AliSQL Plan Cache

阿里云数据库内核组

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2016年加入阿里云，担任数据库内核组高级专家职位

2013年任职于ORACLE MySQL optimizer team担任Principle工程师职位

2012年任职性能分析工程师

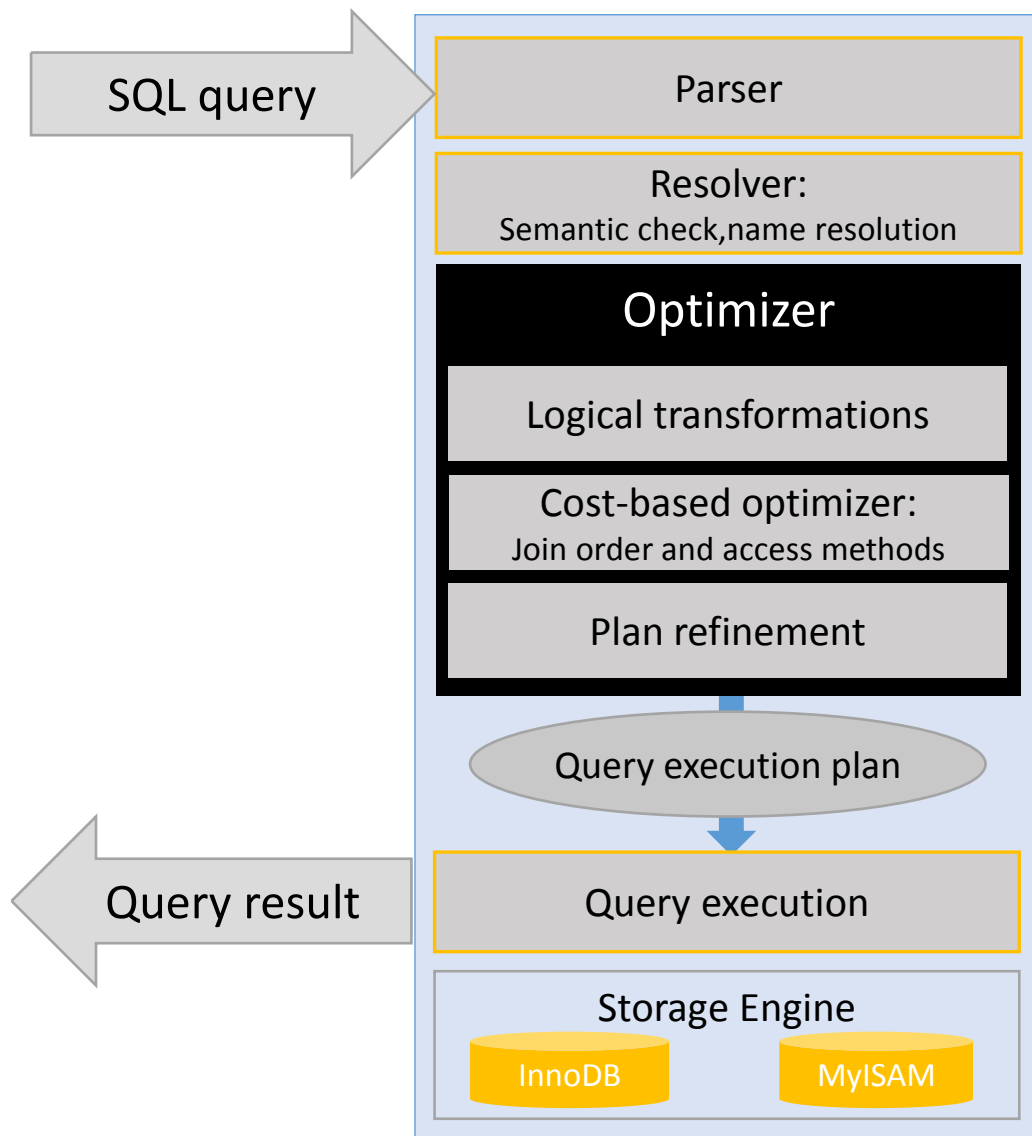2009年任职人大金仓数据库高级研发工程师

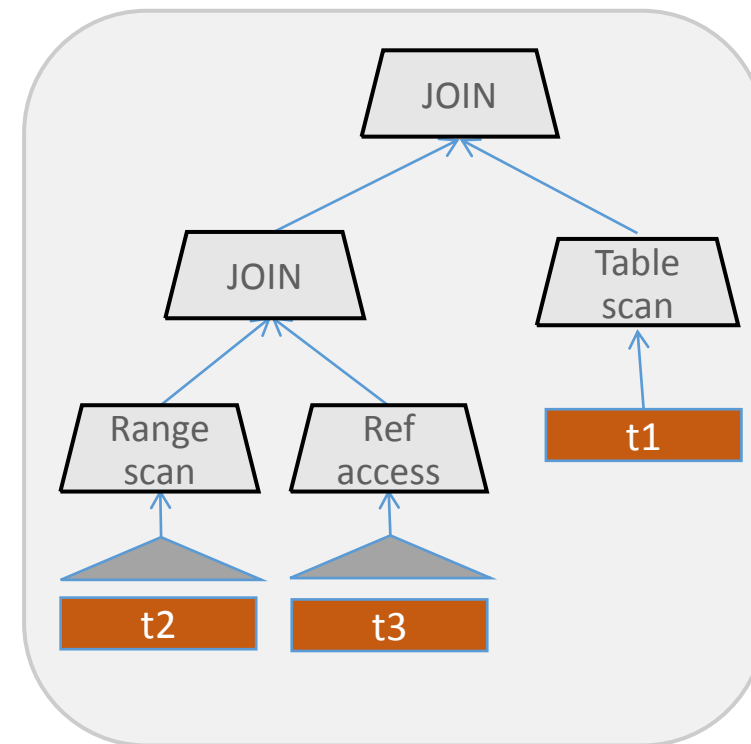# 目 录

SQL query →

Parser
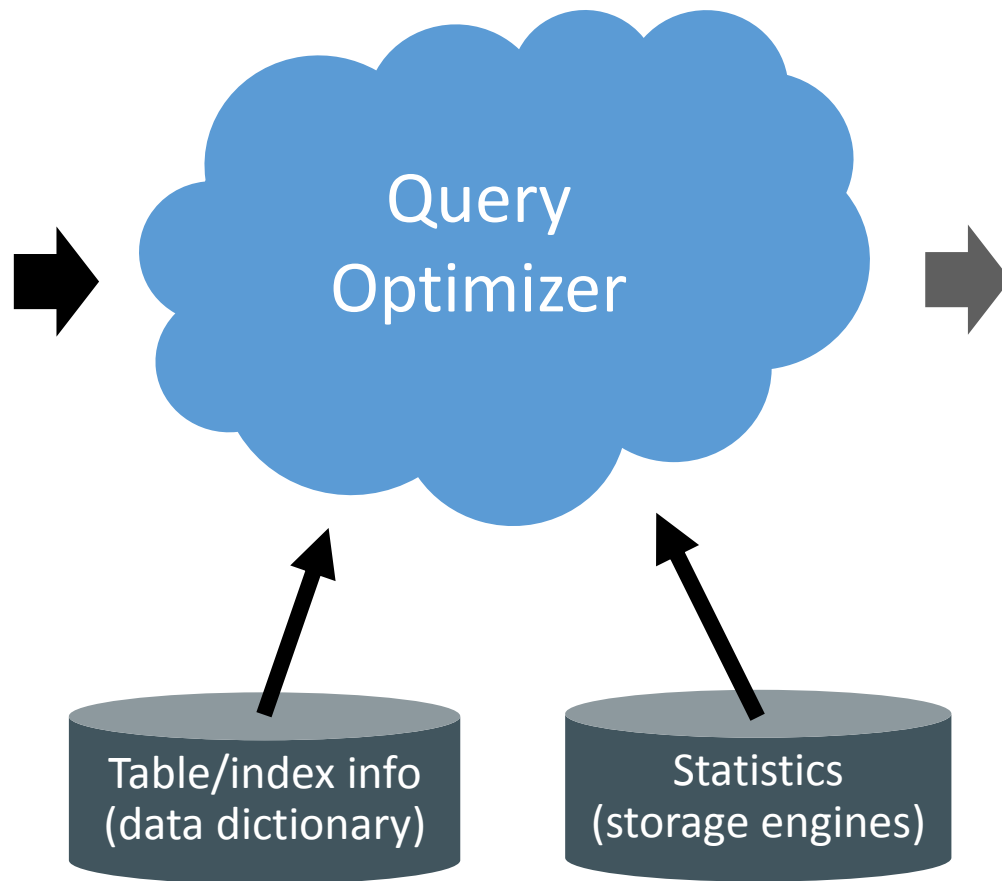
Resolver:
Semantic check,name resolution

Optimizer

Logical transformations

Cost-based optimizer:
Join order and access methods

Plan refinement

Query execution plan

← Query result

Query execution

Storage Engine

InnoDB   MyISAM

SELECT a, b
FROM t1, t2, t3
WHERE t1.a = t2.b
    AND t2.b = t3.c
    AND t2.d > 20
    AND t2.d < 30;

Query Optimizer

Table/index info
(data dictionary)

Statistics
(storage engines)

JOIN

JOIN

Table scan

Range scan

Ref access

t1

t2

t3

Query Plan

The best execution path which is chosen by optimizer.

The structure which can be execute by MySQL server.
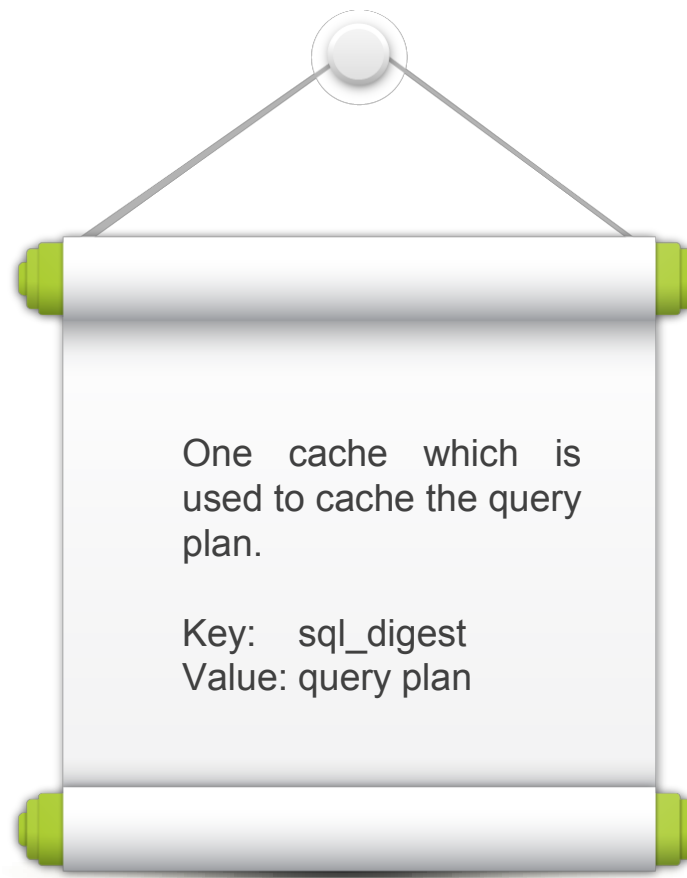
Plan Cache

One cache which is used to cache the query plan.

Key: sql_digest
Value: query plan
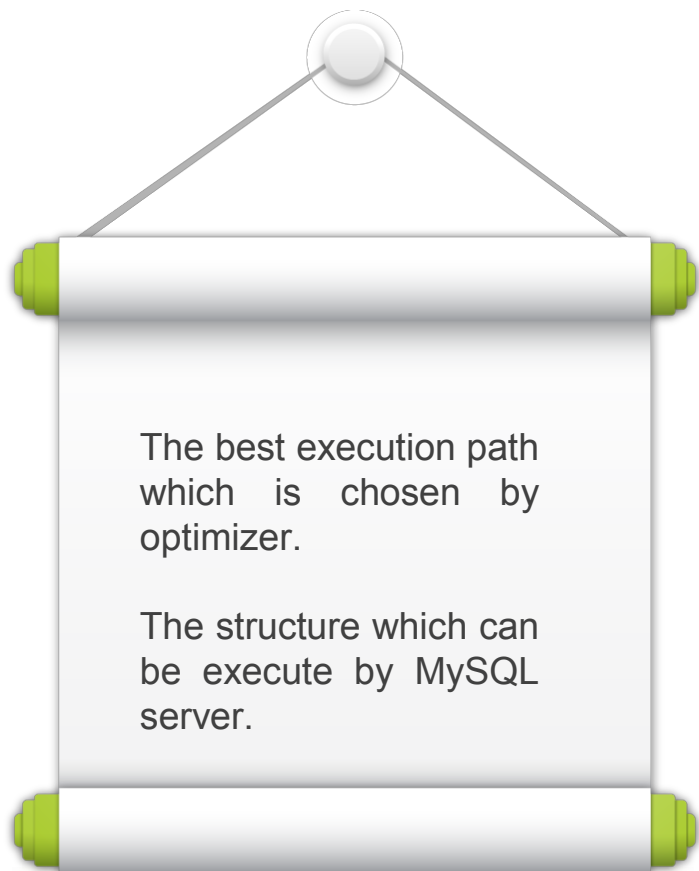
- SELECT * FROM t1 WHERE a > 1;

- select * from t1 where a > 1;

- SELECT * FROM /* comments */ t1 where a > 1;

- select * from t1 where a > 3
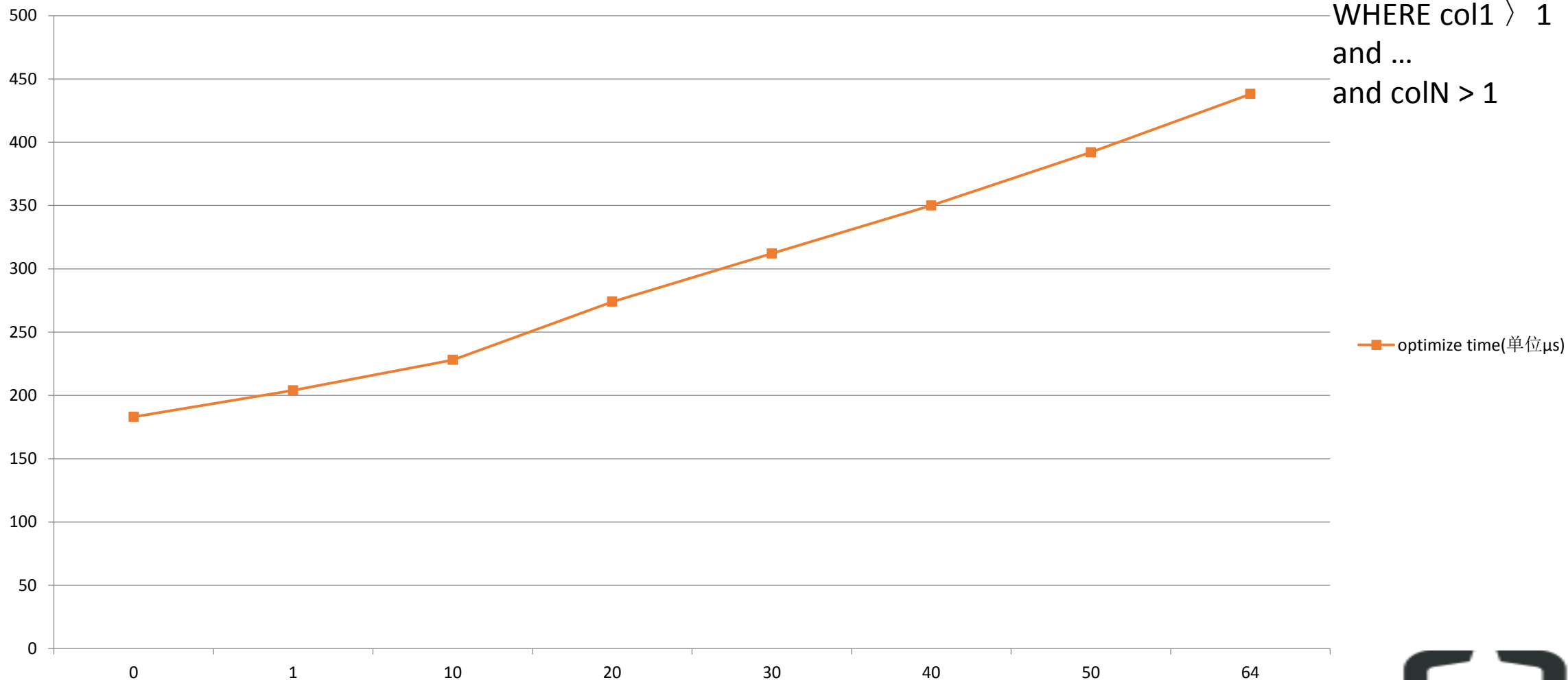
SELECT * FROM `t1` WHERE `a` > ?

- 传统数据库都标配的特性，ORACLE，DB2， SQL SERVER等

- 频繁执行某些查询语句

- 并发量大，CPU成为瓶颈

- 优化器在生成Plan的时候会消耗较长的时间

- 协助用户固化Query Plan

- 实现"真正的"Prepared statement

optimize time(单位μs)

SELECT * FROM t
WHERE col1 〉 1
and ...
and colN > 1
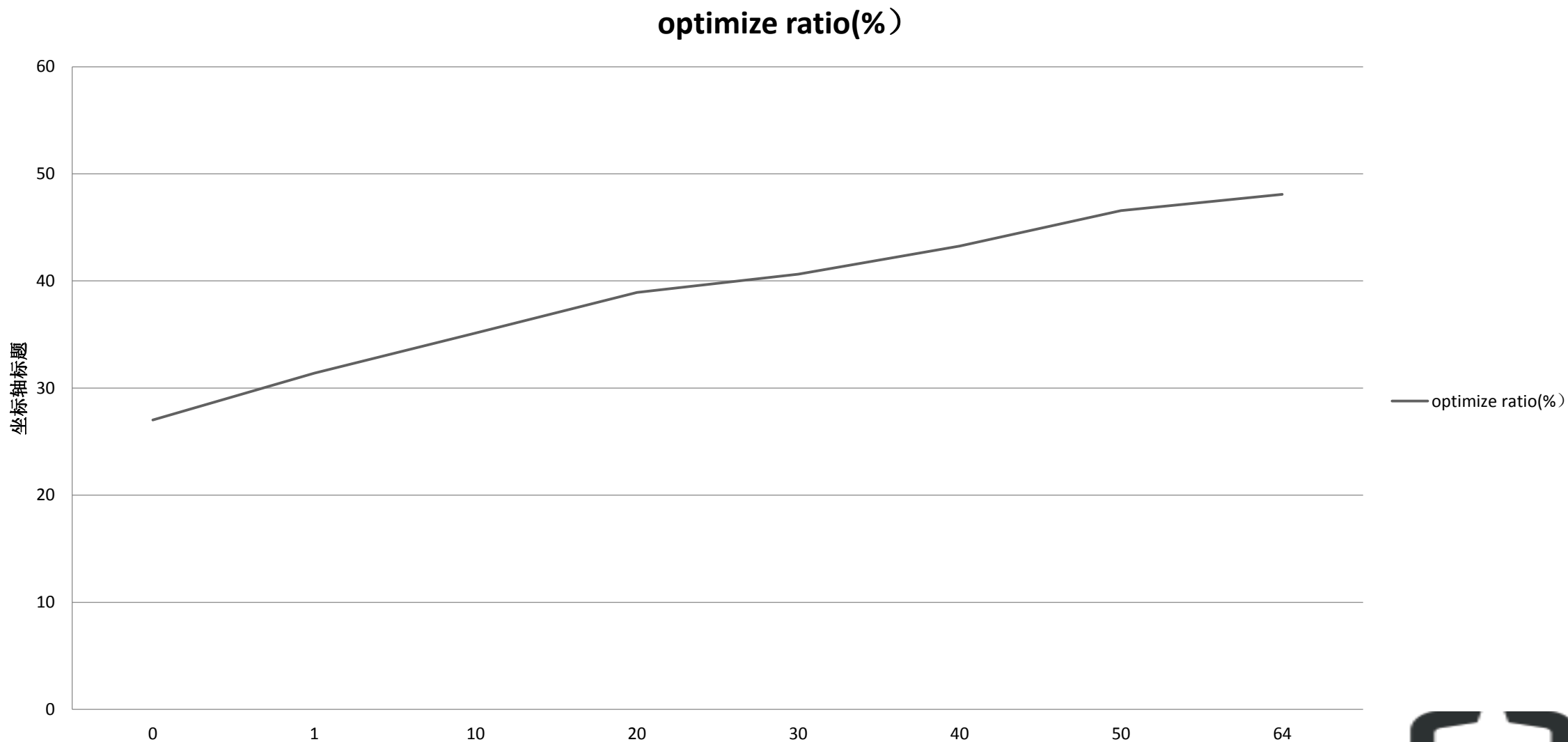
optimize time(单位μs)

SELECT * FROM t1 .. tN
WHERE t1.col1 = tN.col1
and ...
and t1.colN = tN.colN
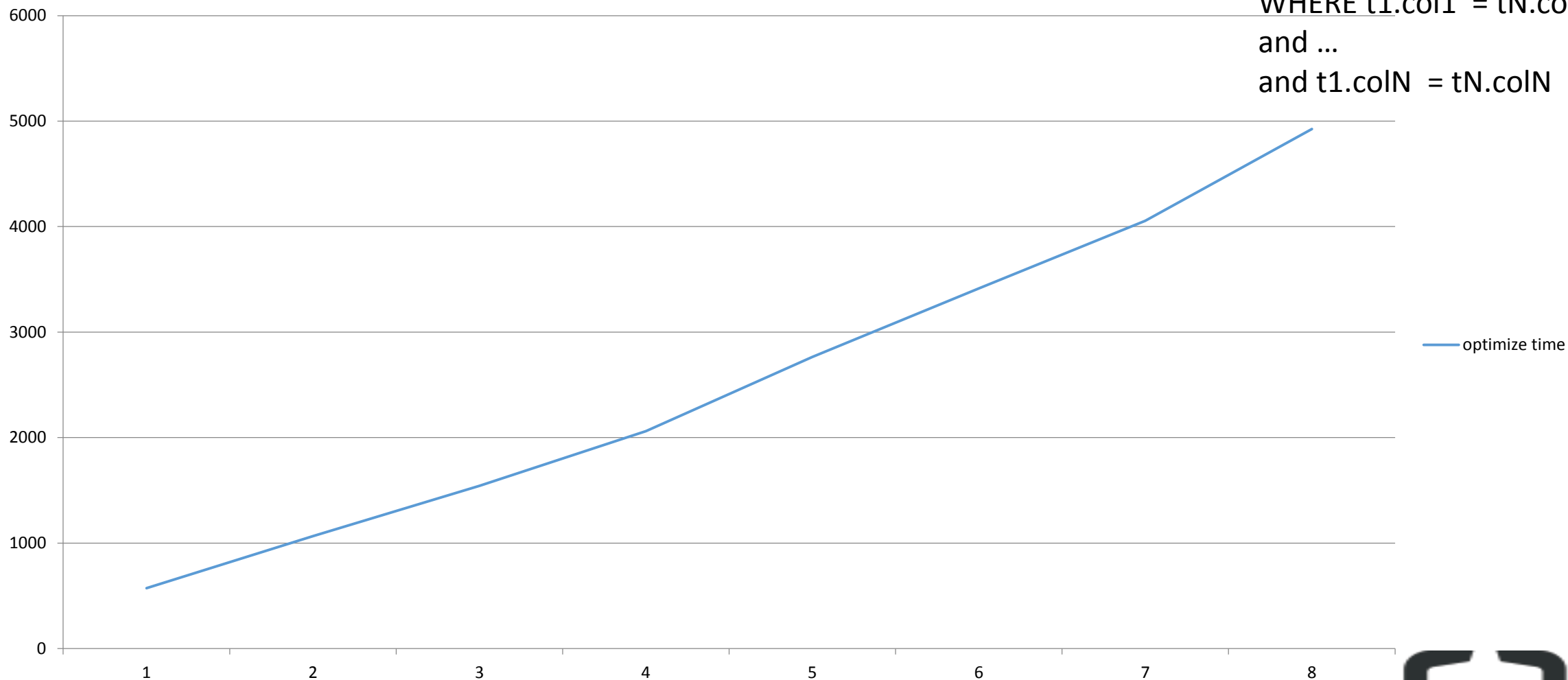
optimize time

optimize ratio(%)

SQL query

Parser

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Query result

Query execution

Storage Engine

InnoDB

MyISAM

Alibaba Cloud
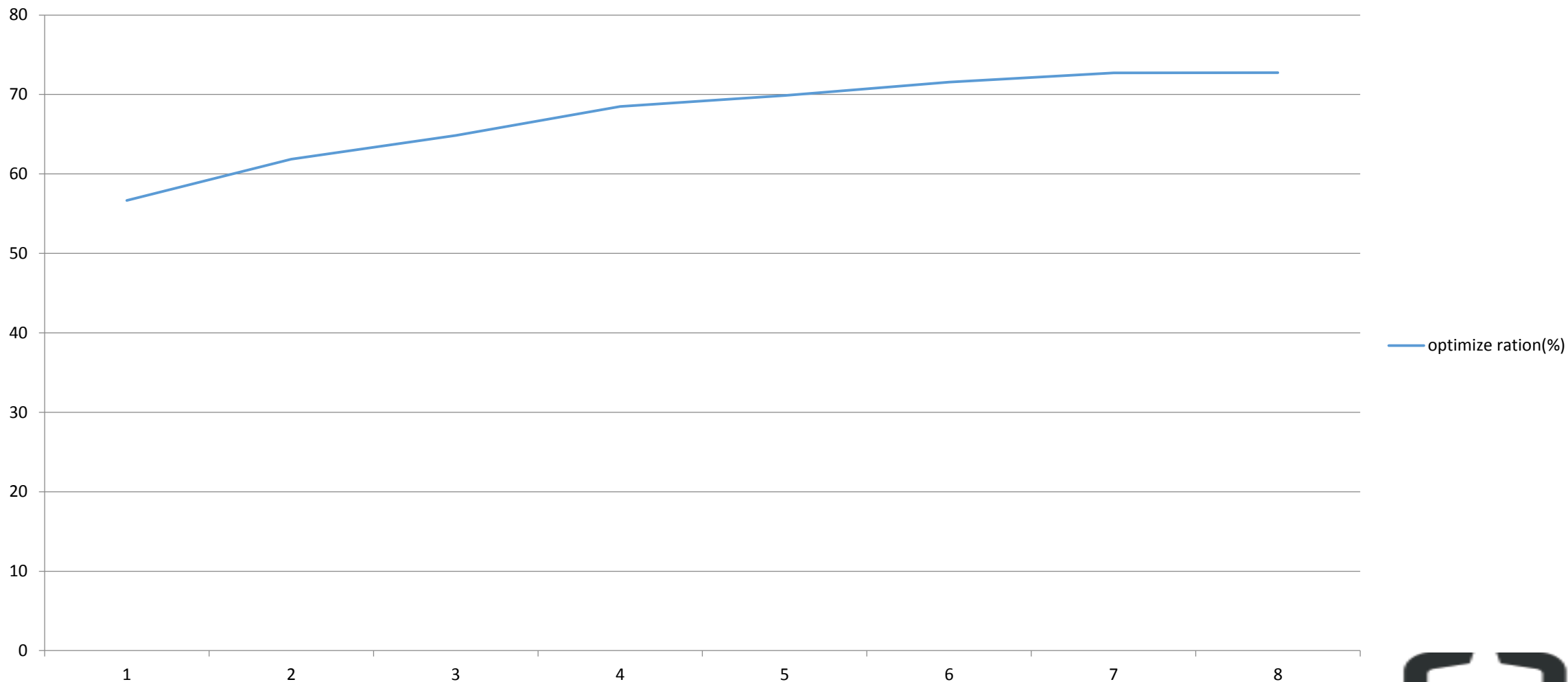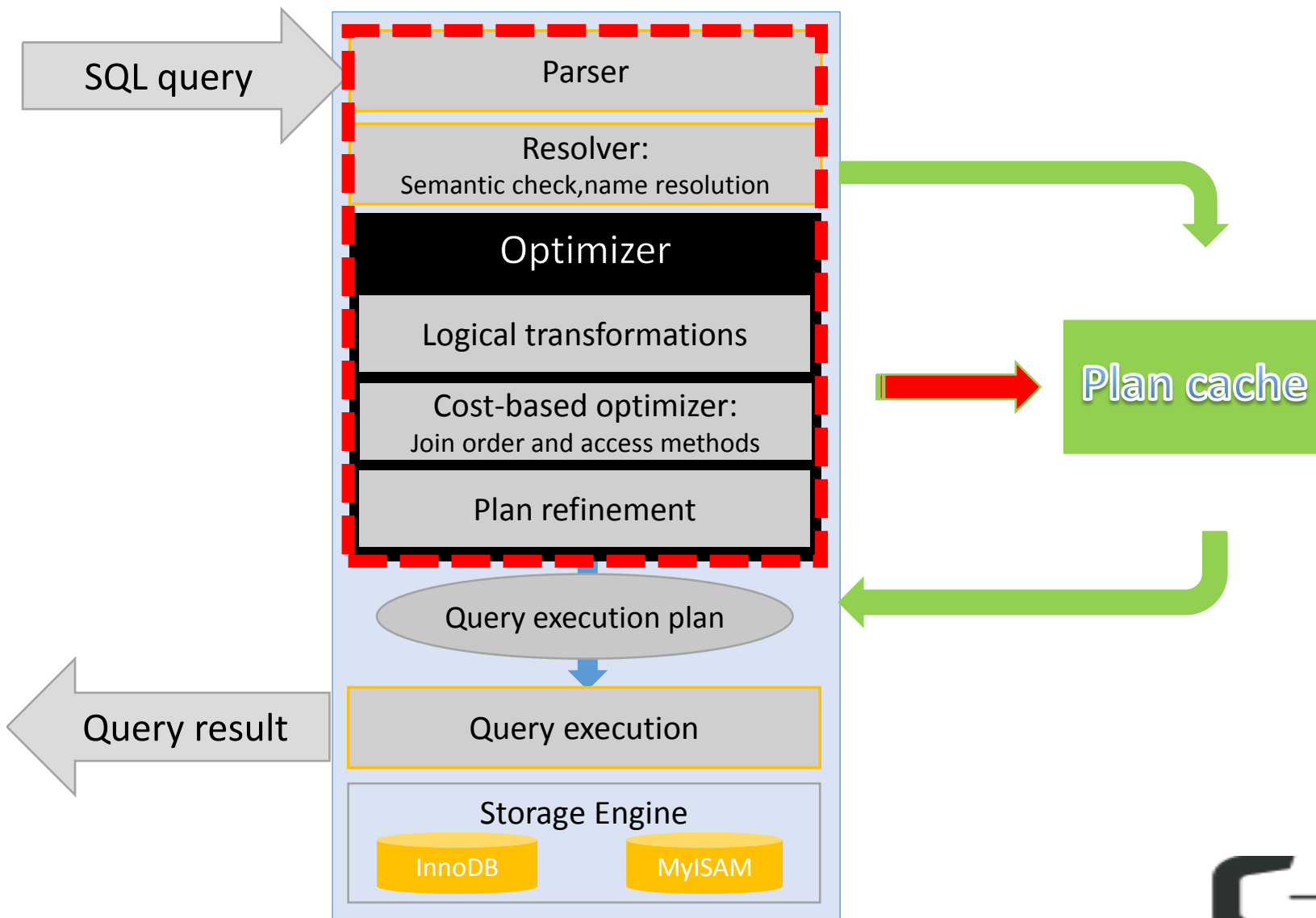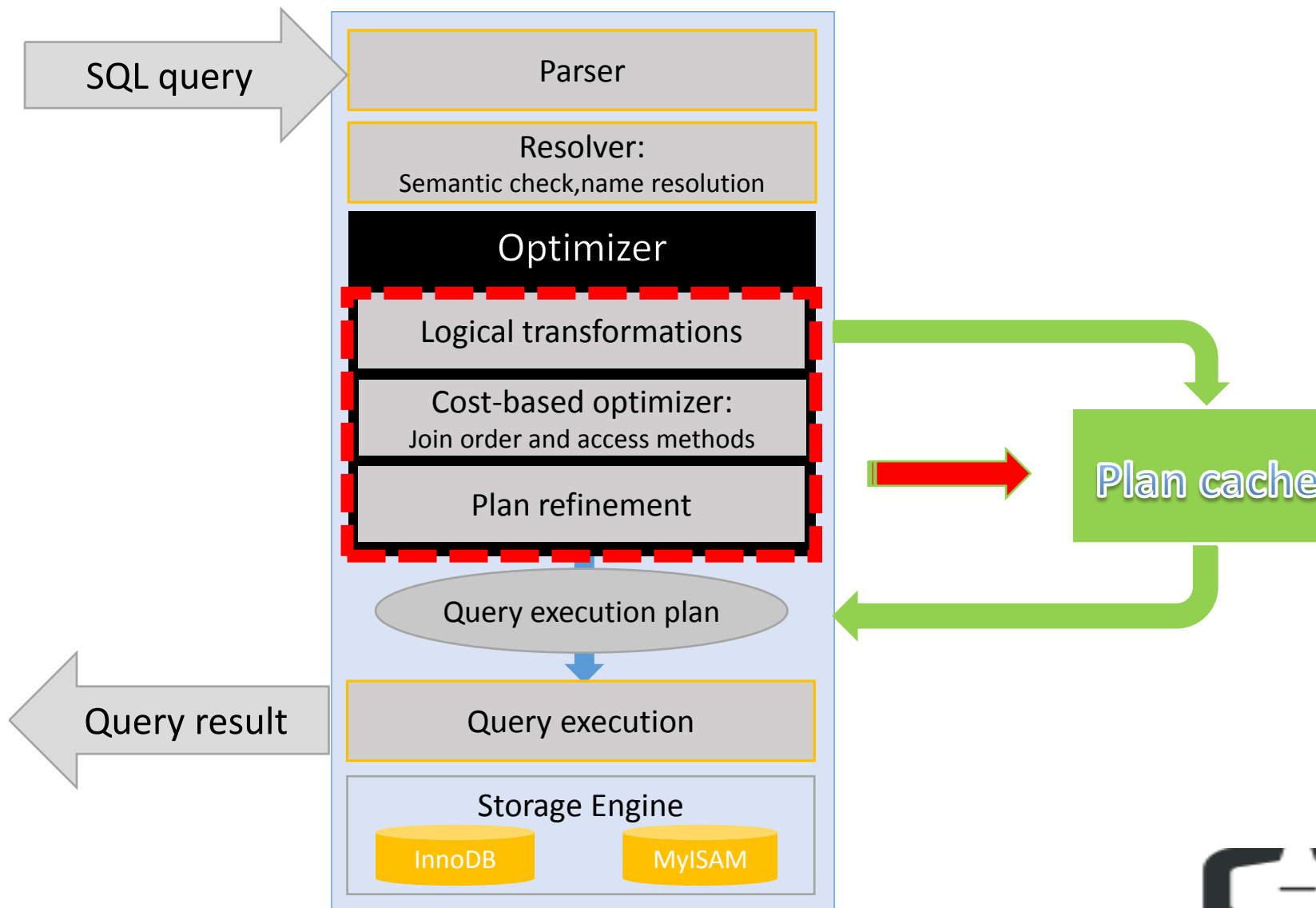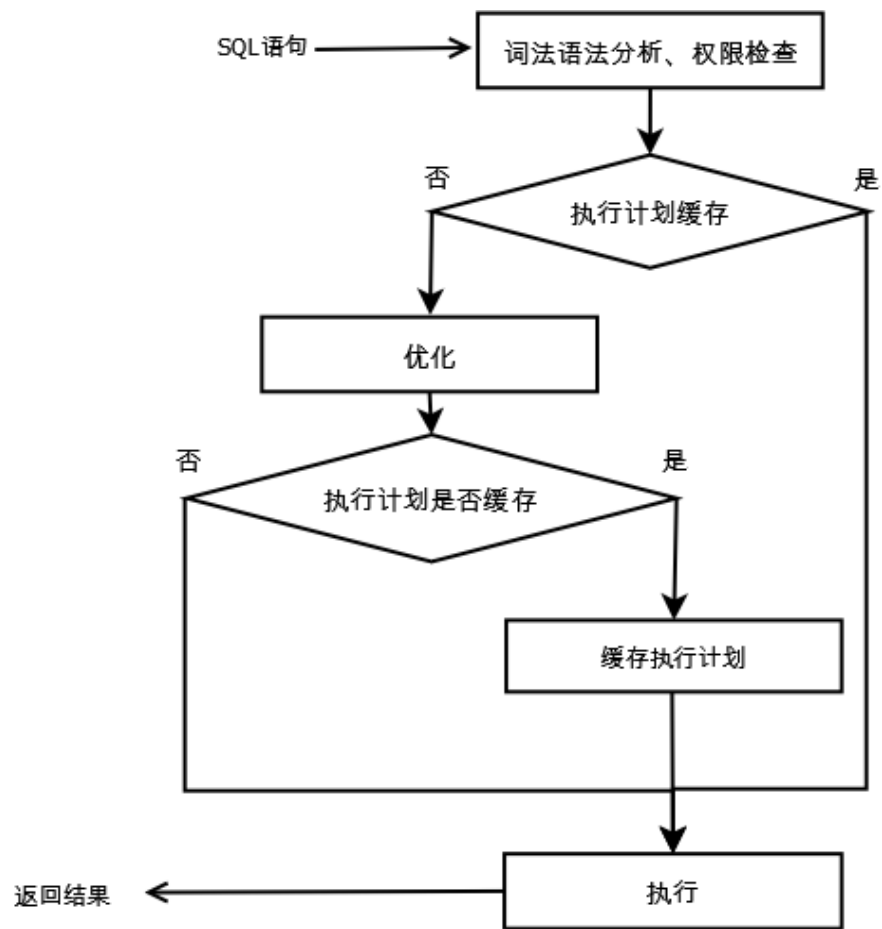
图1
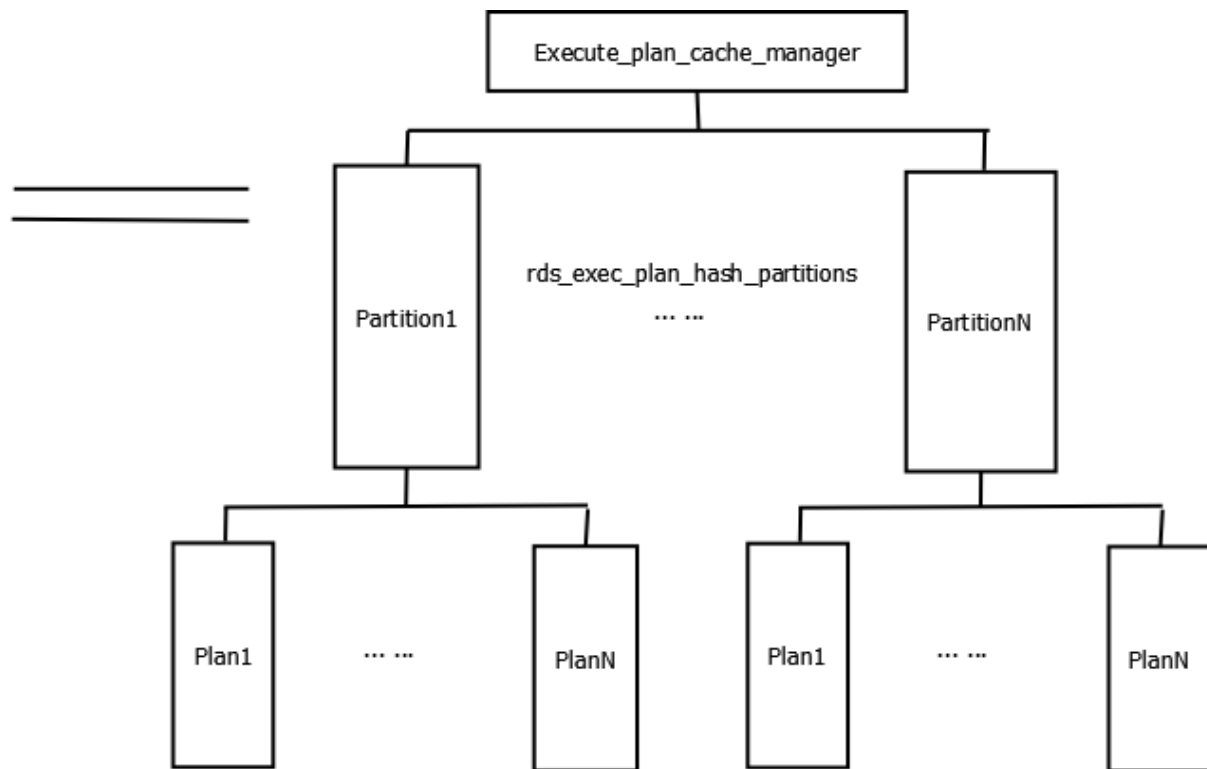
图2

变量名	注释
rds_enable_sql_digest	a) ON 打开sql_digest功能。b) OFF 关闭sql_digest功能(默认)
rds_max_digest_length	a) 设置SQL语句中常量替换后的的长度，设置范围是（128～1M）。b) 默认值是4K。c) 如果SQL语句长度大于该值，query的plan不会被缓存。
rds_enable_exec_plan_cache	a) ON 打开Plan Cache功能。b) OFF 关闭Plan Cache功能，清空Plan Cache(默认)。
rds_exec_plan_hash_partitions	可以有多少个partition来并发存储query plan。默认值是8
rds_max_plan_cache_mem_size	如果Plan Cache中分配到某个Partition中的记录所使用的内存超过了rds_max_plan_cache_mem_size的平均数，即rds_max_plan_cache_mem_size / rds_exec_plan_hash_paritritions, Plan Cache将利用LRU对存在的执行计划记录进行淘汰。

1. TABLE change

2. Set global rds_enable_exec_plan_cache = off

3. Hint NO_PLAN_CACHE

4. Hint FORCE_UPDATE_PLAN_CACHE

1. information_schema.exec_cache_status

| SQL_PRINT | SQL_DIGEST | TABLE_NAME | KEYS | USED_MEMORY | HIT_COUNT | EXTENDED |

2. optimizer_trace

```
{
      "plan_cache": [
        {
         "table": "`tt`",
         "rows": 0,
         "cost": 0,
         "use_cached_plan": "yes",
         "scan type": "ALL"
        }
      ]
 }
```

3. show status like '% plan_cache %'

```
mysql> show status like '%plan_cache%';
+-------------------------------+-------+
| Variable_name                 | Value |
+-------------------------------+-------+
| Execute_plan_cache_hits       | 1     |
| Execute_plan_cache_records    | 1     |
| Execute_plan_cache_used_memory| 1168  |
+-------------------------------+-------+
3 rows in set (0.01 sec)
```

4. Debug log (--debug)

```
mysql> show create table t1;
+-------+-----------------------------------------------------
--------------------+
| Table | Create Table
                       |
+-------+-----------------------------------------------------
--------------------+
| t1    | CREATE TABLE `t1` (
  `a` int(11) DEFAULT NULL,
  `b` int(11) DEFAULT NULL,
  KEY `id1` (`a`),
  KEY `id2` (`b`),
  KEY `id3` (`a`,`b`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8 |
+-------+-----------------------------------------------------
--------------------+
1 row in set (0.00 sec)

mysql> explain select * from t1 where a > 1;
+----+-------------+-------+-------+---------------+------+---------+------+------+-----------------------+
| id | select_type | table | type  | possible_keys | key  | key_len | ref  | rows | Extra                 |
+----+-------------+-------+-------+---------------+------+---------+------+------+-----------------------+
|  1 | SIMPLE      | t1    | range | id1,id3       | id1  | 5       | NULL |    2 | Using index condition |
+----+-------------+-------+-------+---------------+------+---------+------+------+-----------------------+
1 row in set (0.00 sec)
```

AliSQL Plan cache的使用 – 示例


```
mysql> set global rds_enable_exec_plan_cache=on;
Query OK, 0 rows affected (0.00 sec)

mysql> select * from t1 where a > 1;
+------+------+
| a    | b    |
+------+------+
|    2 |    3 |
|    3 |    4 |
+------+------+
2 rows in set (0.00 sec)

mysql> select * from information_schema.exec_cache_status where table_name like '%t1%';
+------------+---------------------------+------------+------+-------------+-----------+----------------------------+
| SQL_PRINT  | SQL_DIGEST                | TABLE_NAME | KEYS | USED_MEMORY | HIT_COUNT | EXTENDED                   |
+------------+---------------------------+------------+------+-------------+-----------+----------------------------+
| 3122753265 | SELECT * FROM t1 WHERE a > ? | test.t1  | id1  |         160 |         0 | range, partition number: 1 |
+------------+---------------------------+------------+------+-------------+-----------+----------------------------+
1 row in set (0.00 sec)
```

AliSQL Plan cache的使用 – 示例


```
mysql> select * from t1 where a > 1;
+------+------+
| a    | b    |
+------+------+
|    2 |    3 |
|    3 |    4 |
+------+------+
2 rows in set (0.00 sec)

mysql> select * from information_schema.exec_cache_status where table_name like '%t1%';
+------------+---------------------+-----------+------+-------------+-----------+----------------------------+
| SQL_PRINT  | SQL_DIGEST          | TABLE_NAME| KEYS | USED_MEMORY | HIT_COUNT | EXTENDED                   |
+------------+---------------------+-----------+------+-------------+-----------+----------------------------+
| 3122753265 | SELECT * FROM t1 WHERE a > ? | test.t1 | id1 |         160 |         1 | range, partition number: 1 |
+------------+---------------------+-----------+------+-------------+-----------+----------------------------+
1 row in set (0.00 sec)

mysql> show status like  '%plan_cache_hits%';
+------------------------+-------+
| Variable_name          | Value |
+------------------------+-------+
| Execute_plan_cache_hits | 1    |
+------------------------+-------+
1 row in set (0.00 sec)
```

```
mysql>  SELECT NO_PLAN_CACHE * FROM t1 where a > 1;
+------+------+
| a    | b    |
+------+------+
|    2 |    3 |
|    3 |    4 |
+------+------+
2 rows in set (0.01 sec)

mysql> SELECT * FROM information_schema.exec_cache_status;
+------------+-----------------------------------+-----------+------+-------------+-----------+---------------------------------+
| SQL_PRINT  | SQL_DIGEST                        | TABLE_NAME| KEYS | USED_MEMORY | HIT_COUNT | EXTENDED                        |
+------------+-----------------------------------+-----------+------+-------------+-----------+---------------------------------+
| 3417261669 | SELECT * FROM `t1` WHERE `a` > ?  | test.t1   | id1  |         160 |         1 | range, partition number: 5      |
+------------+-----------------------------------+-----------+------+-------------+-----------+---------------------------------+
1 row in set (0.01 sec)

mysql> DELETE FROM t1 WHERE a = 1;
Query OK, 10 rows affected (0.03 sec)

mysql> EXPLAIN  SELECT * FROM t1 where a > 1;
+----+-------------+-------+-------+---------------+------+---------+------+------+--------------------------+
| id | select_type | table | type  | possible_keys | key  | key_len | ref  | rows | Extra                    |
+----+-------------+-------+-------+---------------+------+---------+------+------+--------------------------+
|  1 | SIMPLE      | t1    | index | id1,id3       | id3  | 10      | NULL |    1 | Using where; Using index |
+----+-------------+-------+-------+---------------+------+---------+------+------+--------------------------+
1 row in set (0.01 sec)

mysql>  SELECT FORCE_UPDATE_PLAN_CACHE * FROM t1 where a > 1;
+------+------+
| a    | b    |
+------+------+
|    2 |    3 |
|    3 |    4 |
+------+------+
2 rows in set (0.00 sec)

mysql> SELECT * FROM information_schema.exec_cache_status;
+------------+-----------------------------------+-----------+------+-------------+-----------+---------------------------------+
| SQL_PRINT  | SQL_DIGEST                        | TABLE_NAME| KEYS | USED_MEMORY | HIT_COUNT | EXTENDED                        |
+------------+-----------------------------------+-----------+------+-------------+-----------+---------------------------------+
| 3417261669 | SELECT * FROM `t1` WHERE `a` > ?  | test.t1   | id3  |         160 |         0 | index, partition number: 5      |
+------------+-----------------------------------+-----------+------+-------------+-----------+---------------------------------+
1 row in set (0.00 sec)
```
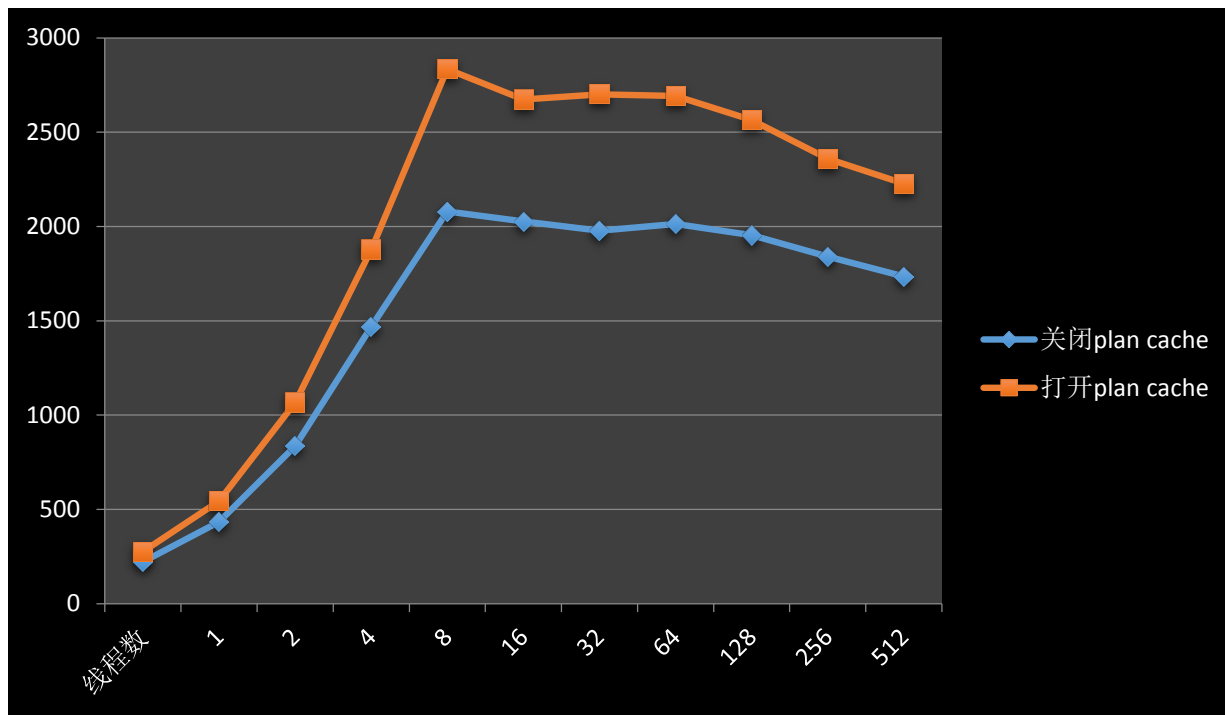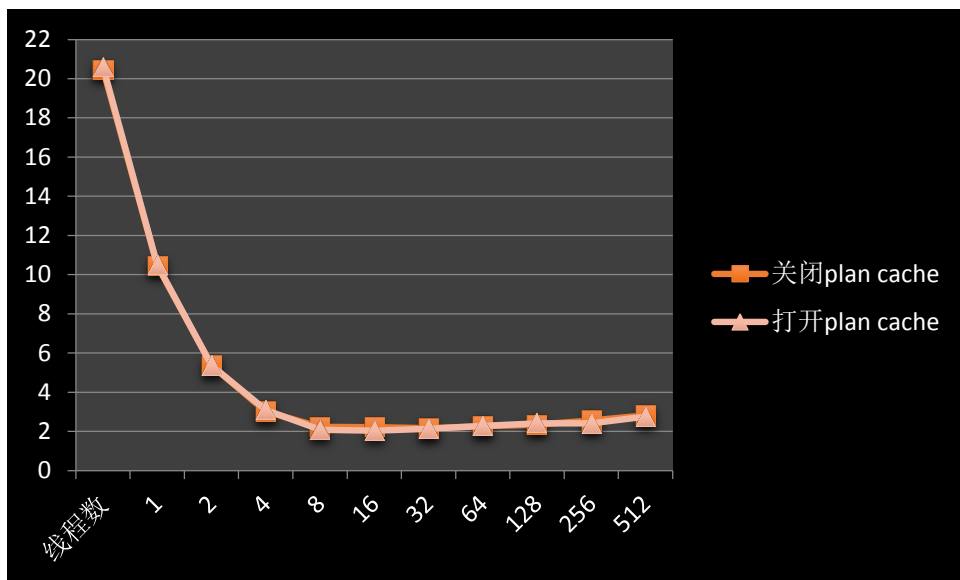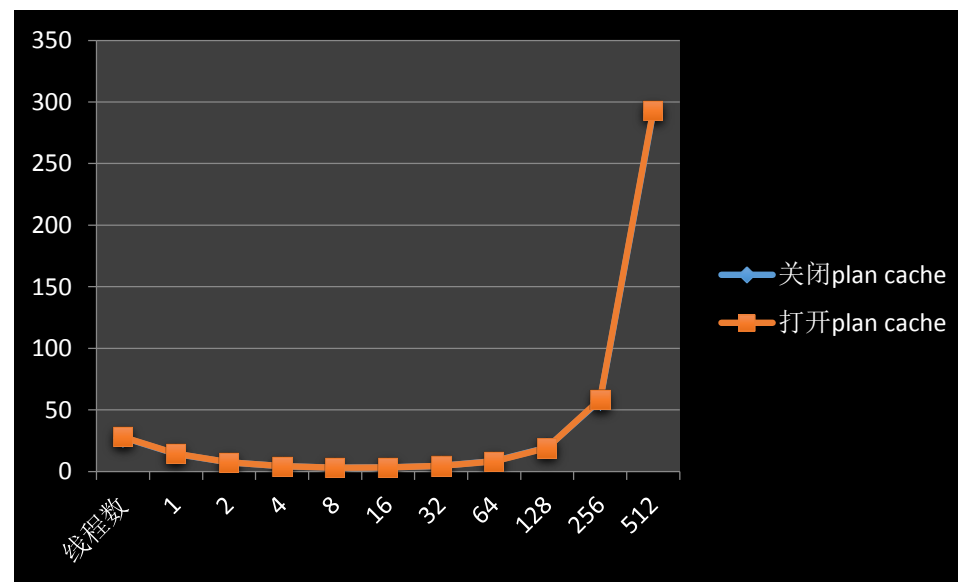
Unit: QPS

QPS improvement

Unit: second

Read-only

Read-write

- RDS_5616

- PolarDB

- RDS 金融版

- AliSQL即将开源，欢迎大家试用

注：目前控制台不支持Plan Cache设置，需要联系DBA

- 当前已经支持的场景
  - SELECT 查询
  - 单表

- 即将支持的场景：
  - 支持多表连接
  - 自动化管理Plan cache
    - Statistics
    - Optimizer_switch
  - 支持 Plan Cache持久化
  - 通过Plan Cache直接调整执行计划

Q & A