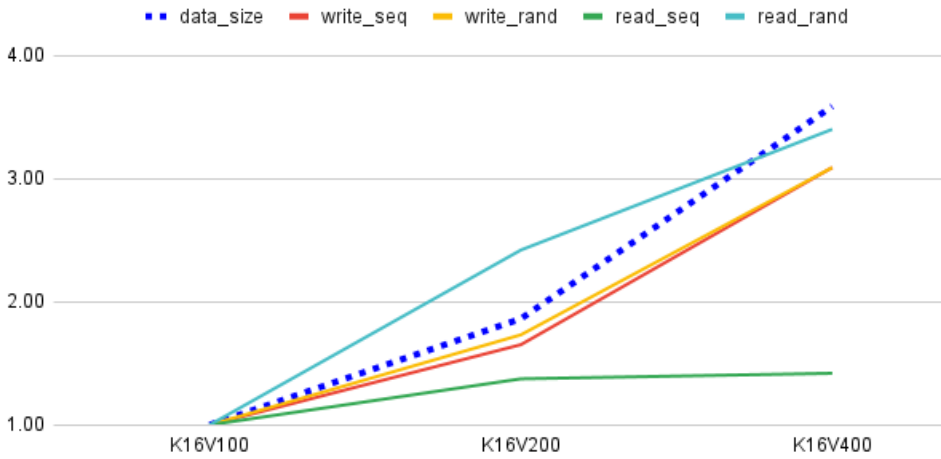


Ratio = [K16, V100/200/400] value / [K16, V100] value

- ✓ data size ∝ throughput
- ✓ if data size is different,
  - maybe throughput would not be the appropriate metrics.

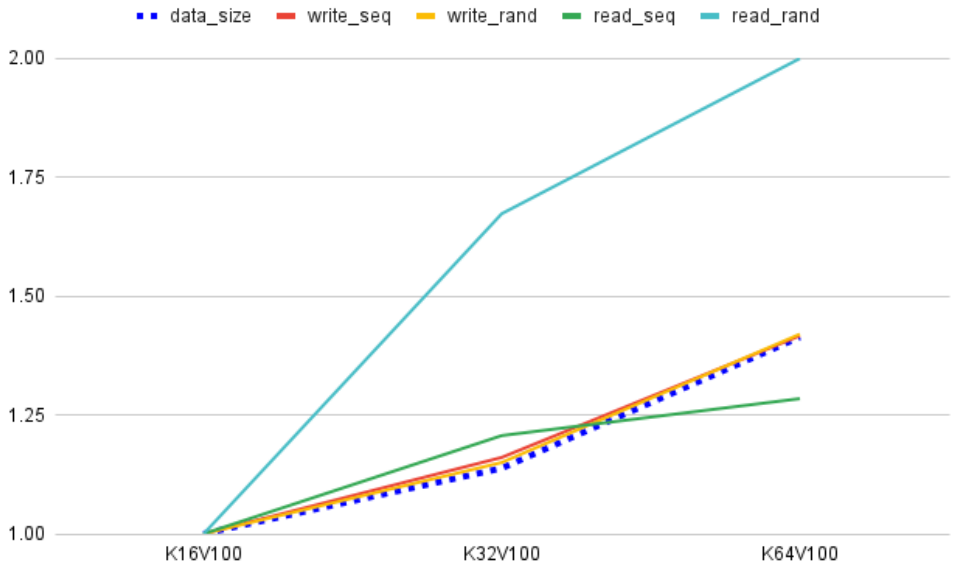
2. db_bench Experiment

- 2. Key_size
  - ✓ Workload
    - Key_size = 16/32/64 Byte
    - Value_size = 100 Byte / Data_number = 10,000,000
    - write_seq/write_rand/read_seq/read_rand
  - ✓ The bigger the key size, the bigger overhead

    -> But data size is much more critical

value_size	data_size	write_seq	write_rand	read_seq	read_rand
16 B	116	16.8	11.8	193.1	4.9
32 B	132	19.5	13.7	233	8.2
64 B	164	23.8	16.7	248	9.8

Ratio (/K16-V100)	data_size	write_seq	write_rand	read_seq	read_rand
K16-V100	1.00	1.00	1	1.00	1.00
K32-V100	1.14	1.16	1.15	1.21	1.67
K64-V100	1.41	1.42	1.42	1.28	2.00



Ratio = [K16/32/64, V100] value / [K16, V100] value

2. db_bench Experiment

- 3. Data_size
  - ✓ Workload
    - Key_size = 16/32/64 Byte / Value_size = 100/200/400 Byte
    - Data_number = 10,000,000
    - write_seq/write_rand/read_seq/read_rand

data_size (B)	write_seq	write_rand	read_seq	read_rand
116	17.8	12.3	195.9	5
132	19.5	13.7	233	8.2
164	23.8	16.7	248	9.8
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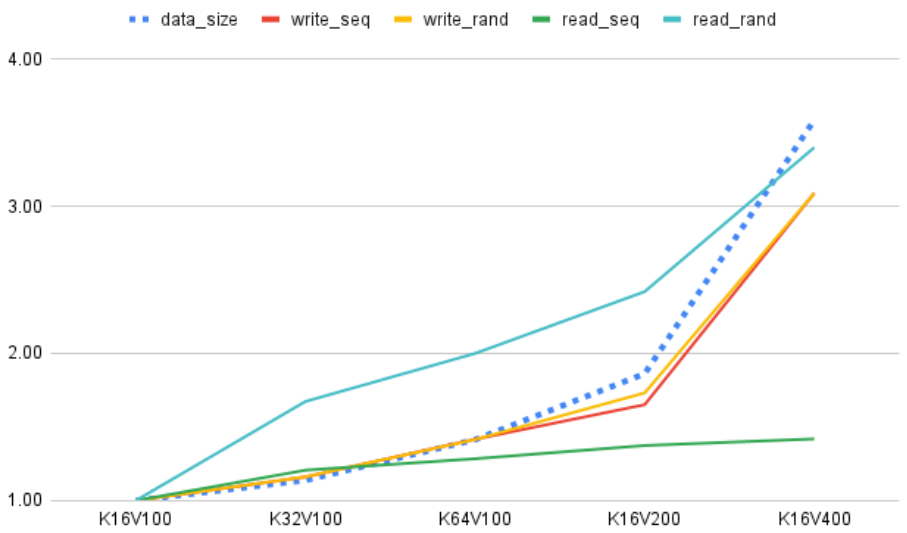


Ratio = [K16/32/64, V100/200/400] value / [K16, V100] value

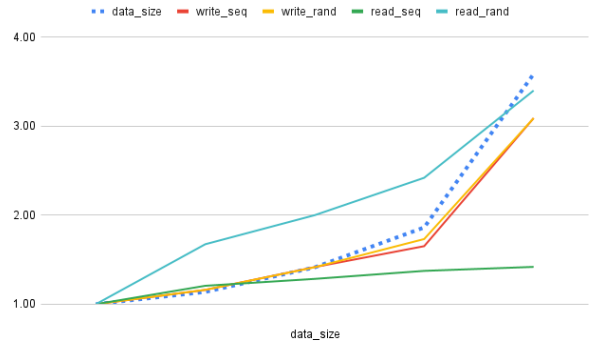
- ✓ Why read_ratio is not directly proportional?

2. db_bench Experiments

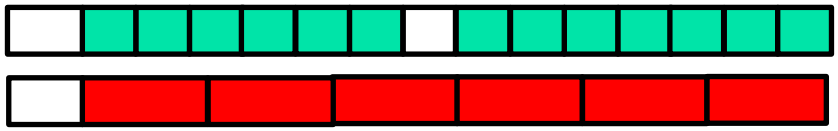
- 4. Why read_ratio is not directly proportional

✓ **Workload**

✓ **Throughput** = $\frac{read\_data}{time}$

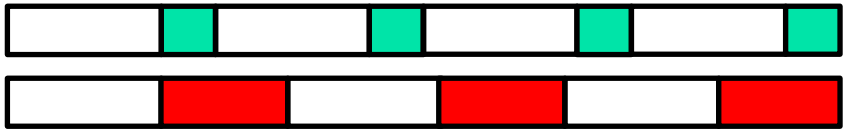


✓ **read_sequential: iterator**



```
void ReadSequential(ThreadState* thread, DB* db) {
Iterator* iter = db->NewIterator(options);
int64_t i = 0;
int64_t bytes = 0;
for (iter->SeekToFirst(); i < reads_ && iter->Valid(); iter->Next()) {
  bytes += iter->key().size() + iter->value().size();
  thread->stats.FinishedOps(nullptr, db, 1, kRead);
  ++i;
```

✓ **read_random: Get**



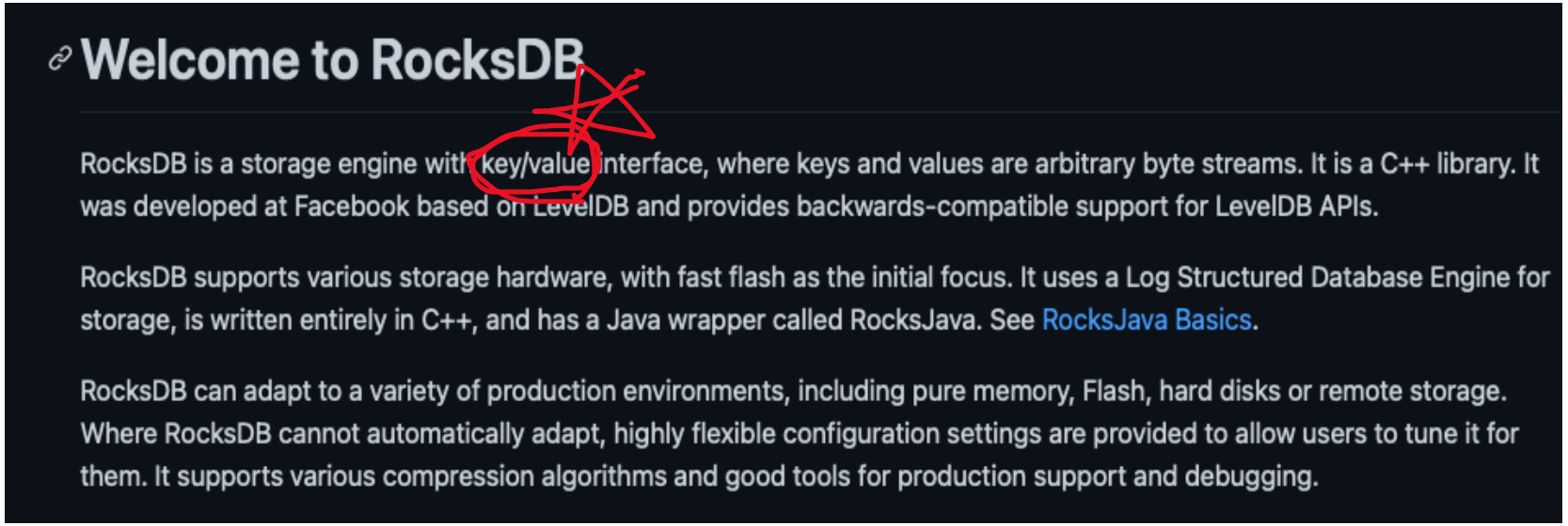
```
void ReadRandom(ThreadState* thread) {
if (FLAGS_num_column_families > 1) {
  s = db_with_cfh->db->Get(options, db_with_cfh->GetCfh(key_rand), key,
                           &pinnable_val, ts_ptr);
} else {
  s = db_with_cfh->db->Get(options,
                           db_with_cfh->db->DefaultColumnFamily(), key,
                           &pinnable_val, ts_ptr);
}
```

2. db_bench Experiments

- 5. Summary
  - ✓ data size ∝ throughput
    - the higher throughput, the better performance? Maybe Not.
  - ✓ if data size is different,
    - throughput would may not be the appropriate metrics.
    - compare with Compaction number/Total execution time
  - ✓ Why read_ratio is not directly proportional?
    - read_sequential: Iterator
    - read_random: Get

3. Topic: Key/Value

- RocksDB is Key/Value DB



4. Goal

- 1. Latest research trends: Key Trace

Characterizing, Modeling, and Benchmarking RocksDB Key-Value Workloads at Facebook

Zhichao Cao, *University of Minnesota, Twin Cities, and Facebook;*
Siying Dong and Sagar Vemuri, *Facebook;*
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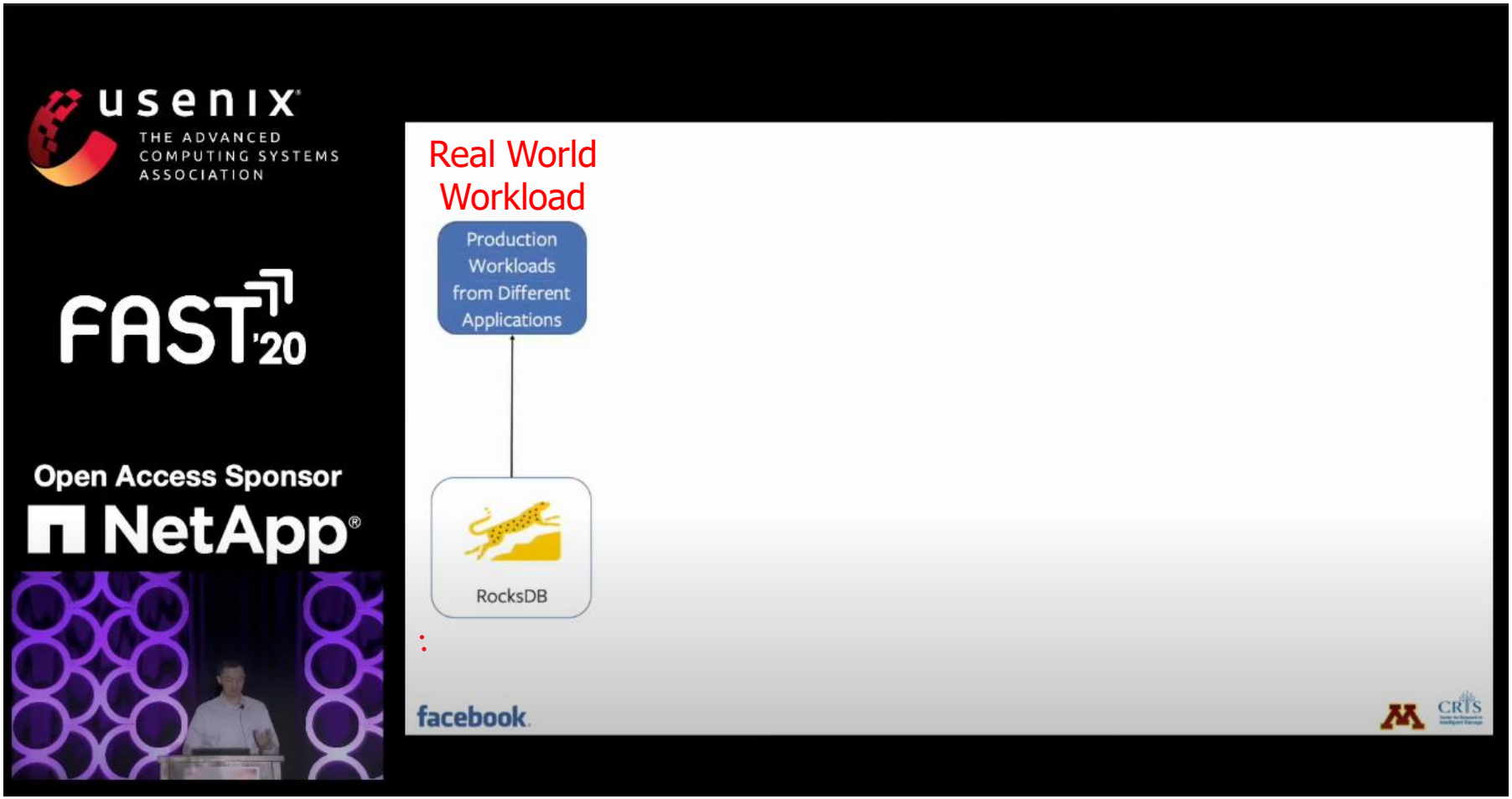
https://www.usenix.org/conference/fast20/presentation/cao-zhichao



Source: FAST '20 - Characterizing, Modeling, and Benchmarking RocksDB Key-Value Workloads at Facebook (https://youtu.be/MZTSjBERXVc)

4. Goal

- 1. Latest research trends: Key Trace

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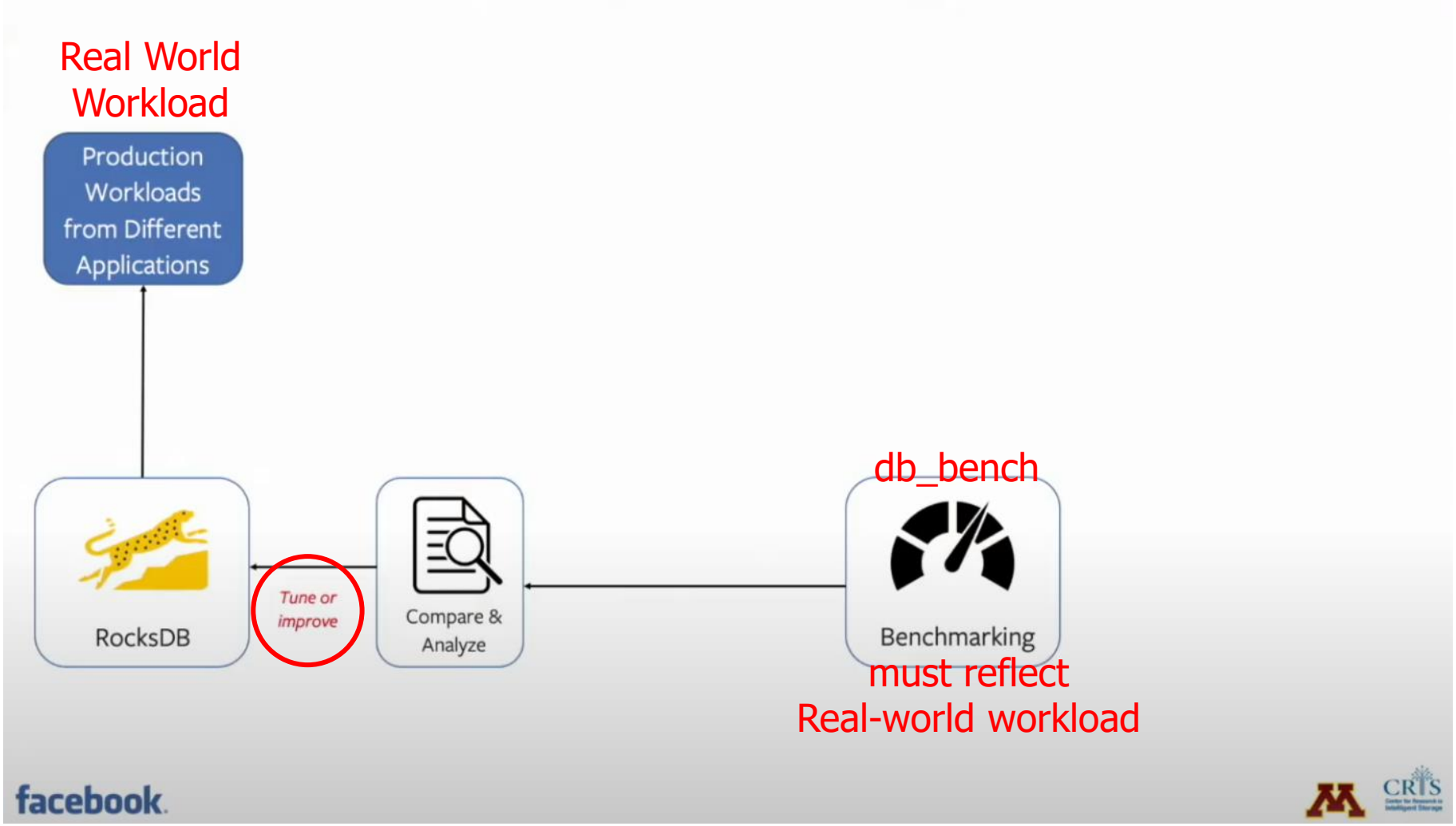

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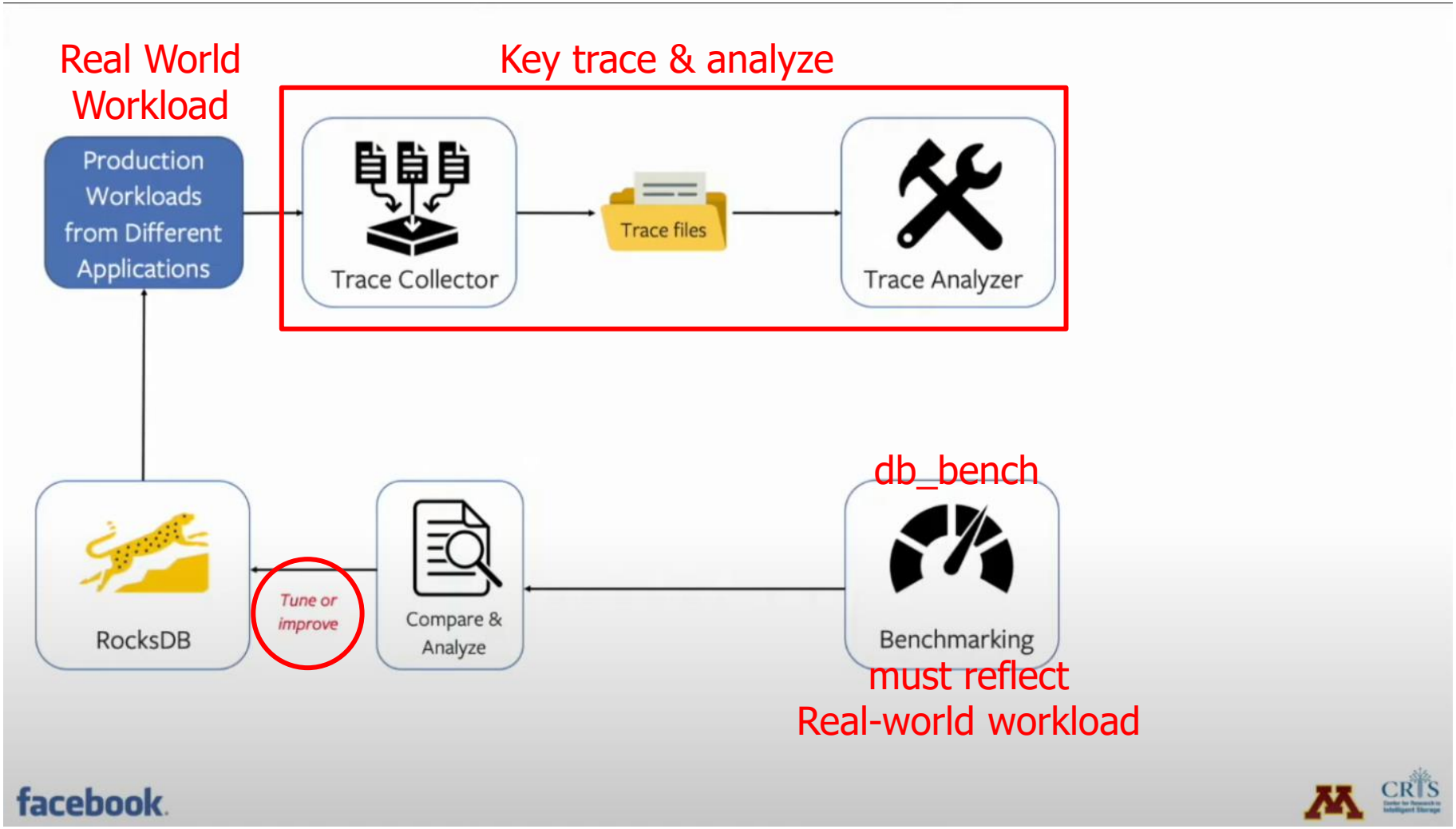

4. Goal

- 1. Latest research trends: Key Trace

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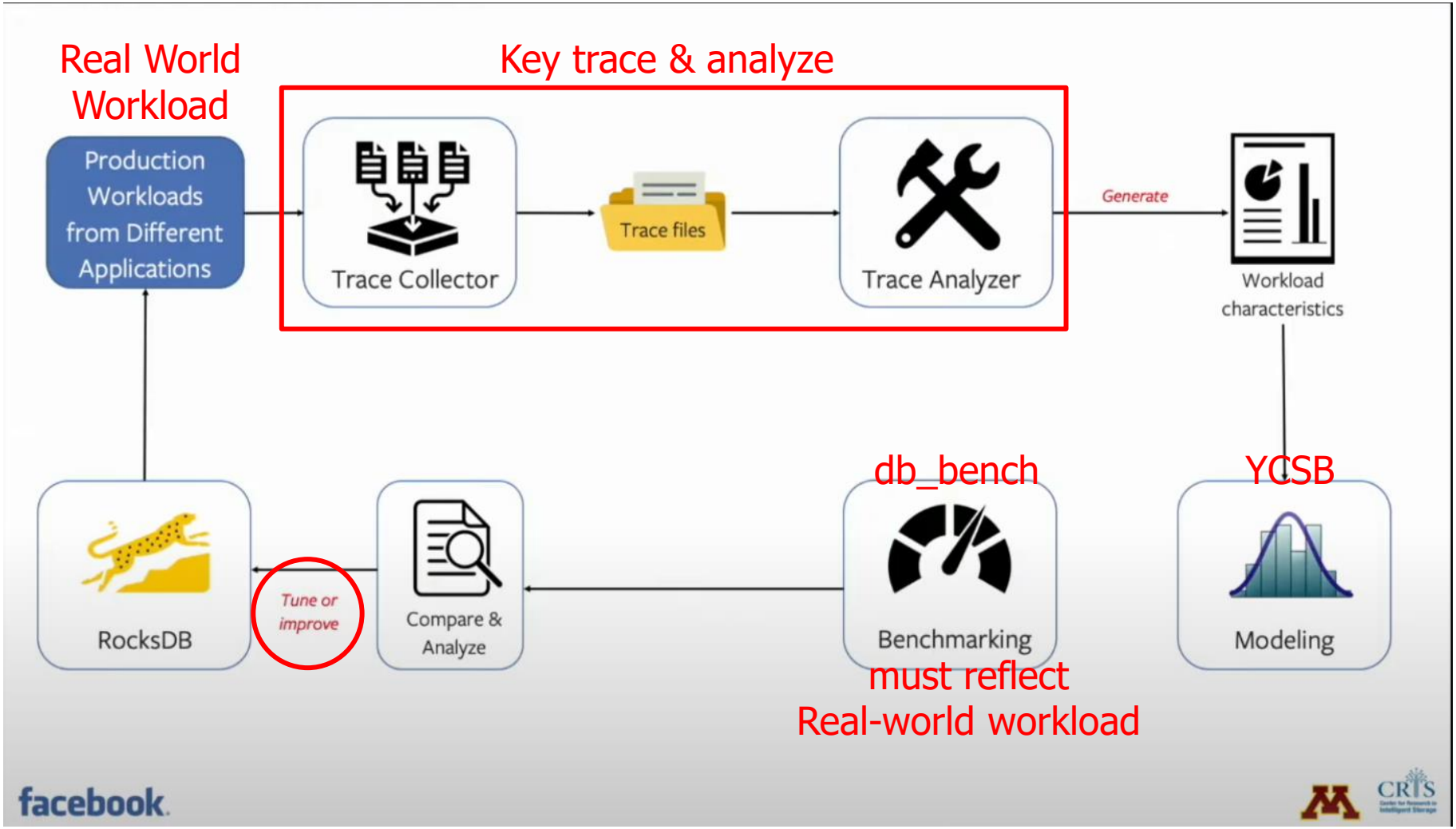
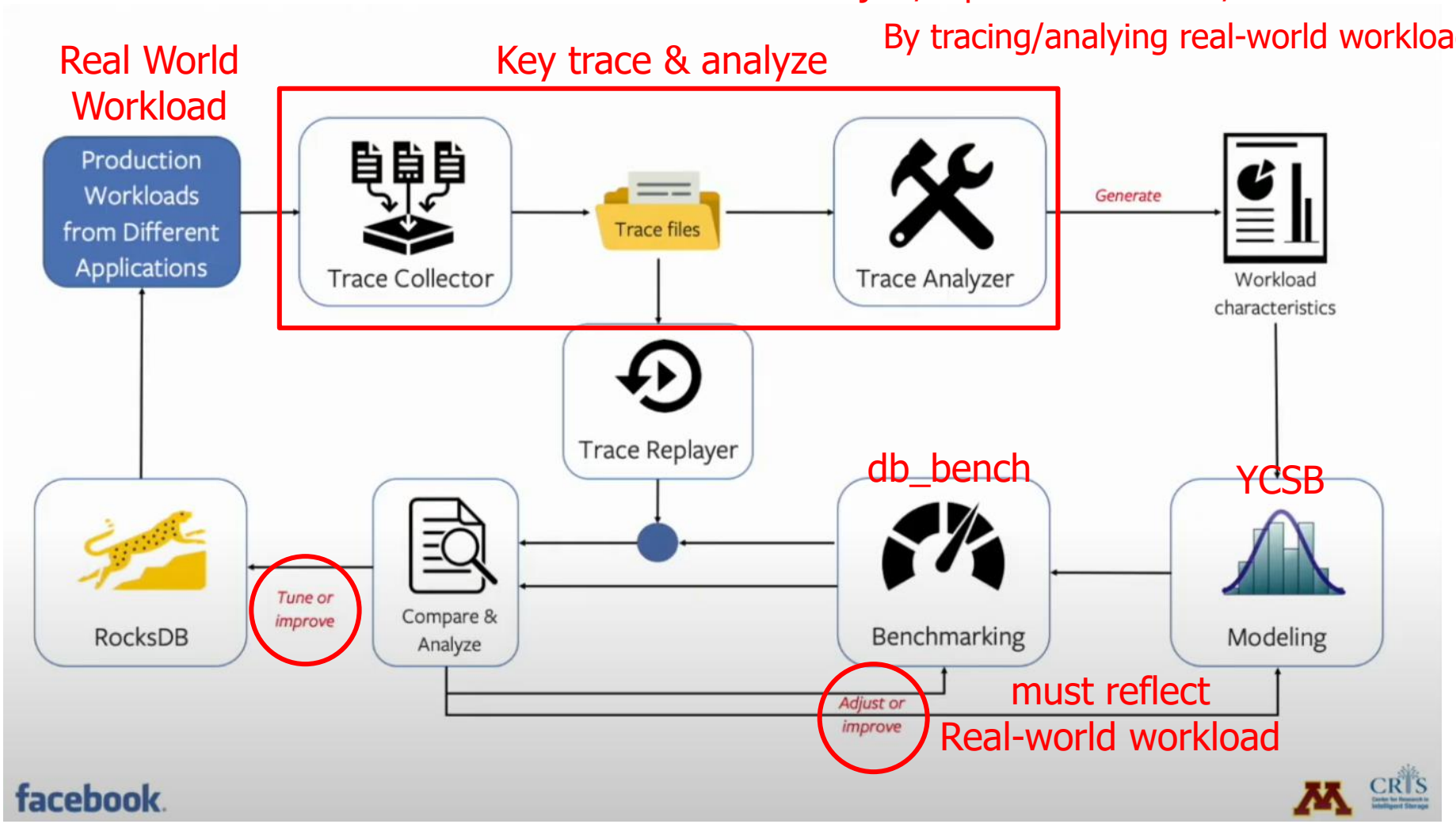


4. Goal

- 1. Latest research trends: Key Trace

For RocksDB in real-world
Adjust/improve benchmark/virtual workload
By tracing/analying real-world workload



4. Goal

- 2. Research topic: One(Two) step forward
  - ✓ Analyze new real-world workload
    - Getting new real-world workload is much harder than analyzing it
  - ✓ Analyze existing virtual workload
    - It's already analyzed (maybe)
  - ✓ Generate/Adjust virtual workload
    - Based on open-source real-world workload
  - ✓ Adjust/Improve rocksdb/db_bench
    - Based on open-source real-world workload
  - ✓ Other open issues/questions
- 3. Final Goal: KSC 2021 submission

Q & A